ICAR-NBFGR

ANNUAL REPORT 2024

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ICAR

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ICAR-National Bureau of Fish Genetic Resources

Towards conserving aquatic genetic resources for sustainable livelihood and nutritional security

ANNUAL REPORT 2024

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Towards conserving aquatic genetic resources for sustainable livelihood and nutritional security

ICAR-NBFGR Annual Report 2024

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Mass scale seed production of captive-bred, Arulius barb (*Dawkinsia arulius*), a fish endemic to Western Ghats

'State Fish' concept, developed by ICAR-NBFGR and adopted by 22 states, for conservation and sustainable utilization

Contents

Preface

India has continued to demonstrate its capability and commitment to global leadership through transformative initiatives in technological innovation, social reforms, economic growth, and self-reliance. Under the visionary leadership of the Government of India, the nation has made remarkable progress toward achieving the Sustainable Development Goals, ensuring national food security, and enhancing climate resilience. In this journey, the ICAR-NBFGR, as a premier Bureau under the ICAR, has played a key role in the conservation, sustainable development, and scientific management of the rich aquatic genetic resources of India. Our mission remains focused on securing aquatic biodiversity and supporting the fisheries sector to augment the livelihoods of fishers and fish farmers.

The year 2024 has been a remarkable period of growth, innovation, and impactful contributions. ICAR-NBFGR achieved significant milestones through advanced research programmes, strategic collaborations, extensive capacity-building initiatives, and community-centric approaches. Our dedicated efforts have focused on conserving indigenous fish species, promoting sustainable aquaculture, evaluating the impacts of climate change, and enhancing the livelihoods of vulnerable communities dependent on aquatic resources. The Bureau's unwavering commitment to excellence was acknowledged through several prestigious awards and recognitions, such as the National e-Governance Award 2024 (Silver) for the National Surveillance Programme for Aquatic Animal Diseases for the establishment of e-Governance system for aquatic animal disease management. This award, conferred by the Department of Administrative Reforms and Public Grievances, Government of India, presented during the 27th National Conference on e-Governance in Mumbai by Hon'ble Chief Minister of Maharashtra, Shri Eknath Shinde, and Hon'ble Deputy Chief Minister of Maharashtra, Shri Devendra Fadnavis. ISO/IEC 17025:2017 Accreditation was received upon our Aquatic Animal Health Laboratory for detecting 25 critical aquatic pathogens, including those recognized by the World Organisation for Animal Health (WOAH) and emerging pathogens affecting finfish, crustaceans, and molluscs. The innovative mobile application 'ReportFishDisease' was recognized among the top five ICAR technologies during the 96th ICAR Foundation Day. The Bureau secured four prestigious Rajbhasha Awards for its outstanding contributions to the promotion of Hindi, including recognitions for the Rajbhasha magazine *"Matsya Lok"* and excellence in the implementation of the Official Language Policy. NAAS Fellowship 2024 and the Green Scientist Lifetime Achievement Award were conferred upon the Former Director, Dr. Uttam Kumar Sarkar, recognizing his outstanding scientific contributions to fisheries research and conservation. Several

of our esteemed scientists also received national and international awards, further exemplifying the Institute's leadership and excellence in aquatic research.

The year witnessed the gracious presence of several distinguished dignitaries, who provided invaluable guidance and encouragement to our scientific community, such as Prof. S. P. Singh Baghel, Hon'ble Union Minister of State for Fisheries, Animal Husbandry & Dairying, visited our campus, interacted with the staff, and reviewed the Institute's research and outreach activities. Dr. Himanshu Pathak, Former Hon'ble Secretary (DARE) & Director General (ICAR), visited our Agatti facility in Lakshadweep and inaugurated the Display-cum-Interpretation Centre for Marine Ornamentals. His interaction with over 100 women beneficiaries engaged in community aquaculture projects reflects our Institute's commitment to integrating research with socio-economic empowerment. He unveiled the State Fish of Uttar Pradesh, *Chitala chitala*, at the Ganga Aquarium, launched a book on DNA Barcoding, inaugurated an online Crustacean Database, and other significant scientific resources.

The discovery and documentation of 10 new aquatic species and one new distributional record enrich the scientific understanding of India's aquatic biodiversity. Breakthrough in captive breeding of the endangered Black-Collared Yellow Catfish (*Horabagrus nigricollaris*), is a significant step toward the conservation of threatened species. The Bureau's publications and knowledge dissemination through over 83 research articles in national and international peer-reviewed journals, encouraging future scientific endeavours. The release of two Hindi books and six comprehensive scientific books, including a prestigious Springer publication on *Sustainable Management of Fish Genetic Resources*, contributes to global knowledge platforms. The Bureau's conservation initiatives and community empowerment are widely recognised, including the distribution of high-quality fish seeds to various institutions and organisations, supporting river ranching initiatives. Establishment of livelihood development facilities for local communities, focusing on the conservation and ranching of endangered fish species. One of the most notable events was the ranching programme at Shivanasamudra Fish Sanctuary in the Cauvery River, graced by the esteemed presence of Padma Shri Dr. S. Ayyappan, Hon'ble Former Secretary (DARE) & DG (ICAR), further enhancing the conservation and livelihood outcomes for local communities. Over 3,500 fish farmers benefited from 52 capacity-building programmes under SCSP, STC, NEH, NICRA, and CRP components, ensuring the transfer of critical technologies for sustainable aquaculture development.

The Bureau jointly organised several key events, such as the National Workshop on *"Conservation of Indigenous Fishes in Changing Climate Scenario"* in collaboration with SKUAST-Kashmir. An International Hybrid Symposium on *"Changing Status of Ecosystem Health of the River Ganga: An Update and Review"* was organized in collaboration with the Aquatic Ecosystem Health & Management Society, South & Southeast Asia Chapter; Central University of South Bihar; the University of Delhi; the Aquatic Biodiversity Conservation Society (ABCS), Lucknow; and Vijnana Bharati (Vibha Bihar State). The Bureau released significant publications, including *"State Fishes of India"* and the *"Barcode Atlas of Indian Fishes"*, under a major collaboration with the Zoological Survey of India. The institutional linkages were strengthened by signing five new MoUs, expanding our collaborative network to 42 organizations, universities, and research institutes.

The Bureau actively participated in national campaigns, including *Swachhta Pakhwada*, *Ek Ped Maa Ke Naam*, and several environmental and social awareness programmes. The Bureau prepared an impactful video documentary showcasing ICAR-NBFGR's outreach and community empowerment initiatives through technology demonstrations, capacity development, and the distribution of essential fishery and aquaculture inputs. The Bureau celebrated key global and national events, including World Wetlands Day, International Women's Day, World Intellectual Property Day, World Environment Day, International Yoga Day, World AMR Awareness Week, World Fisheries Day, and the 41st Foundation Day of the Bureau, which featured an open house for over 500 students, inspiring future generations of scientists. Aligned with the vision of Viksit Bharat, ICAR-NBFGR remains committed to advancing innovations in fisheries resource management, conservation genetics, aquatic animal health, and socio-economic development of fisheries communities. We pledge to continue bridging the gap between advanced scientific research and societal well-being, contributing to India's aspiration of becoming a global leader in sustainable fisheries and aquaculture.

We express our heartfelt gratitude to the visionary leadership of the Ministry of Agriculture & Farmers' Welfare and the Ministry of Fisheries, Animal Husbandry & Dairying. We are deeply indebted to Dr. Himanshu Pathak, Former Hon'ble Secretary (DARE) & Director General (ICAR); Dr. M. L. Jat, Hon'ble Secretary (DARE) & Director General (ICAR); Dr. Joykrushna Jena,

Deputy Director General (Fisheries Science), ICAR; Dr. Shubhadeep Ghosh, Assistant Director General (Marine Fisheries), ICAR; and Dr. Devika Pillai, Assistant Director General (Inland Fisheries), ICAR. We gratefully acknowledge the support of Dr. Abhilaksh Likhi, Hon'ble Secretary, Department of Fisheries; Ms. Neetu Kumari Prasad, Joint Secretary (Marine Fisheries); and Shri Sagar Mehra, Joint Secretary (Inland Fisheries & Administration). We express our heartfelt gratitude to Dr. W. S. Lakra, Chairman RAC, along with all esteemed members of RAC, for their valuable suggestions and guidance. We sincerely thank DKMA, ICAR, for their continued support in the publication of ICAR web news and other outreach materials. Finally, I extend my heartfelt gratitude to the dedicated scientists, technical staff, and administrative personnel of ICAR-NBFGR, whose unwavering commitment and tireless efforts have made these achievements possible. As we move forward, I encourage all members of our fraternity to embrace innovation, foster interdisciplinary collaborations, and continue our collective efforts to conserve, develop, and manage India's aquatic genetic resources for a sustainable and prosperous future.

Kajal Chakraborty
Director
May 30, 2025

Dedicated to our beloved
Former Secretary, DARE & Director General, ICAR
Padma Shri Dr. Subbanna Ayyappan

December 10, 1955 – May 10, 2025

Executive Summary

The research outputs of ICAR-NBFGR presented here reflects the work carried out under the 26 in-house research projects, 9 corpus projects, 11 ICAR Plan funds and 14 externally funded projects.

Exploration, species characterization and cataloguing of fish genetic resources

- Investigation of fish diversity in river Banas revealed distribution of 56 species belonging to 38 genera of 19 families, 11 orders.
- Germplasm exploration was done in distinct landscapes of middle and lower stretch of Godavari river (Nanded, Karimnagar, Adilabad and West Godavari) during pre-monsoon and the post monsoon (upstream Godavari) to collect the data on fish diversity, and habitat parameters from 19 prioritized sites.
- Under the NEH component, a total of 5 caves and different north eastern rivers such as Umiam river in Meghalaya and Assam (41 species; 18 families), Doyang river, Nagaland (32 species; 12 families), Subansiri river (200 species; 34 families), Zungki river (17 species) and Tizu river (25 species) were explored.
- Discovered 4 new fish species (*viz. Schistura sonarengaensis, Glyptothorax punyavratai, Glyptothorax hymavatiae* and *Garra ngopi*) from North-East India.
- Breeding and larval rearing was achieved for important species including *Trichogaster chuna, Devario devario, Badis assamensis, Channa gachua* and *C. quinquefasciata.* Karyotyping of 7 species, *C. bleheri, C. gachua, B. badis, B. assamensis, Puntius terio, Mystus tengra, M. bleekeri, Pethia conchonius, P. canius, Trichogaster lalius* and *T. fasciata* were done.
- Deep-sea fish specimens (1100) were collected from 9 landing centres along the Indian coast, resulting in identification of 173 species, belonging to 75 families and 32 orders. The highest species diversity was found in order Perciformes (32 species), followed by Anguilliformes (18 species). A total of 53 molecular signatures were developed for different deep-sea species.
- 58 fish species across seven orders and 14 families recorded from Shimsha river (between Shisha Sangama to Kowdley). Large-growing barbs such as *Tor remadevii, T. khudree* and *Hypselobarbus carnaticus* were recorded alongside 4 exotic species (*Clarias gariepinus, Oreochromis niloticus, O. mossambicus,* and *Pterygoplichthys* sp.). Molecular analysis of 12 mitochondrial COI gene sequences showed *T. remadevii* and *T. khudree* co-existing in the river.
- Fish diversity assessment of Bakhira Wildlife Sanctuary (Ramsar wetland) was done, with a total of 58 species. Deciphered the decadal changes (1993-2024) in the seasonal water spread dynamics of the Bakhira wetland.
- Methodologies were standardised for quantifying meta structure such as; density plot, loading plot, temporal changes plot-probability based, temporal changes-heat map, sustainability & accuracy canonical plot & ROC curve for multivariate assessment of role of environmental parameters in landscape composition, on a time series data.
- Habitat surveys were conducted in high altitude (about 14,400 ft) areas in the Teesta Basin, near Zero-point. The temporal trend (1994-2023) in atmospheric Temperature-max and min (°C) pertaining to Teesta-Upper basin and Lower basin was assessed. The habitat suitability map of state fish of Sikkim, *Neolissochilus hexagonolepis* was validated.
- In Subarnarekha river, a total of 75 species (Freshwater: 35 and Brackishwater: 40) were documented from 10 locations with good proportion of carnivorous species (44%).
- The study on the ecosystem dynamics and conservation strategies of the Sarayu river was conducted along 6 stations and identified 61 fish species across 45 genera and 22 families.

Characterization and evaluation of genetic resources, intra-specific diversity and genetic stocks

- Captive breeding of 2 endemic fishes of Western ghats (*Horabagrus nigricollaris*, *Hemibagrus punctatus*) and a freshwater prawn (*Macrobrachium lammarei*) was achieved. A new species, *Horabagrus obscurus,* from Chalakudy river, Kerala was also bred in captive condition. Till date, captive breeding of 16 fish species has been optimized for quality seed production.
- Growth performance of stinging catfish, *Heteropneustes fossilis* under polyculture and monoculture was evaluated. Comparative assessment of genetic diversity in hatchery stock vs. crossbred stock using cryomilt from riverine rohu, was evaluated.
- Successfully developed a monoclonal antibody (MAb) against serum Ig of *Clarias dussumieri*. The MAb was characterized using various immunoassays.
- Genome sequencing of *Heteropneustes fossilis* and *Labeo bata* was done to identify microsatellite loci associated with neutral and adaptive divergence.
- Silver nanoparticle conjugated fish scale quantum dots using sugarcane leaf extract was produced through green biosynthesis method. Piezoelectric energy harvesting was done from fish scales for low-power devices as clean green energy. A fish scale collagen-based earth connected triboelectric nanogenerator was developed.

Genomic resources for important fishes

- Whole genome assembly of fish *Trichogaster chuna*, *Chitala chitala* and *Neolissochilus pnar* was generated. DEGs and Functional Enrichment Analysis was carried out for *Catla catla* brain tissue at 2 temperatures, which revealed 5925 DEGs, 4281 upregulated and 1644 downregulated. Immune-related genes (1294) and associated SSRs were identified from kidney transcriptome of *Cyprinus carpio*. A molecular marker and Loop Mediated Isothermal Amplification (LAMP) assay for early gender determination of rohu was developed.
- A pipeline was designed for repeat identification like tandem repeats (microsatellites, minisatellites), LINEs, SINEs, LTRs from genomes.
- Two on-line databases on genomic resources, namely HilsaTranscriptSSRdb and CatlaTranscriptSSRdb, were developed.
- MicroRNA (miRNA) analysis between fast- and slow-growing individuals of *Clarias magur* led to identification of 557 miRNAs and a few genes association with growth in *C. magur*.
- Genomic resource databases including FBIS, FMiR, FishMicrosat and Fish Karyome under FisOmics webportal were updated.
- The mitogenome sequence of bubble-tip anemone, *Entacmaea quadricolor* was assembled and the mitogenome size of *E. quadricolor* was estimated to be 20,720 bp.
- Transcriptome data for *Conus inscriptus* and *C. monile* were successfully generated and analysed for identification of conotoxins. Detected 6,066 unigenes coding for 23 conotoxin superfamilies and 1,046 genes coding for unknown conopeptides from *C. inscriptus*.
- Five bioactive peptides with anticancer potential were custom synthesised for assessing *in vitro* toxicity and anti-cancer effect on human skin cancer cell line A431. The anti-cancer peptides are a part of repertoire of 232 bioactive peptides extracted from muscle of *Clarias magur* having anticancer, ACE inhibitor, antimicrobial, anti-fungal and anti-viral properties.
- Genome of *Trichogaster chuna* was characterized, with interspersed repeats (29.68%), LINEs (4.58%), DNA elements (2.58%) and SSRs (439,092).

Ex situ and *in situ* conservation

- Explant culture of different tissues of 2 fish species resulted in 3 cell lines *viz. Osteobrama belangeri* muscle, and *Chitala chitala* muscle and gill cell lines. Two new cell lines were added to the NRFC repository, and 8 fish cell lines distributed for R&D. Till date, the institute houses accessions of 86 cell lines/gametes.
- Cryomilt of rohu (560 ml) was supplied to 3 hatcheries of Uttar Pradesh and Bihar, and 25 lakh quality spawn was produced.
- FRP carp hatchery was established at scheduled caste beneficiary site and common

carp seeds were produced in the hatchery. Organized the capacity building programmes on sustainable fish farming.

- Genetic variability was analysed in 174 samples of pearlspot collected from 10 locations along the Indian coast and a total of 73 distinct cyt b mtDNA haplotypes were identified in 9 stocks.
- Production was upscaled for the clown fishes, *Amphiprion akallopisos*, *A. perideraion*, and *Premnas biaculeatus* based on market demand and beneficiary requests. Crossbreed was developed between *A. ocellaris* (M) × *A. percula* (F) for gaining popularity among the beneficiaries and hobbyists. Income of Rs. 23,000 to 25,000/- was obtained by 86 beneficiaries during 8 months.
- Broodstock for 14 indigenous clownfish species were developed and juvenile production continued for 5 species (*Amphiprion percula, A. ocellaris, A. sebae, A. clarkii, and A. nigripes*).
- Exploratory surveys were conducted at 3 new uninhabited islands of Lakshadweep. Seed production of *Thor hainanensis* & *Ancylocaris brevicarpalis* is being continued for the supply to the beneficiaries. Upscaled the production of shrimp, *Cuapetes purushothanmani*, besides experimental successes obtained with *Stenopus hispidus*.
- Optimized the breeding protocol for ornamental fishes including *Pethia sethnai*, *Dawkinsia arulius*, *D. tambraparniei*, *Haldoria fasciata* and *Mesonoemacheilus triangularis*. Germplasm resource center of koi carp was strengthened with brooders of different variables (Kohaku, Hi Utsuri, Ki Utsuri, Shiro Utsuri Tancho showa, Yamabuki ogon and Shushui). Growth and breeding protocol for these varieties of koi carps documented.

Documentation of fish genetic resources of India

- CrustaceaRIS, an online information system for crustacean resources of India was updated, and currently presents data of 506 shrimps and prawn species, 946 crabs, and 23 lobsters from Indian waters.
- Patent landscape reports for technologically relevant areas such as bioactive peptides, fish antifreeze proteins, bioink applications in agriculture and fisheries, and *C. magur* identification technologies documented. Women-led micro-entrepreneurs were empowered through ornamental aquaculture for increased income generation.
- DNA barcode of 75 fish individuals of 23 species from Gomti river, Lucknow was generated.
- A DNA based method was developed to differentiate *Clarias magur* and *C. gariepinus* and their hybrids. Chromosomes were prepared from the hybrid individuals of *C. magur* (♀) x *C. gariepinus* (♂) and the diploid chromosome number (2N) for the hybrid offsprings was 53, mean of 2N of parents *C. magur* (50) and *C. gariepinus* (56).
- A stakeholder-based survey including 240 stakeholders was conducted in 4 villages surrounding the Pichavaram mangroves to assess climate change-induced vulnerabilities. The perception of climate change was analysed using climate data from 1951-2021, revealing a significant increase in temperature. In the Sundarban region, surveys conducted with 180 stakeholders. Fish diversity data collected from rivers, estuarine, and coastal habitats revealed 64 fish species in the Sundarban region.
- Traditional knowledge-based innovation was explored in Rameshwaram, Tamil Nadu. Policy brief was drafted on issues and challenges associated with governance and protection of biodiversity in Areas Within National Jurisdiction and Areas Beyond National Jurisdiction.
- Impact of the interventions undertaken for socio-economic upliftment of selected tribal farmers in Sonbhadra district of Uttar Pradesh during previous years was assessed through primary survey of the beneficiaries. Several capacity development programmes for fish farmers were conducted for livelihood improvement through aquaculture.
- A total of 100 freshwater fish species from Ganga river and its tributaries were collected, and otolith shape and size were documented.
- In Bundelkhand region, the temporal trend of climatic variables, *viz*. rainfall, temperature maximum and temperature minimum was assessed (1974-2023). Climate-resilient deep pools were mapped in the rivers of the region, *viz*. Yamuna, Ken and Dhasan rivers.

Evaluation of fish genetic resources; exotics and health management

- Aquatic Animal Health Laboratory received NABL accreditation (ISO: IEC 17025:2017) for 25 WOAH/ NACA-listed/emerging pathogens affecting finfish and shellfish.
- 'ReportFishDisease' app was popularized for reporting disease cases affecting finfish, shrimp, and molluscs through awareness programmes in various states. The iOS version of RFD app, as well as desktop version of the RFD app for State Fisheries Departments/ NSPAAD collaborating centres and coordinating institute developed.
- Positive controls were developed for Lymphocystis virus, Wenzhou shrimp virus 8, *Macrobrachium rosenbergii* golda virus, Salmonid alphavirus and Candidatus *Haptobacter penaei*.
- Three new diseases, namely infection with *Macrobrachium rosenbergii* golda virus, Bacillary necrosis of pangas and Infection with koi herpesvirus were reported for the first time in the country.
- Under passive disease surveillance, a total of 41 disease cases were reported from Indian Major Carps, pangasius and pacu farms from different districts of Uttar Pradesh. An extensive disease surveillance of food and ornamental fishes in Kerala included 52 sampling events, testing 616 specimens for pathogens using PCR-based diagnostics.
- A total of 346 bacterial isolates comprising *E. coli*, *Aeromonas* spp. and *Staphylococcus* spp. were recovered from a total of 120 specimens of freshwater fish ponds from Uttar Pradesh and fish cages from Jharkhand, and AMR profiles were determined.
- Antifungal efficacy of 4 therapeutic agents clotrimazole, econazole nitrate, griseofulvin, and ketoconazole against different life stages of *Saprolegnia* was determined. Different modes of application and dosage of BKC have been standardized for its efficient use as disinfectant in different life stages of IMC. Critical dose and duration for application of BKC as therapeutics in rohu has been standardized in an immersion trial with pathogenic bacterium, *Aeromonas veronii.*
- The conjugation efficiency for horizontal gene transfer of AMR genes from ceftriaxone resistant donor *Aeromonas* spp. to recipient *Aeromonas hydrophila* was assessed at different temperatures. Whole genome sequencing of *A. hydrophila*, strain RJTS revealed that the genome has 4,490 protein coding sequences, 99 tRNA genes, and 4 rRNA genes.
- A cross-reactive MAb with serum Ig of all IMCs and other fish species including silver carp, grass carp, Nile tilapia and singhi developed. The MAb can also detect *F. columnare*-specific antibodies in the serum of *L. rohita*.
- TiLV inactivated using heat or formalin for immunizing Nile tilapia. A monoclonal antibody against serum IgM of Nile tilapia developed.
- A detailed survey was conducted at 5 sites to assess exotic species in the Sarayu river and a total of 40 indigenous fish species along with exotic sucker catfish, *Pterygoplichthys* sp., documented.
- The exotic mussel, *Mytella strigata*, was found to dominate in Kerala backwaters, particularly during monsoon, displacing native bivalves, green mussel (*Perna viridis*) and short-neck clam (*Paphia malabarica*).
- The farm-level prevalence of EHP was observed to be approximately 30% based on sampling from 30 inland saline shrimp farms in Haryana. EHP-associated white faecal disease is almost negligible in the Inland saline shrimps.
- Standardized the protocol to conduct low temperature experiment with *Pangasianodon hypophthalmus*
- Bivalent vaccines combining inactivated *A. jandaei* and *E. tarda* were developed and tested in oscar fish, with high Relative Percent Survival (RPS) rates of 92.6% for the formalin-inactivated vaccine and 82.5% for the heat-inactivated vaccine.

Publications

- The institute published 70 research articles in different peer-reviewed journals, 33 popular/technical articles, 7 books, over 30 book chapters, 4 training manuals, 4 technical bulletins, 3 booklets and 7 leaflets.

Extension and community outreach

- Various extension and community outreach activities under NEH, SCSP and TSP in

Arunachal Pradesh, Assam, Jharkhand, Karnataka, Kerala, Lakshadweep, Nagaland, Rajasthan, Sikkim, Tamil Nadu, Telangana, Tripura, Uttar Pradesh, West Bengal etc. were conducted.

Conference/webinar/ workshop

- National Workshop on 'Advances in Fish Systematics: Morphological and Molecular Approaches' was organised in collaboration with ZSI, Kolkata at Hyderabad during January 18-19, 2024. The workshop was participated by over 50 delegates, involving researchers, academicians and students.
- Satellite Symposium on 'Fish Genetic Resource and Conservation', was jointly organised in collaboration with ICAR-CIFRI, Barrackpore at Kolkata on February 24, 2024, under 13th Indian Fisheries and Aquaculture Forum. A total of 6 lead, 10 oral and 16 poster presentations on various aspects of aquatic genetic resource management was delivered.
- International Hybrid Symposium on 'Changing Status of Ecosystem Health of the River Ganga: An Update and Review', organised by Aquatic Ecosystem Health & Management Society, South & Southeast Asia Chapter, in collaboration with Central University of South Bihar, University of Delhi, ABCS, Lucknow and Vijnana Bharati during June 10-11, 2024. Over 40 presentations, including 9 keynote lectures, were delivered during the symposium, and over 100 participants were present.
- National Scientific Hindi Seminar cum Workshop on 'New directions in fish conservation science' organised in collaboration with ABCS, Lucknow on September 25, 2024. More than 170 participants from 26 research and academic institutions participated in hybrid mode.
- National Workshop on 'Conservation of Indigenous Fishes of Jammu & Kashmir in the Changing Climate Scenario' organised in collaboration with SKUAST-K and ABCS, Lucknow at Faculty of Fisheries, Rangil, SKUAST-K during November 18-19, 2024. The program was attended by over 200 researchers with 12 lead, 56 oral and 20 poster presentations.
- A brainstorming session on 'Climate adaptive conservation of aquatic genetic resources' was organised at NAAS complex, New Delhi on December 20, 2024, in collaboration with National Academy of Agricultural Sciences, New Delhi, where a total of 50 participants participated.

Live Fish Germplasm Resource Centre and Ganga Aquarium

- The institute produced 814 lakh spawn of 14 species and a revenue of Rs. 7.48 Lakhs generated. Fish seeds were supplied to State Fisheries Departments, fish farmers and hatchery owners. Around 20,000 visitors visited the Ganga Aquarium, and a revenue of Rs. 3.10 Lakhs generated. A total of 7304 visitors visited the National Fish Museum and Repository, and a revenue of Rs. 1.19 Lakhs generated.

Introduction

India is endowed with a vast and diverse range of topographical features that host a treasure of natural resources. These resources uphold ecological balance and safeguard valuable genetic diversity, and also provide significant opportunities for supporting livelihoods. However, much of this resource base remains untapped, underutilized and is increasingly threatened by anthropogenic activities as well as ecological changes. Recognized as a vital component of the country's biological wealth, these resources are crucial for ensuring food and nutritional security for the growing population, as well as serving ornamental and other human needs. As such, there is a pressing need to systematically document, characterize, manage, and sustainably utilize them. Robust scientific understanding is essential to conserve and successfully utilize these genetic resources for nutritional and environmental well-being of humanity.

India stands among the few nations taking proactive steps to advance scientific research in fish genetic resource management. The ICAR-National Bureau of Fish Genetic Resources (ICAR-NBFGR) was initially established at Prayagraj, Uttar Pradesh, in December, 1983 under the aegis of Indian Council of Agricultural Research (ICAR), Government of India, and later on shifted to Lucknow, Uttar Pradesh in 1999. The Institute has since evolved into a premier research organization featuring state-of-the-art infrastructure in genomics, bioinformatics, disease diagnostics and management, *ex situ* conservation, and environment-controlled experimental units dedicated to provide scientific support for the management and conservation of fish genetic resources of the country. The institute is also equipped with supporting infrastructure including a farm, wet laboratories, an animal house, a public aquarium, fish museum, guest house etc.

Currently, ICAR-NBFGR operates through four divisions—three based at its headquarters in Lucknow and one in Kochi—along with the Aquaculture Research & Training Unit at Chinhat, Lucknow. The institute has consistently worked to build in-house expertise and generate scientific knowledge to address emerging challenges in fish genetic resource (FGR) management, aligning its efforts with the evolving national priorities and advancements in technology. It has witnessed remarkable growth, not only in terms of infrastructure development but also through the expansion of its research programs into critical and emerging areas. These include whole-genome/ transcriptome sequencing, population genetics, transcriptomics, sperm cryopreservation, molecular diagnostics and therapeutics for aquatic diseases, a national surveillance program for aquatic

Budget (April, 2024-March, 2025)

(Rs. in lakh)

Budget Head	Budget Estimate (2024-2025)	Expenditure (April- December, 2024)	Expenditure (April, 2024 - March, 2025)
Institute			
Capital	511	87.99	511
General	735	537.16	735
NEH Component			
Capital	25	13.2	25
General	150	57.1	150
TSP Component			
Capital	10	4.9	10
General	80	35.37	80
SCSP Component			
Capital	15	13.6	15
General	145	62.3	145
Grand Total	**1671**	**811.62**	**1671**

Staff Position

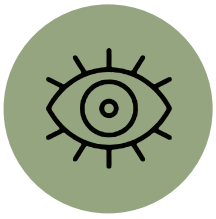
(as on December 31, 2024)

Sl. No.	Category of posts	Sanctioned Post	Staff in position	Post vacant
1.	Research Management (Director)	1	1	-
2.	Scientific	44	35	9
3.	Technical	38	27	11
4.	Administrative	27	19	8
5.	Multi-tasking Staff	18	11	7
	Total	**128**	**93**	**35**

animal diseases, diagnostics for OIE-listed pathogens and aquatic microbes and studies on antimicrobial resistance in fisheries and aquaculture. Additionally, the institute has undertaken exploration of lesser-known and remote geographical regions to assess fish biodiversity.

Through strategic collaborations and partnerships across the country, the Bureau has extended its reach in genetic resource management, while simultaneously promoting sustainable use of aquatic resources to support livelihoods and enhance stakeholder engagement.

Vision, Mission & Mandate



VISION

Assessment and conservation of fish genetic resources for intellectual property protection, sustainable utilization and posterity.

MISSION

Collection, cataloguing and documentation of fish genetic resources using operational strategies of partnership and cutting-edge technologies.

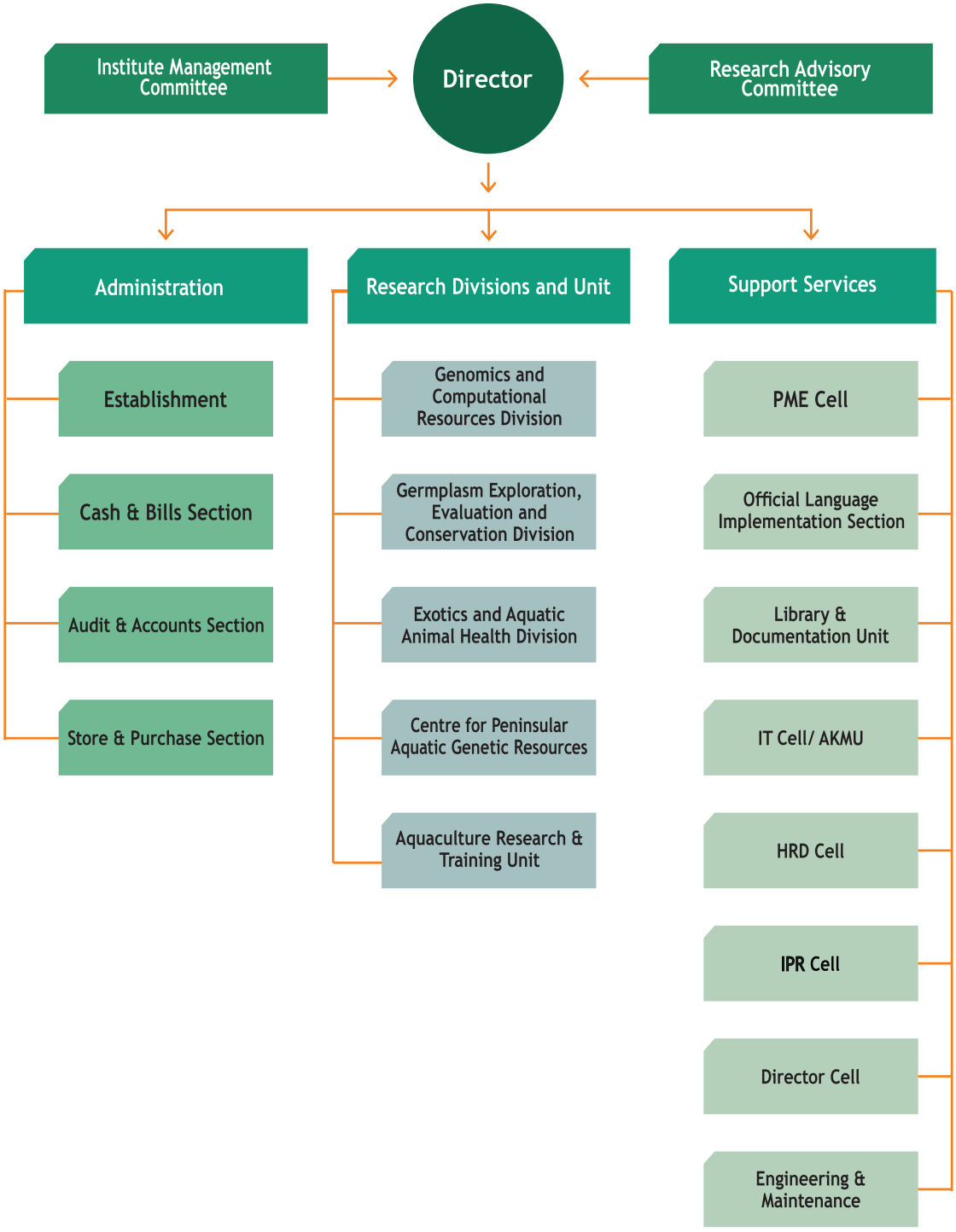
MANDATE

Exploration, characterization and cataloguing of fish genetic resources.

Maintenance and preservation of fish genetic resources for conservation and utilization of prioritized species.

Evaluation of indigenous and exotic germplasm including risk assessment and fish health.

Organogram


Institute Management Committee
Director
Research Advisory Committee
Administration
Establishment
Cash & Bills Section
Audit & Accounts Section
Store & Purchase Section
Research Divisions and Unit
Genomics and Computational Resources Division
Germplasm Exploration, Evaluation and Conservation Division
Exotics and Aquatic Animal Health Division
Centre for Peninsular Aquatic Genetic Resources
Aquaculture Research & Training Unit
Support Services
PME Cell
Official Language Implementation Section
Library & Documentation Unit
IT Cell/ AKMU
HRD Cell
IPR Cell
Director Cell
Engineering & Maintenance

Species Discovered in 2024

Scientific Name	:	***Glyptothorax punyabratai***
Location of Discovery	:	Brahmaputra river drainage in Arunachal Pradesh
Ecosystem	:	Freshwater
Use	:	Minor commercial

Scientific Name	:	***Creteuchiloglanis nuthemuensis***
Location of Discovery	:	Duphlokho river, Arunachal Pradesh
Ecosystem	:	Freshwater
Use	:	Minor commercial

Scientific Name	:	***Garra ngopi* sp. nov**
Location of Discovery	:	Tinam stream, Brahmaputra river basin, Arunachal Pradesh
Ecosystem	:	Freshwater
Use	:	Minor commercial

Scientific Name	:	***Glyptothorax hymavatiae***
Location of Discovery	:	Doimukh stream, a small tributary of Kameng river, Arunachal Pradesh
Ecosystem	:	Freshwater
Use	:	Minor commercial

Scientific Name : ***Schistura sonarengaensis***

Location of Discovery : Limestone caves in the South Garo Hills district of Meghalaya

Ecosystem : Freshwater

Use : Minor commercial

Scientific Name : ***Ophichthus naevius* sp. nov.**

Location of Discovery : Mudasalodai Fish Landing Center, off Cuddalore coast, southeast coast of India, Bay of Bengal

Ecosystem : Marine/Deep-sea

Use : Minor commercial

Scientific Name : ***Ariosoma kannani* sp. nov.**

Location of Discovery : Rameshwaram fish landing centre, Tamil Nadu, Gulf of Mannar, East Coast of India, Bay of Bengal

Ecosystem : Marine/Deep-sea

Use : Minor commercial

Scientific Name : ***Ariosoma gracile* sp. nov.**

Location of Discovery : Kalamukku fishing harbour, off Kerala coast, Arabian Sea

Ecosystem : Marine/Deep-sea

Use : Minor commercial

Scientific Name	**:**	***Ariosoma thoothukudiense* sp. nov.**
Location of Discovery	:	Thoothukudi fishing harbour, off Thoothukudi, Bay of Bengal
Ecosystem	:	Marine/Deep-sea
Use	:	Minor commercial

Scientific Name	**:**	***Horabagrus obscurus* sp. nov.**
Location of Discovery	:	Chalakkudy river in Western Ghats, Kerala
Ecosystem	:	Freshwater
Use	:	Commercial (food and ornamental)

Exploration, Species Characterization and Cataloguing of Fish Genetic Resources

Exploration activities at Lachung, North Sikkim, Teesta basin

Understanding and assessing components of biological diversity is vital for developing accurate species or region-specific management plans. Recent efforts have focused on aquatic ecosystems such as the Deep sea, Northeast region, Ramsar sites in Uttar Pradesh, the Ganga basin, and Godavari basin.

The institute, working independently or through networks, has documented numerous species from rivers, wetlands, and marine environments. Given that many aquatic habitats in India remain underexplored, such efforts are crucial for uncovering isolated, high-endemism regions and previously underestimated biodiversity. This work supports the development of targeted conservation strategies and domestication protocols for priority species.

Project

Investigation of fish diversity of fish communities along the river Banas flowing through Rajasthan, India

Period: April, 2021–March, 2024

Personnel: Ajey Kumar Pathak (PI), Kantharajan G., Raghvendra Singh and Ravi Kumar

Funding support: Institutional, ICAR-NBFGR

During the period, analysis of data collected revealed distribution of 56 species belonging to 38 genera of 19 families, 11 orders. Upon comparison of the species richness, Banas river represents nearly 35% of the species, as reported from Ganga river. The adjacent river basins Luni reported nearly half of species richness as compared to Banas, and Chambal reported nearly equal to Banas. The analysis of fish data from Banas river showed that Cyprinidae is the richest family in terms of species diversity followed by Bagridae, and abundantly recorded species were *Cirrhinus reba, Systomus sarana, Mystus cavasius.* Moreover, the analysis presented the occurrence of exotic species such as *Clarias gariepinus, Oreochromis niloticus, Ctenopharyngodon idella, Cyprinus carpio* and *Hypophthalmichthys nobilis.* The analysis of water quality parameters showed variation between sites and seasons depending on the rainfall and water flow pattern. The analysis of land use, land cover intensity around the perennial pools using geospatial approaches found to be varied in the riparian buffer and was highest in Bhaopur. To understand the growth pattern and condition of the prioritised fish species, the length-weight relationship, condition factor and relative condition factor of 24 indigenous and one invasive non-native freshwater species, belonging to 8 families, were analyzed and the findings showed that the Banas river provides suitable habitat for proliferation of the fish species and the results generated can be useful for managing the fish stocks and their population of this semi-arid river system.

Project

Quantifying agrobiodiversity and ecosystem services in Godavari river basin landscape

Period: September, 2021 - November, 2025

Coordinator: Uttam Kumar Sarkar

Personnel: Rajeev Kumar Singh (PI), Lalit Kumar Tyagi, Achal Singh, Rejani Chandran, Kantharajan G.

Funding Support: The Alliance of Bioversity International & CIAT

This program aims to evaluate the discharge of terrestrial effluents into the aquatic ecosystems across different landscapes for developing recommendations to balance agricultural development with the sustainability of aquatic ecosystems and the conservation of biodiversity. The study focuses on 4 landscapes — Nanded (NAN), Adilabad (ADI), Karimnagar (KAR), and West Godavari (WG) — analyzing the changes in Land Use Land Cover (LULC) and the impact of terrestrial effluents on aquatic ecosystems.

Fish diversity assessment

An extensive survey was conducted during pre-monsoon in April, 2024 across four landscapes along the Godavari river to assess fish diversity and habitat parameters at 18 prioritized sites. These included river confluences, tail ends of reservoirs, and barrages/ sites near industrial discharge points, urban zones, agricultural areas, hilly regions, and reserve forests. Fish diversity was evaluated through landing centers and local fish markets. The plankton samples were collected from 18 prioritized sites (Fig. 1) and preserved for further study. A separate exploratory survey was conducted in December, 2024 in the upstream section of the Godavari river for fish diversity assessment.

A total of 95 fish species, belonging to 25 families and 13 orders, have been recorded till date from the study area. Five exotic species, *Cyprinus carpio, Hypophthalmichthys nobilis, Ctenopharyngodon idella, Oreochromis mossambicus,* and *O. niloticus* were also recorded. Species-rich family were Cyprinidae (n=38) followed by Bagridae (n=11). Endemic species like *Rita bakalu, R. kuturnee, R. gogra, Clupisoma bastari, Hypselobarbus curmuca,* and *H. kolus* were also recorded.

Occurrence of aberrant extra dorsal fins in a 'Near Threatened' butter catfish, *Ompok bimaculatus* (Bloch, 1794) was recorded for the first time from Yellampalli barrage (KAR landscape) in Godavari river basin. The specimen was taxonomically confirmed through morphological

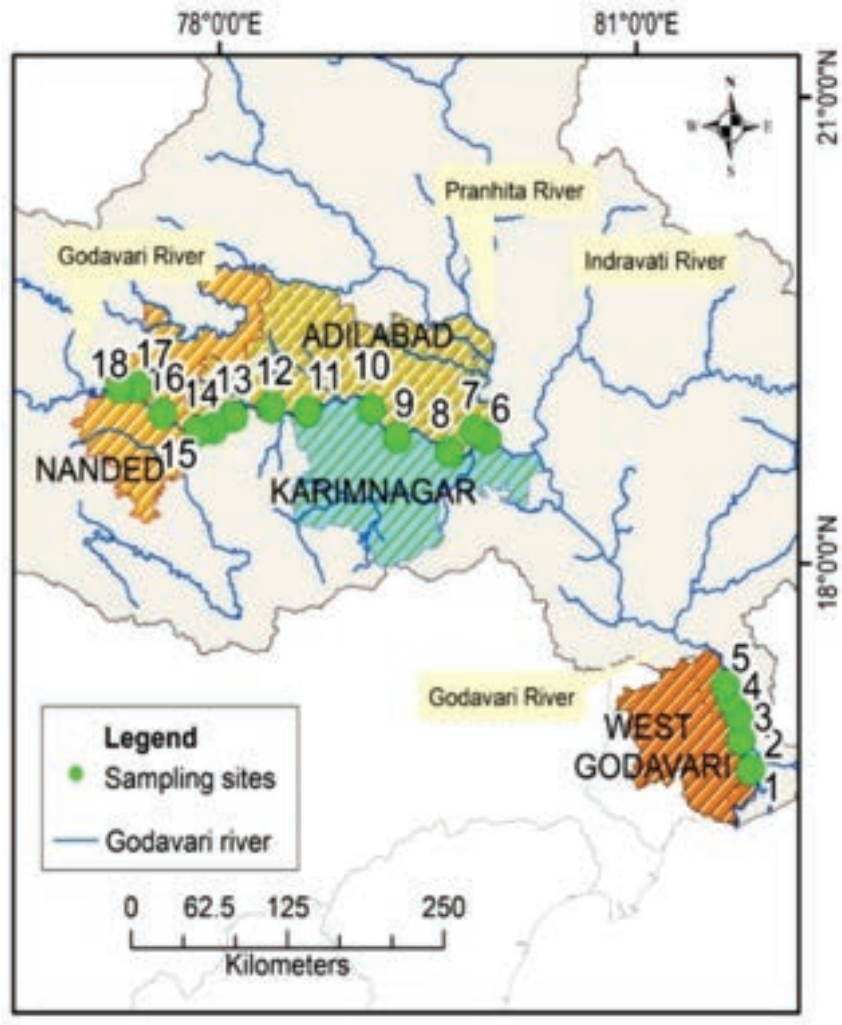


Fig. 1. Sampling sites along Godavari river (April, 2024)

features and molecular attributes. This highlights the occurrence of deformities in the natural fish populations of man-made ecosystems.

Physico-chemical parameters

Physico-chemical parameters of water, *viz*. temperature, pH, salinity, DO, conductivity, ORP, and TDS, were recorded (Fig. 2). Nutrient parameters such as ammonia, phosphate, total chlorine, and copper were analyzed on-site. The recorded nutrient parameters indicate high concentrations in Nanded landscape compared to other landscapes. The recorded Ammonia concentration in Vishnupuri (1.5 mg/l) is higher than the optimum concentration (<0.5 mg/l) (Fig. 3).

The pH varied between 7.64 – 7.88 in WG, 7.76 – 7.89 in KAR, 7.36 – 7.71 in ADI and 7.7 – 8.62 in NAN landscapes. Highest value of ORP was recorded at Pattiseema in WG landscape. High electrical conductivity (6323 mS/cm), recorded at Siddhantham, may be attributed to reduced inflow and ingress of saline water into the downstream section of the river in WG. The highest TDS and TSS were reported in Siddhantham (3163 ppm) in WG landscape and Panchagudi (687 ppm) in ADI landscape, respectively.

Fish diversity and community structure assessment

Species richness was reported to be higher in riverine habitats followed by fragmented and catchment inundated habitats (Fig. 4). High diversity index was recorded from riverine habitats. The primary cause of low diversity may mainly be attributed to habitat simplification, leading to spatial heterogeneity loss in reservoir habitats.

The dominance of omnivore fishes was recorded in riverine (36 sp.) and fragmented habitats (24 sp.), while carnivorous fish (14 sp.) equally dominated the assemblage in catchment inundated habitats. Omnivores were the dominant feeding guild, followed by carnivores based on the abundance. The dominance of benthopelagic > demersal > pelagic fishes in all habitats was evident.

The season wise water quality assessment revealed the parameters significantly differed across seasons rather than sites (all found within the optimum range required for the fish except at few sites) (Fig. 5). However, physical waterscape variables (depth, channel wet width and edge density) significantly differed across sites.

Fishermen's perception of ecosystem services

Majority of the fishermen

Fig. 2. Recording of water quality parameters during April, 2024 at Kovvur, WG Landscape

interviewed opined that their preferred/target fish species have decreased over time, the sizes of the fish caught reduced, and the availability and quality of aquatic habitats including aquatic vegetation gone down. Major causes for above changes perceived by the fishermen were: loss of essential fish habitats including deep pools, river bed sedimentation, deteriorated water quality due to runoff, reduced primary productivity of rivers, and overfishing. A few fishermen also perceived that the pollutants resulting from the chemicals used in agriculture get mixed with run-off water and reach rivers, which sometimes causes fish mortality. Measures suggested by the fishermen for enhancement

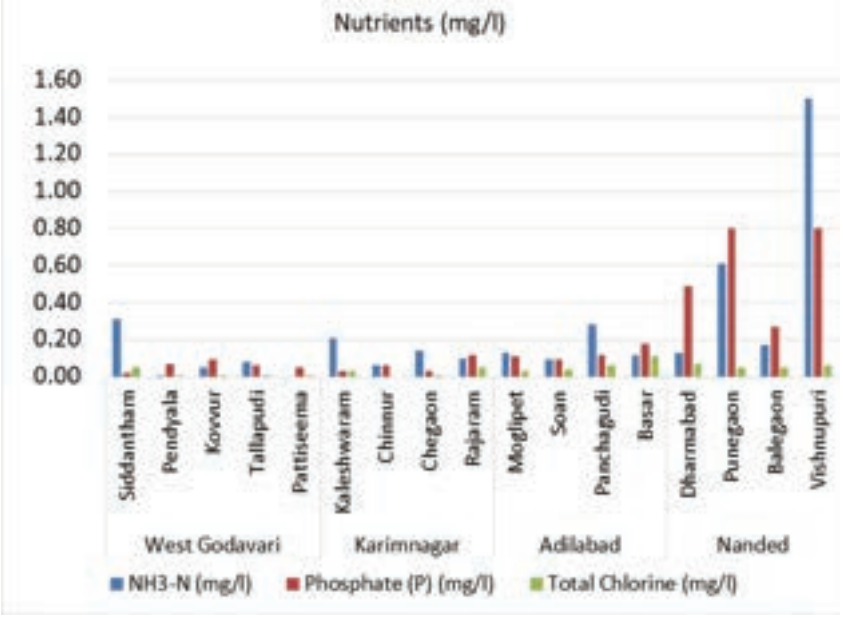


Fig. 3. Nutrient parameters measured at four landscapes

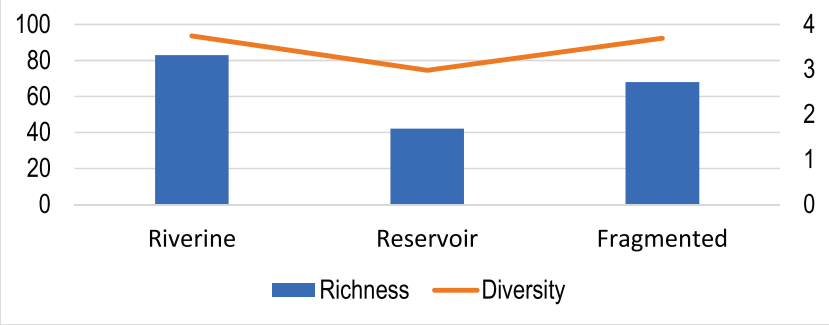


Fig. 4. Habitat category-wise fish diversity recorded in selected landscapes

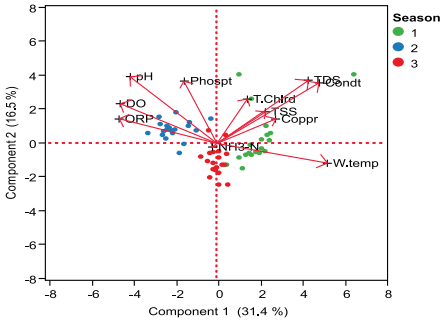


Fig. 5. Seasonal variations in water quality parameters in the selected habitats

Fig. 6. Participants of the awareness program

of aquatic diversity and fisheries resources included ranching of fish seed, maintaining water level (environmental flow) in rivers, and reduction in usage of chemicals/pesticides in agriculture. Information pertain to cultural and recreational services were also noted.

Stakeholder awareness program organized

A Stakeholder Awareness Program on Fish Conservation in Godavari Basin was organized at Chegaon village in Mancherial District (KAR landscape) on April 21, 2024 to aware farmers on the importance of conserving indigenous fishery resources in Godavari Basin for sustainable livelihood development. About 25 fishermen participated in the program (Fig. 6).

Project

Participatory programme on exploration and characterization of fish germplasm resources and indigenous knowledge in North-Eastern region of India

Period: April, 2020 - March, 2025

Coordinator: Uttam Kumar Sarkar

Personnel: Rejani Chandran (Nodal Officer), Lalit Kumar Tyagi, Mahender Singh, Ajey Kumar Pathak, Sangeeta Mandal, Aditya Kumar, Labrechai Mog Chowdhury, Raghvendra Singh, Tarachand Kumawat, G. Kantharajan and Amit Singh Bisht

Collaborators: Dandadhar Sarma, Kouberi Nath, Hrishikesh Choudhury, Pranay Punj Pankaj, Sarbojit Thaosen, Ratul Chandra Bharali, Limatemjen, and Trishna Barman

Fig. 7. Explorations carried out at Krem Mawjymbuin cave of Meghalaya

Fig. 8. Newly discovered loach, *Schistura sonarengaensis*

Funding support: ICAR-NEH Component

Under the North-East (NE) component, the Institute is conducting research programs across the North-Eastern region of India in collaboration with various regional institutions. The key programs under this project include: 1) exploration and documentation of fish germplasm resources and indigenous knowledge from selected rivers and areas of the NE region; 2) establishment of regional live fish germplasm resource centers for indigenous food and ornamental fishes to promote resource enhancement and sustainable livelihood generation and; 3) cytogenetic characterization of endemic fish species from the NE India.

Under the program 1, following 6 subprojects are being undertaken:

1) Exploration and characterization of cavernicole fish species of Meghalaya (PI: Dr. Dandadhar Sarma, Professor, Gauhati University)
2) Exploration and evaluation of ichthyofaunal diversity and assemblage, and habitat ecology of Umiam River, North East India (PI: Dr. Hrishikesh Choudhury, Assistant Professor, Gauhati University)
3) Impact of Doyang Hydroelectric Project (DHEP) on ichthyofaunal diversity along the Doyang river, Nagaland: Conservation implications, indigenous traditional fishing practices, and the potential for ecotourism development (PI: Dr. Pranay Punj Pankaj, Assistant Professor, Nagaland University)
4) Exploration and evaluation of fish biodiversity, distribution pattern and habitat ecology of Tizu River (lower stream) in Phek district, Nagaland (PI: Dr. Sarbojit Thaosen, Associate Professor, Haflong Govt. College)
5) Exploration and evaluation of fish biodiversity and habitat ecology of Subansiri river (Downstream) (PI: Dr. Ratul Chandra Bharali, Assistant Professor, Udalguri College)
6) Exploration & Evaluation of fish faunal diversity of Tizu and Zungki river of Chindwin drainage system Nagaland (PI: Dr. Limatemjen, Associate Professor, Kohima Science College)

Explored five caves, *viz*. Krem Mawjymbuin (Fig. 7), Krem Leiwlong, Krem Chiabole, Krem Nakama, Krem Sonarenga in Garo, Khasi and Jaintia Hills of Meghalaya. A total of 16 fish species were collected, including one cavernicole species. Three species under the genus *Schistura* and *Glyptothorax* are being validated. A new species, *Schistura sonarengaensis* (Fig. 8), was described based on three cave-dwelling populations from Krem Sonarenga, Krem Nakama, and Krem Chiabole in Soutj Garo Hills, Meghalaya.

Fig. 9. Endemic fishes of Meghalaya recorded from the Umiam river basin: *a. Physoschistura elongata; b. Danio meghalayensis; c. Pethia shalynius; d. Schistura reticulofasciata*

Monthly surveys were conducted at 10 sampling sites along the Umiam river spaning Meghalaya and Assam states (Fig. 9). A total of 41 fish species (18 families) were recorded, including three exotics. Cyprinidae and Bagridae contributed 39% and 9.7%, respectively. The highest number of species belonged to Least Concern (27 sp.), followed by Vulnerable (5 sp.) and Near Threatened (1 sp), based on IUCN Red List criteria. Five fish species, *Barbonymus gonionotus, Ctenopharyngodon idella, Cyprinus carpio, Hypophthalmichthys molitrix* and *Oreochromis mossambicus* and four endemic fish species, *viz. Danio meghalayensis, Pethia shalynius, Physoschistura elongata* and *Schistura reticulofasciata*,

were recorded in the upstream and midstream sections of the Umiam river (Fig. 9). The river clearly showed variation in fish assemblage pattern and diversity based on the differences of river bed, *viz.* rocky bottom, sandy bottom, and a combination of both. More diversity was observed in midstream and downstream sites compared to upstream sites. *Neolissochilus hexagonolepis* was recorded as the most abundant species along the upstream and midstream of the Umiam river.

In order to assess the ichthyofaunal resources, the exploratory survey was conducted at different sampling sites of Doyang river, Nagaland. A total of 32 fish species were documented (5 orders, 12 families). The indigenous traditional knowledge concerning the fishing practices carried out by the tribal communities was also recorded. A total of 3 types of fishing gear, 1 fishing accessory, 1 fishing craft, and 2 miscellaneous fishing techniques were documented in Doyang river (Fig. 10). Habitat inventory of all the sampling sites was prepared. Market surveys and stakeholder consultations were conducted to assess the interest and potential impacts on ecotourism development.

In Tizu river, three exploratory surveys were carried out at six different sites. A total of 25 species were documented during the sampling. Different types of traditional fishing methods practiced by the villagers were recorded.

Subansiri river was explored at 16 sampling locations. Fish sampling (pre-monsoon, monsoon, and retreating monsoon) was carried out from the foothills of Arunachal Pradesh to the site of confluence with river Brahmaputra. Experimental fishing resulted in documentation of 200 fish species belonging to 34 families under 101 genera. Cyprinidae was the dominant family represented by 70 species, followed by Sisoridae (16). Fish diversity at each sampling site was documented, physico-chemical analysis of water carried out, and anthropogenic impact on the river were recorded. The impact of a dam at Gerukamukh, for hydroelectric power generation, is being analyzed. ITKs related to fishing of the local community were also recorded.

Fig. 10. Cylindrical trap used in Doyang river, Nagaland

Exploration in the Zungki river at 6 sites (Langdangsee, Thang Nokyan, Lengnyiu, Trongpuh, Longmatra, and Zungki-Mutriki Confluence) resulted in documentation of 17 fish species. Cyprinidae was the dominant family and anthropogenic activities, like dynamite fishing, electrofishing, chemical fishing, and extraction of boulders and gravel, were observed at multiple sites. Physical habitat features, water quality parameters, and GPS coordinates of all the sites were recorded.

Explorations by the ICAR-NBFGR team in Arunachal Pradesh led to the discovery of following 4 new species:

- *Glyptothorax punyabratai* from Tung stream, a tributary of Tissa river
- *Creteuchiloglanis nuthemuensis* from Duphlokho river in West Kameng district
- *Garra ngopi* sp. nov., from Brahmaputra river basin
- *Glyptothorax hymavatiae,* a new sisorid catfish

Under the program 2, following 2 subprojects are being operated:

1) Development of live germplasm resource center for indigenous food and ornamental fishes for resource enhancement and sustainable livelihood generation in Assam (PI: Dr. Dandadhar Sarma, Professor, Gauhati University)
2) Collection, stock development and captive breeding of economically important vulnerable native fish germplasm for conservation and mass seed production (PI: Dr. Kouberi, Nath, Scientist, Tripura center of ICAR Research Complex for NEH Region)

Efforts were undertaken to upscale the breeding and larval rearing techniques of commercially important and endemic ornamental fishes at Live germplasm resource Centre, Assam. Breeding and larval

rearing of breeding and larval rearing of *Trichogaster chuna, Devario devario, C. gachua* and *C. quinquefasciata* were successfully carried out with 75-85% success in larval rearing. Breeding and larval rearing of *D. aequipinnatus, Danio dangila, T. chuna*, and *Badis assamensis* were carried out successfully with 95% fertilization and more than 85% success in larval rearing. Breeding and larval rearing of *Channa stewartii, Microphis deocata*, and *Ctenops noblilis* were also carried out with a higher percentage (>90%) of success through natural breeding techniques. Retention of the colour of the selected indigenous species, *viz. Pethia gelius* and *Oreichthys crenuchoides* was made successfully with formulated supplementary feed along with astaxanthin-rich herbal products such hibiscus and synthetic astaxanthin as feed additives. A total of 4 breeding experiments were carried out for the species of *Ompok pabda, Clarias magur* and *Heteropneustes fossilis* with 90% success in breeding and 80% success in larval rearing of *O. pabda*, and *H. fossilis*.

The growth of *Systomus sarana* was studied for 110 days under controlled conditions in an indoor tarpaulin circular tank (5000L). The initial mean weight of *S. sarana* stocked at 300 nos/5000L was 12±0.05g. The stocked fish were fed with floating pelleted feed @ 5% body weight. After 110 days of stocking, the mean weight, survival, and daily weight gain were recorded to be 56.75±0.075g, 50%, and 0.41g/day respectively.

Under program 3, following one subproject is undertaken

1) Karyotyping and banding of some selected indigenous fish species of the undivided Goalpara district & Adjacent districts of Meghalaya (PI: Dr. Trishna Barman, Assistant Professor, Goalpara College)

A total of 10 sites (Urpad Bheel, Singimari Bheel, Hasila bheel, Kumri Bheel, Panchgaratna Ghat, Kachari Ghat, Tamronga Bheel, Daloni Bheel, Dheer Bheel and Balbala Bheel) of Goalpara district were explored, and 15 species collected. Cytogenetic profiling of *Channa bleheri, C. gachua, Badis badis, B. assamensis, Puntius terio, Mystus tengra, M. bleekeri, Pethia conchonius, P. canius, Trichogaster lalius* and *T. fasciata* was done.

Project

Taxonomic studies of the deep-sea fish resources along Southern coasts of India

Period: April, 2022 - March, 2025

Personnel: Teena Jayakumar T. K. (PI) and Arun Sudhagar S. (till April, 2024)

Funding support: Institutional, ICAR-NBFGR

The deep-sea ecosystems within India's Exclusive Economic Zone (EEZ) are known for their rich biodiversity. However, detailed information on the diversity of deep-sea fish fauna in the Indian EEZ remains scarce. Acknowledging the critical need for effective management of deep-sea fishery resources, this project was undertaken to systematically document the diversity of deep-sea fish species along the Southern coasts of India.

Surveys were carried out at Munambam, Kalamukku and Kollam (Kerala) (Fig. 11a), Kasimedu, Nagapattinam (Fig. 11b), Cuddalore, Mudasalodai, Tuticorin and Colachel (Tamil Nadu). Six hundred and forty specimens of 134 species were collected from different landing centres of Kerala, where catch was dominated by the *Psenopsis cyanea, Parascombrops pellucidus, Bembrops caudimacula, Cubiceps baxteri* and *Chlorophthalmus bicornis*. Some rare species recorded were *Chlorophthalmus*

Fig. 11. Deep sea fish landing at: a. Sakthikulangara landing centre, Kollam, Kerala, and b. Nagapattinam landing centre, Tamil Nadu

Fig. 12. Images of species collected from landing centres of Southern coasts of India: a. *Chlorophthalmus corniger*, b. *Polyipnus indicus*, c. *Glossanodon macrocephalus*, d. *Antigonia capros*, e. *Alepocephalus bicolor*, f. *Epigonus elongatus*, g. *Parateleopus indicus*, h. *Astronesthes martensii*

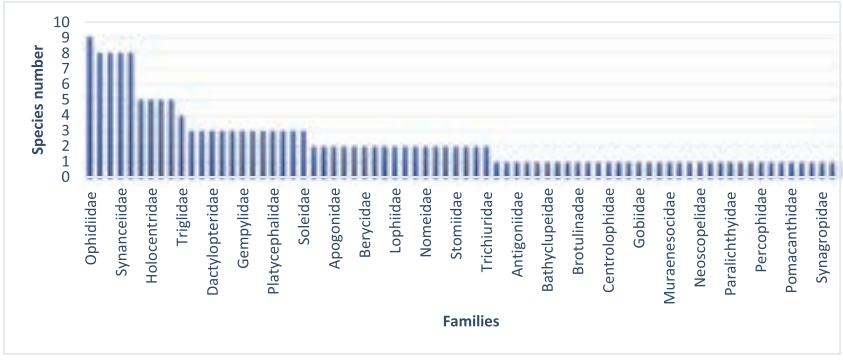


Fig. 14. Family wise deep-sea species composition from Southern coasts of India

acutifrons, Xenocephalus sp., *Dasyscopelus obtusirostris, Parateleopus indicus* (Fig. 12), *Lepas sp., Bathysphyraenops* sp. and *Eptatretus wadgensis*. Four hundred and sixty specimens of 92 species were collected from different landing centres of Tamil Nadu, where catch was dominated by *Trichiurus auriga, Neopinnula orientalis, Neoharriotta pinnata*, and *Zenopsis conchifer*. Few rare species *Bathypterois articolor, Coryphenoides* sp. and *Lamprogrammus* sp. were documented. The species diversity of deep-sea fishes and abundance were more in Sakthikulangara landing centre in Kerala, followed by Nagapattinam landing centre in Tamil Nadu.

A total of 1100 fish specimens of 173 species, belonging to 75 families and 32 orders, were collected from different locations

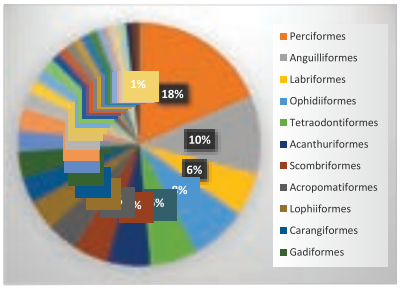


Fig. 13. Order wise deep-sea species composition from Southern coasts of India

(Figs. 13, 14). The highest species diversity was found in order Perciformes (32 species), followed by Anguilliformes (18 species), Labriformes (17 species), Ophidiiformes (13 species), Tetraodontiformes (11 species), Acanthuriformes (10 species), Scombriformes (8 species), Acropomatiformes (7 species), Lophiiformes (7 species), Carangiiformes (6 species), Gadiformes (6 species), Callionymiformes (5 species) and Holocentriformes (5 species). The orders Perciformes, Anguilliformes, Labriformes, Ophidiiformes and Tetraodontiformes contributed to 49% of species diversity. Among the families, Ophidiidae was the most speciose with 9 species followed by Scorpaenidae, Congridae, Synanceiidae and Uranoscopidae (8 species each).

Molecular analysis using the cytochrome oxidase 1 gene was carried out for the species of the family Uranoscopidae, Scorpaenidae, Lophiidae, Ophidiidae, Callionymidae, Ogcocephalidae, and Macrouridae. A total of 53 molecular signatures were developed for different species. As an integrated taxonomic approach, morpho-meristic characters and molecular markers were used for resolving the taxonomic ambiguity in many

families. Molecular signatures were developed for 9 species (*Sirembo jerdoni, Neobythites stefanovi, N. steatiticus, Ophidion smithi, Ophidion* sp., *Dicrolene* sp., *Glyptophidium oceanium, Pycnocraspedum squamipinne*, and *Lamprogrammus fragilis*) of family Ophidiidae. The interspecific genetic distance for COI gene in the family Ophidiidae ranged from 10.2-22.9% with an overall mean genetic divergence of 15.08%. *P. squamipinne* and *G. oceanium* were most abundant, while *S. jerdoni* was rare in the landings. In the family Uranoscopidae, *Uranoscopus marmoratus, U. crassiceps, U. guttatus, U. archionema, Uranoscopus* sp., *Xenocephalus* sp., *X. elongatus* and *Ichthyoscopus lebeck* were documented with genetic divergence ranging from 7.1% to 28.4% with an overall mean genetic divergence of 19.0%. The species in the genus *Xenocephalus* were encountered very rarely.

Project

Exploration of the tributaries of Cauvery river for fish species diversity and detailed studies on mahseer

Period: April, 2023 - March, 2025

Personnel: V.S. Basheer (PI), Charan Ravi and Divya P.R.

Funding support: Institutional, ICAR-NBFGR

This project focuses on documenting the freshwater fish fauna in the tributaries of the Cauvery river. It also aims to resolve taxonomic ambiguities related to the identity of the mahseer, a keystone species of the Cauvery river.

Exploratory surveys

Explorations were conducted in the Shimsha river, covering 12 stations between Shisha Sangama to Kowdley in Karnataka (Fig. 15). A total of 58 fish species belonging to 7 orders and 14 families, including 4 exotic species (*Clarias gariepinus, Orechromis niloticus, O. mossambicus* and *Pterigoplychthys* sp.) were documented with Cyprinids being dominant (35%). Among the large growing mahseer, *Tor remadevii, T. khudree*, and Carnatic carp, *Barbodes carnaticus*, were recorded (Fig. 16).

Identification of mahseer using molecular marker

Majority of the mahseer inhabit main Cauvery river and for breeding purpose they migrate to the tributaries of Cauvery and other small tributaries. This was observed by sampling small rivulets of Shimsha river. Out of 12 sequences of mitochondrial COI gene generated, only 4 samples aligned with *T. remadevii* (~33%), while rest aligned with *T. khudree* indicating their co-existence in Shimsha river.

Biological studies of *Barbodes carnaticus*

Biological data, like length, weight, food and feeding, gonad weight, and maturity stages, of 44 samples of Carnatic carp was recorded. Gonadal observation showed that all were immature fishes. Weight ranged from 150 to 250 g, while length varied from 80 to 200 mm. Gut content showed mostly algal matter (85%) with some aquatic insects and molluscs.

Mapping of exotic fishes

Interview with the local people indicated that African catfish, *C. gariepinus,* was found in upper reaches of the river in good numbers in addition to sucker catfish, *Pterygoplichthys* sp.

Fig. 15. Exploration sites at Shimsha river

Fig. 16. Mahseers recorded from Shimsha river

Project

Fish diversity assessment of Ramsar wetlands of Uttar Pradesh by integrating ecological approaches and stakeholder perception under climate change scenario

Period: April, 2023 - March, 2026

Personnel: Rejani Chandran (PI), Rajeev Kumar Singh, L. K. Tyagi, Achal Singh, A. K. Pathak, Kantharajan G., Amit Singh Bisht and Deva Narayan

Funding support: Institutional, ICAR-NBFGR

The Ramsar Convention designates wetlands of international importance to conserve surface water, preserve ecosystems, and promote sustainable development in biodiversity-rich regions. Considering the impact of climate change, this project aims to catalogue fish diversity and assess fish communities in the Ramsar wetlands of Uttar Pradesh. The findings will help in understanding the ecosystems of these wetlands and facilitating the development of sustainable management strategies for aquatic germplasm resources.

The surveys were carried out at six Ramsar sites, namely, Sur Sarovar (Agra), Sarsai Nawar Jheel (Etawah), Saman Bird Sanctuary (Mainpuri), Sandi Bird Sanctuary (Hardoi), Parvati Arga Bird Sanctuary (Gonda), and Bakhira Wildlife Sanctuary (Sant Kabir Nagar). Data on fish diversity, plankton diversity, and habitat parameters were collected from various locations of above Ramsar sites.

Sur Sarovar (Keetham Lake)

Sur Sarovar, a 431-hectare human-made reservoir, near Agra, Uttar Pradesh, supports resident and migratory birds and over 60 species of fish. Sampling was conducted at 5 sites (Fig. 17) during different seasons to assess its ecological and water quality parameters. During the monsoon season.

Samples of water, plankton, sediment, and habitat parameters were collected from 5 locations across Sur Sarovar (Fig. 17). Elevated levels of pH, conductivity, and TSS were recorded near the Pump House, indicating effluent discharge as a point source of pollution. Foaming along the banks was also observed. Analysis revealed the presence of over 30 plankton species, with a significant abundance of *Microcystis* sp., suggesting algal blooms and eutrophication. The recorded

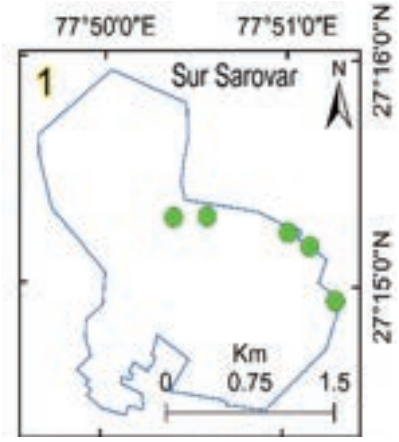


Fig. 17. Sampling sites of Sur Sarovar

plankton density and water quality parameters indicated a decline in the water quality.

During the post-monsoon survey, experimental sampling recorded only Tilapia species (Fig. 18). Mass mortality and foaming observed along the banks was likely caused by sewage inflow through the riverine source (Fig. 19). The findings highlight significant ecological and water quality challenges threatening the biodiversity and sustainability of Sur Sarovar.

Fig. 18. Documentation of exotic species, *Oreochromis niloticus,* from Sur Sarovar

Fig. 21. Fish landing at Bakhira Wildlife Sanctuary

Fig. 19. Foaming and fish mortality observed in Sur Sarovar

Bakhira Wildlife Sanctuary

This is the largest natural floodplain wetland of eastern Uttar Pradesh (2,894 ha). The wetland is internationally significant for its biodiversity, particularly its birdlife, supporting over 80 bird species. Exploratory surveys at 6 sampling locations (Fig. 20) revealed 57 fish species (9 orders; 22 families). Cyprinidae was the most diverse family followed (Fig. 21) by Danionidae. Other important species included the Vulnerable *Wallago attu*, Endangered *Clarias magur*, and Near Threatened species, *Ailia coila* and *Paramabassis lala*. The DNA isolation from over 200 specimens has been completed and sequencing of COI gene is in progress.

The wetland faces significant anthropogenic pressures such as sedimentation, habitat destruction from soil erosion, expansion of agricultural fields, water pollution, and eutrophication. Aquatic weeds cover approximately 95% of the wetland, indicating poor water quality and habitat degradation.

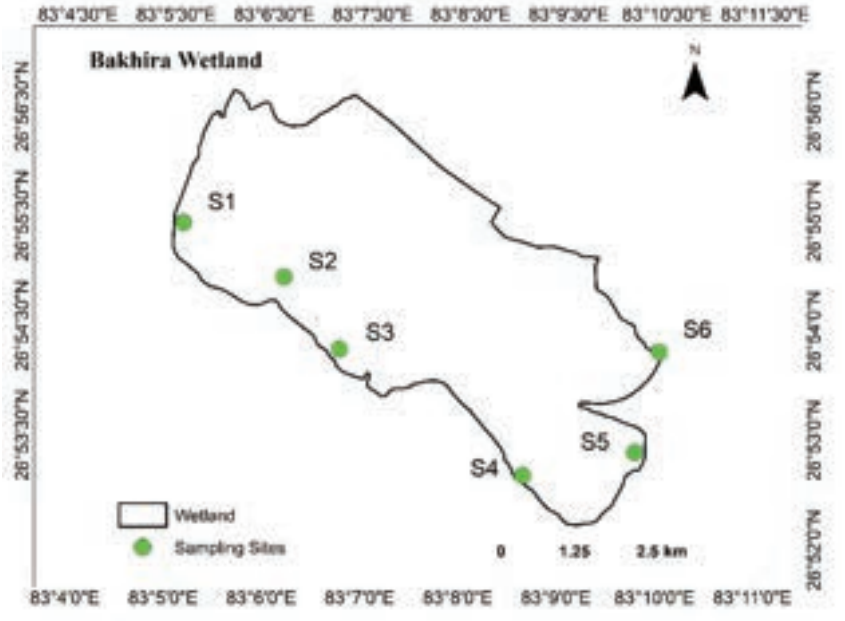


Fig. 20. Sampling sites of Bakhira Wildlife Sanctuary

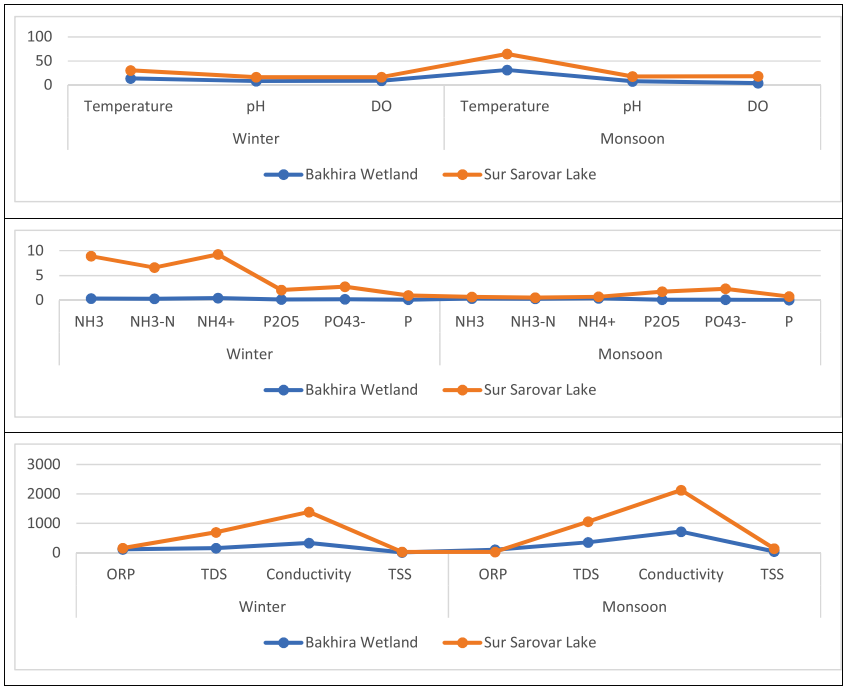


Fig. 22. Seasonal changes in the water quality parameters of Bakhira and Sur Sarovar wetlands

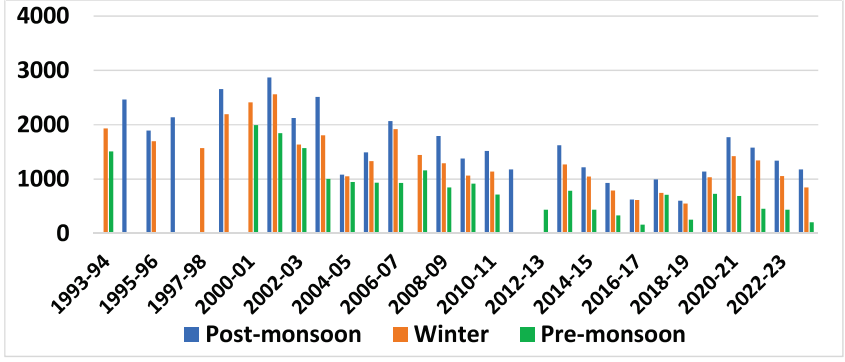


Fig. 23. Seasonal water spread dynamics of Bakhira wetland

Comparative water quality assessment of two wetlands

Seasonal changes in the water quality parameters between both the Ramsar sites (Fig. 22).

Geospatial water spread assessment

The seasonal water spread dynamics of the Bakhira wetland was studied using Landsat images (1994 to 2024) (Fig. 23). The satellite images were processed in ArcMap 10.8.1, and the water maps were developed using the Modified Normalized Difference Water Index.

The assessment revealed a high water spread in the post-monsoon season, followed by winter and pre-monsoon.

Project

Quantifying meta-structure matrices of biodiversity & ecosystem services for the assessment of fish genetic resources

Subproject 1: Quantifying meta-structure matrices in Western Ghats

Period: April, 2023 - March, 2026

Coordinator: Uttam Kumar Sarkar

Personnel: V. S. Basheer (PI), Divya P.R. and Charan Ravi

Funding support: Institutional, ICAR-NBFGR

Periyar is one of the biggest rivers in Kerala having many tributaries, finally draining to Arabian sea. Fish exploration surveys were carried out in 4 different stations of the river, starting from Valara in Idukki district to Bhuthathankettu in Ernakulam district (Fig. 24). The sampling areas were covered within the forest area. Most of the habitat was characterized with sandy shore, rock boulders, and shallow streams with gravel beds. During the survey, 44 fish species, belonging to 12 orders and 19 families including 5 exotic species (*Clarias gariepinus*, *Orechromis niloticus* and *O. mossambica, Cyprinus carpio* and *Pterigoplychthys spp*), were recorded, where Cypriniformes order dominated (Table 1, Fig. 25). In Bhuthathankettu area, presence of Indian major carps, *Labeo rohita* and *Catla catla*, were documented, which might have been introduced by Kerala Fisheries Department, as a part of improvement programme. Samples of endangered Mahseer, *Tor khudree*, were available in

Pooyankutty area. A number of Kooral, *Hypsilobarbus koorali* were available in all sampling areas. More number of minor barbs, *Halduria fasciata*, *Dwakinsia filamentosa*, were recorded in sampling sites.

Endemic catfishes, *Clarais dussmieri* and *Ompok malabaricus* were rarely obtained. It was observed that most of the fishes (77%) belonged to Least Concern category and 2% were Endangered (Fig 26).

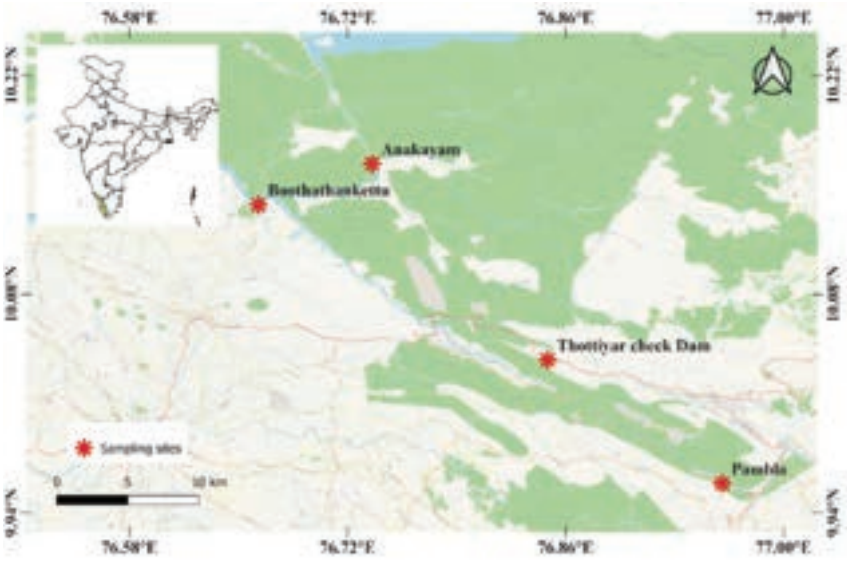


Fig. 24. Sampling sites of Periyar river

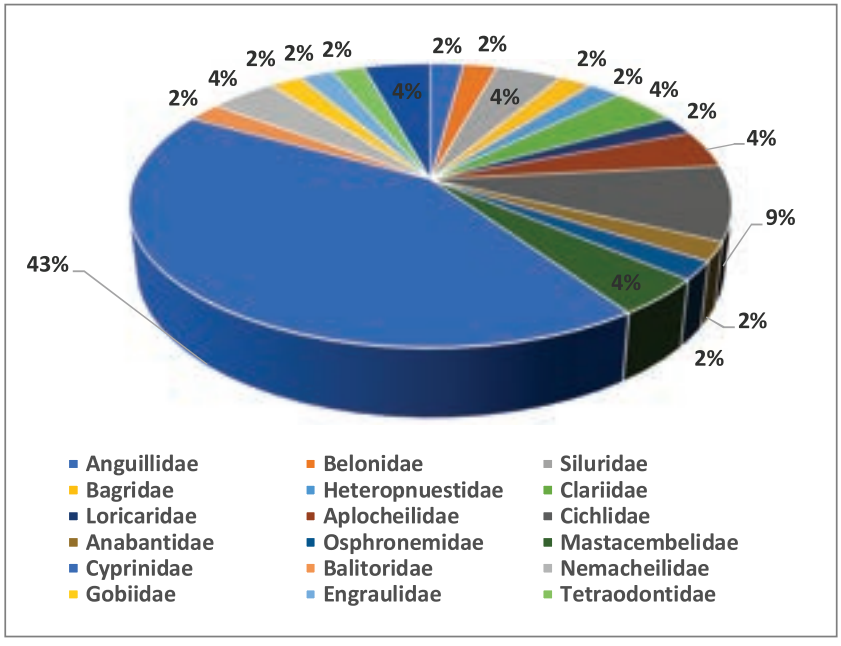


Fig. 25. Family-wise fish composition from Periyar river

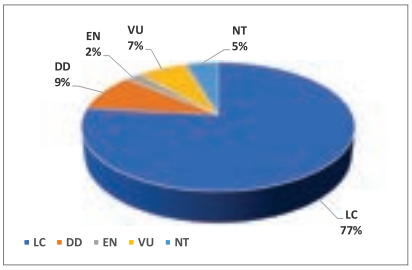


Fig. 26. Conservation status of the fishes from Periyar river

Subproject 2: Quantifying meta-structure matrices in Ganga basin

Period: April, 2023 - March, 2026

Coordinator: Uttam Kumar Sarkar

Personnel: Achal Singh (PI), Rejani Chandran, Raghvendra Singh, Tarachand Kumawat, Ajey Kumar Pathak, Jaspreet Singh and Vikas Kumar

Funding support: Institutional, ICAR-NBFGR

The project seeks to apply statistical modeling to predict the structure of fish communities in the Ganga basin of India under various climate change scenarios. Data collected from both primary and secondary sources on species occurrence, diversity, and water quality parameters will be utilized to develop models for species presence and absence, distribution, and dominance within this significant river basin.

Species diversity model for Ganga river landscapes

Metadata on number of species distribution for Ganga river basin for various landscapes, *viz*. Allahabad, Varanasi, Kanpur, from literature survey (published papers 1960-2024, Annual reports, FSI- website) was collected. The data included fish species (presence and absence), water quality parameters and environmental parameters, but

Table 1. Fish species recorded in Periyar river

Order	Family	Scientific name
Anguilliformes	Anguillidae	*Anguilla bengalensis*
Beloniformes	Belonidae	*Xenentodon cancila*
Siluriformes	Siluridae	*Wallago attu*
		Ompok bimaculatus
	Bagridae	*Mystus armatus*
	Heteropnuestidae	*Heteropneustes fossilis*
	Clariidae	*Clarias dussumieri*
		Clarias gariepinus
	Loricaridae	*Pterygoplichthys pardalis*
Cyprinodontiformes	Aplocheilidae	*Aplocheilius lineatus*
		Aplochielus blockii
Cichliformes	Cichlidae	*Psuedotroplus maculatus*
		Etroplus suratensis
		Oreochromis mossambicus
		Oreochromis niloticus
Anabantiformes	Anabantidae	*Anabas testudineus*
	Osphronemidae	*Pseudosphromenus cupanus*
Synbranchiformes	Mastacembelidae	*Mastacembelus armatus*
		Macrognathus guentheri
Cypriniformes	Cyprinidae	*Labeo catla*
		Cirrhinus mrigala
		Cyprinus carpio
		Labeo rohita
		Dawkinsia filamentosa
		Dawkinsia assimilis
		Haluduria fasciata
		Pethia ticto
		Puntius vittatus
		Tor khudree
		Garra mullya
		Amblypharyngodon melettinus
		Opsarius bakeri
		Devario malabaricus
		Devario aequipinnatus
		Rasbora daniconius
		Salmophasia boopis
	Balitoridae	*Travavancoria jonesi*
	Nemacheilidae	*Nemacheilus guentheri*
		Nemacheilus triangularis
Gobiiformes	Gobiidae	*Glossogobius giuris*
Clupeiformes	Engraulidae	*Thryssa scratchleyi*
Tetraodontiformes	Tetraodontidae	*Carinotetraodon travancoricus*
Perciformes	Channidae	*Channa marulius*
		Channa striata

for predictive modelling, species abundance data is required. Species abundance data from the Genetic Biodiversity Information System (GBIF) portal was available for Kanpur for the period 1974-1977, Varanasi for the years 1914, 1955, 1956, 1957 and no species abundance data was available for Allahabad.

Species distribution model for Ganga river landscapes

Metadata on IMC catch at Ganga river basin landscapes-Allahabad and Varanasi were collected for the years 1959-2020 from published journals. It was observed that IMC catch for Allahabad was in range of 6.65-35.82 tonnes with lowest catch of 6.65 tonnes during 1991-2000 and highest catch of 35.82 tonnes during 1981-1990. Similarly, for Varanasi the catch was in range of 0.9-3.4 tonnes during period 1959-1969. The lowest catch was 0.9 tonnes for 1962-63 and 1963-64 while, highest catch was 3.6 tonnes during 1960-61 (Fig. 27). The fish landings data may be used for predictive modelling.

Assessing role of environmental parameters

The species diversity and distribution model provided information about presence of variations in distribution of species within landscapes (Allahabad, Varanasi, Kanpur) over period from 1960 to 2019. Discriminant Analysis of Principal Components was used for analysis of metadata matrix, which provided density and composition plots. Density plot showed three peaks for each landscape (Fig. 28). The infograph further explained that Allahabad and Kanpur have distinct, high density value in a small score range, while Varanasi has low density value in wider score range. Loading plot explains that environmental parameters, *viz*. total dissolved solids (mg/l), alkalinity (mg/l), total hardness (mg/l), BOD (mg/l) with

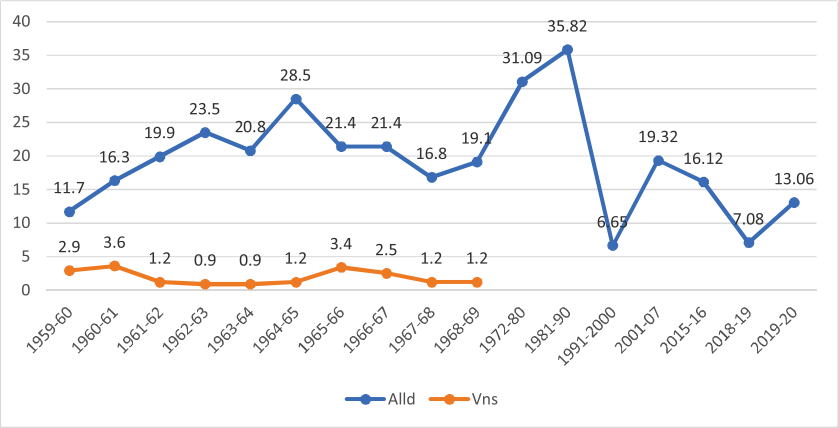


Fig. 27. Average catch of IMC (tonnes) for Ganga River landscapes-Allahabad (Alld) and Varanasi (Vns) during 1960-2020

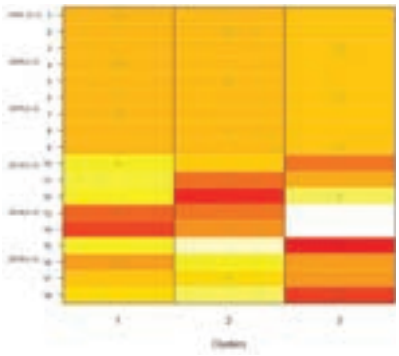


Fig. 31. Heatmap (red, yellow, white, pink) showing temporal changes for reflecting differences among 3 landscapes

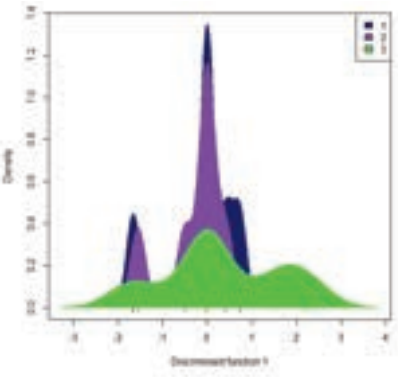


Fig. 28. Density over discriminant function in reflecting differences among the landscapes: 1. Allahabad (blue), 2. Kanpur (violet), 3. Varanasi (green).

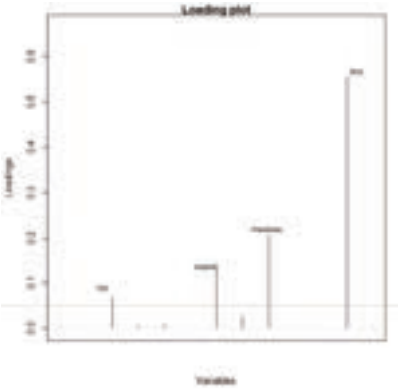


Fig. 29. Loading plot for identified parameters having higher contribution (or loadings) in composition of 3 landscapes

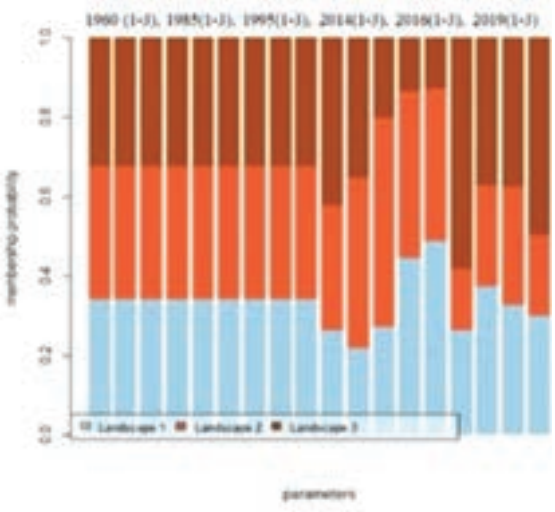


Fig. 30. Temporal changes parameters' posterior probability for discrimination among the landscapes

loadings >0.05, were observed to play significant contribution in composition of 3 landscapes (Fig. 29). The temporal changes in landscape composition were observed on the basis of probability distribution (Fig. 30) and also differences within landscapes (or clusters) were highlighted (Fig. 31).

Measures of sustainability and accuracy

The data on 13 environmental parameter's distribution among three landscapes were arranged in a matrix (18*13) and subjected to discriminant analysis with two discriminant parameters, (Lambda=1, Gamma=1). These 13 parameter-based discriminant analyses provided sustainability measured by (-)2 log likelihood for distinction among three landscapes (Fig. 32). Another measure for accuracy was estimating the area under receiver operating characteristic curve (AUROC) for three landscapes, indicating higher area for Kanpur followed by Allahabad, Varanasi (Fig. 33). This also explains the role of environmental parameters in landscape composition.

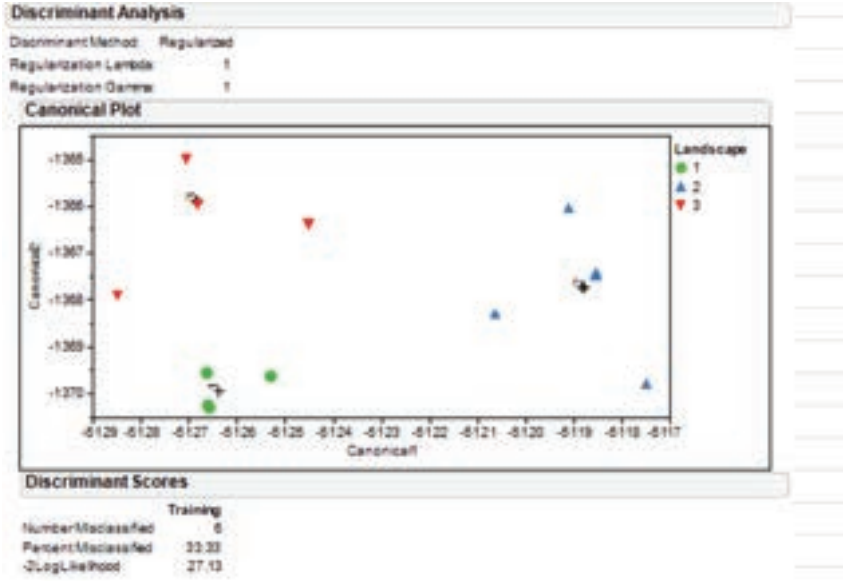


Fig. 32. Sustainability measure in canonical plot for three landscapes from the discriminant analysis of matrix

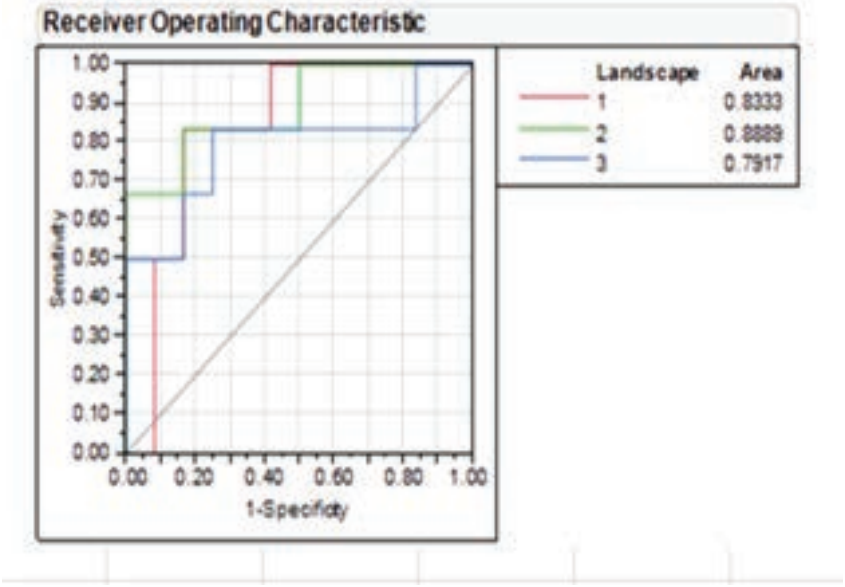


Fig. 33. Area under receiver operating characteristics curve for three landscapes from discriminant analysis of matrix

Subproject 3: Quantifying meta-structure matrices in NEH region

Period: April, 2023- March, 2026

Personnel: Rejani Chandran (PI), L. K. Tyagi, Achal Singh, A. K. Pathak, Labrechai Mog Chowdhury, Kantharajan G. and Amit Singh Bisht

Funding support: ICAR-NEH Component

The project focuses on exploring prioritized areas of the NEH region to investigate fish genetic diversity and apply statistical modeling to predict changes in fish community structure over time under shifting climate scenarios. The study was conducted in the Teesta river, which originates from Lake Chalamu at the Pahunri (or Teesta Kangse) glacier at 7,068 m asl in eastern Himalayas and flows through Sikkim and West Bengal before entering to Bangladesh.

Documenting fish diversity and water quality

Two extensive exploratory surveys were undertaken along the Teesta river from 21 prioritized sites, including high-altitude regions at Zero-point (16,000 ft msl), Yumthang Valley, and Tarai region of North Bengal, during Pre-Monsoon (May, 2024) and post-monsoon (November, 2024) seasons to collect data on fish diversity and habitat parameters (Fig. 34).

Fish diversity was assessed from selected sampling sites (Fig. 35), fish landing centres, and local fish markets. Experimental fishing was carried out at 12 sites employing the expertise of local fishermen to capture indigenous fish diversity. In each haul, the total number of species, total number of individuals in a sample, and total number of individuals of each species were recorded. A total of 96 fish species belonging to 10 orders and 26 families were recorded from the study area. Cyprinidae was observed as the richest family, in terms of the number of species (27 species) followed by Danionidae (15 species). As per IUCN Red List, 5 species belonged to Near Threatened category, while 3 species were Vulnerable, and one Endangered (Fig. 36). Two exotic species, *viz. Hypophthalmichthys nobilis* and *Oreochromis niloticus,*

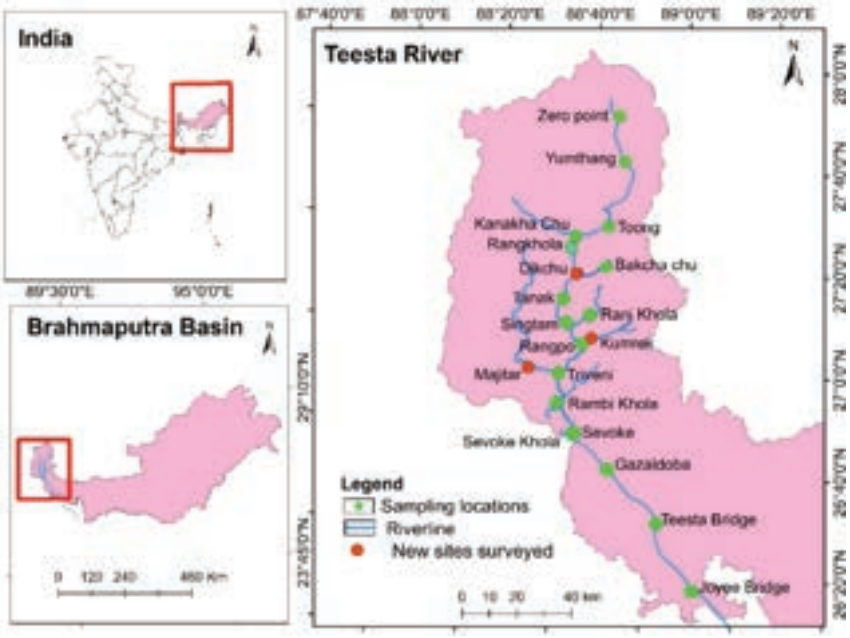


Fig. 34. Sampling locations in Teesta river

were recorded. The genomic DNA was isolated from 98 tissue samples and COI amplicons were sequenced.

Water quality assessment

Water quality parameters, namely temperature, pH, DO, conductivity, ORP, Total suspended solids and TDS, were recorded. The water temperature (ranged from 5.64°C to 34.93°C). A higher range of pH (7.7-8.91), conductivity (37-154 µs/cm), and TSS (15-150.2) was observed during the post-monsoon season owing to the flash floods and landslides (Fig. 37).

Assessment of flash flood on habitat and fishery ecosystem services

The impact of the flash flood (October 4, 2023) on Teesta river's physical habitat, morphometry, and ecosystem services was assessed through a geospatial approach supplemented with field surveys. The riverbed mapping of Sentinel-2 satellite imagery during pre and post-flash flood periods revealed an expansion of floodplain, both area and width, in selected locations, with the highest increase in Tanak and Rangpo sites. The spectral indices, *viz.* Normalised Difference Water Index and Normalised Difference Turbidity Index, revealed reduced depth in deep pools and increased turbidity, post-flash flood suggesting impaired habitat conditions which may influence the distribution and abundance of fish species (Fig. 38). The questionnaire-based fishermen's perception survey revealed the loss of numerous ecosystem services, linked with livelihood and income generation.

Fig. 35. View of experimental fishing in Rangkhola, tributaries of Teesta river, Sikkim

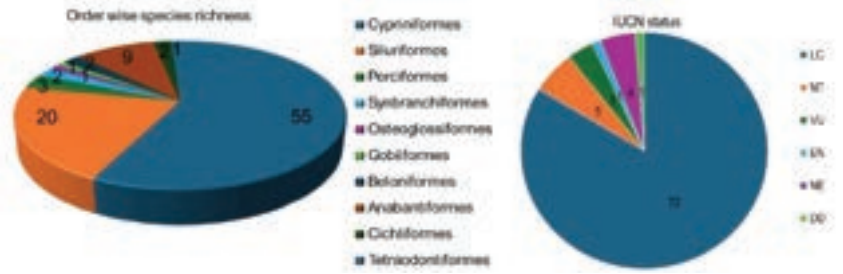


Fig. 36. Order-wise species richness and IUCN status of fishes recorded from Teesta river

Fig. 37. Water quality assessment at Lachung, North Sikkim

Habitat suitability mapping of Chocolate Mahseer

Ecological and habitat-specific parameters were used to prioritize, and map the suitable habitats for the flagship and economically important species, *Neolissochilus hexagonolepis*, in Teesta river basin, employing a geospatial approach. The river's topography, hydrological, and physio-chemical status datasets were developed and overlaid using GIS. The highly suitable zones were primarily identified along the tributaries (Rangit river; Rangpo Chu) and their confluence point, owing to riffles or pools with suitable substrate availability and optimal water quality, which serve as safe refuges. The stretch between Dikchu to Rangpo and Sevoke downstream was identified as a potential habitat among the Teesta main channel.

Fig. 38. Boulder and debris accumulation due to flash flood in Teesta river

Assessment of anthropogenic stressors in Teesta river

Anthropogenic stressors affecting the riverine habitats along the Teesta river basin were identified, classified, and mapped through primary data, *viz.* field surveys, stakeholder interviews, and geospatial approach, supplemented with secondary data. The spatial mapping of identified anthropogenic risks will be conducted using a suitable habitat assessment model. This will support conservation of riverine habitats and establishing mitigation measures. The input datasets pertaining to water quality, and habitat fragmentation (dams) were developed to compute the risk score of Teesta river for aquatic biodiversity based on the exposure and consequence.

The data of climatic variables (Temperature-max and Temperature-min) pertaining to Teesta-Upper and Lower basins were extracted for 30 years (1994–2023) from the Indian Meteorological Department (IMD). The decadal mean values of both T_{min} and T_{max} indicated an increasing pattern. The Mann-Kendal trend analysis revealed a significant ($p<0.001$) increase in the T_{min} in both the upper and lower basins. However, the increasing trend was not significant for T_{max} in both upper and lower basins. The comprehensive data analysis on the interrelationship of climate, habitat, and fish diversity in the community is under progress.

Project

Assessment of ichthyofaunal diversity and habitat status with traditional knowledge in fisheries along Subarnarekha river and its tributaries for cataloguing, conservation and management

Period: April, 2024 - March, 2027

Personnel: Ajey Kumar Pathak (PI), Mahender Singh, Raghavendra Singh, Tarachand Kumawat, Jaspreet Singh, Ravi Kumar and Vikas Kumar

Funding support: Institutional, ICAR-NBFGR

The river Subarnarekha (460 km in length) originates from Chotanagpur plateau near Ranchi (Fig. 40), and drains into the Bay of Bengal near Chaumukha in Orissa. Major tributaries are Raru, Kanchi, Karkari, Kharkai, and Dulung. The catchment area of the Subarnarekha river basin extends over 19,296 km^2 and accounts for 0.6% of the geographical area of India.

Sampling along 10 sites in Subarnarekha river was conducted to collect the data on fish, habitat and water quality parameters (Fig. 39).

Fig. 39. Origin place of Subarnarekha river

Fig. 40. Sampling sites of Subarnarekha river

Fish biodiversity assessment

A total of 75 species (Freshwater: 35 and Brackishwater: 40; including one shark, 69 fish and 5 shellfish species) belonging to 16 order, 35 family and 58 genera were documented. Perciformes was dominant, followed by Cypriniformes, Clupeiformes, Siluriformes and others were below 5% (Fig. 41). Family Cyprinidae represented the highest number of species, followed by Sciaenidae, Engraulidae, Channidae, Polynemidae, and others (<2%).

Based on feeding habits in both freshwater and brackishwater habitats: the carnivorous were highest in number (44%), followed by omnivorous and herbivorous species. The IUCN status of fishes is illustrated in Fig. 42.

Identification of habitat structure

Different habitat structures were identified along the upper, middle and downstream segments of the river are presented in Fig. 43.

Water quality parameters

The water quality analyses revealed that the river was suitable for fish survival; however, low dissolved oxygen levels (<5 ppm) recorded in Getulsud Dam, Chandil Dam, and several urban

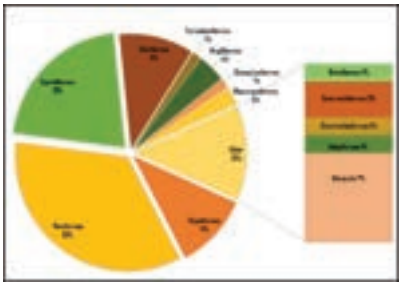


Fig. 41. Fish diversity (%) under different orders

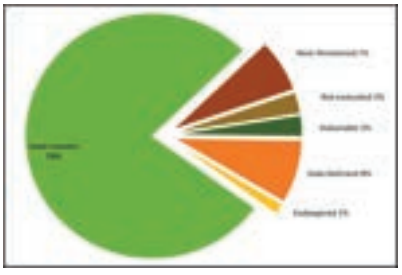


Fig. 42. IUCN status of fish diversity found in Subarnarekha river

water bodies might indicate eutrophication. Some sites revealed the existence of contaminated water (higher ammonia and

Fig. 43. Different habitat structure along the Subarnarekha river

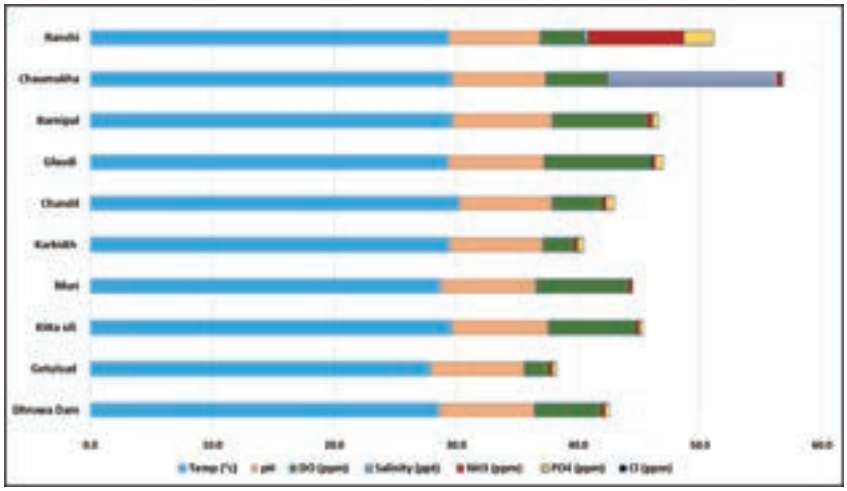


Fig. 44. Water quality parameters from different sampling sites

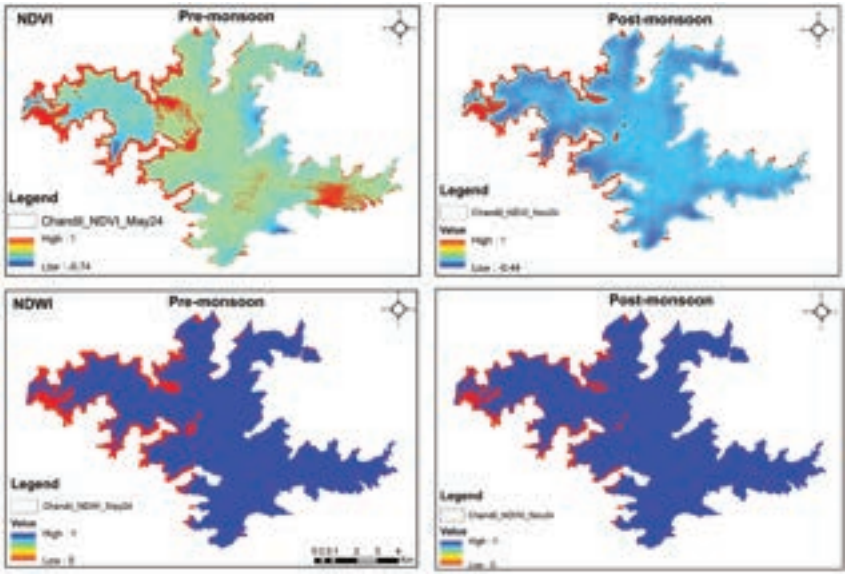


Fig. 45. Spatial water quality indices of Chandil dam

phosphate concentrations) in the Subarnarekha river (Fig. 44). Higher turbidity in the post-monsoon period and more vegetation in the pre-monsoon season was evident in Chandil dam. Lower water levels during the pre-monsoon season and chlorophyll range was more or less similar in both the seasons (Fig. 45).

Project

Ecosystem Dynamics and conservation strategies of the sacred rivers: Assessment of physicochemical attributes, fish biodiversity, and human impacts

Period: April, 2024-March, 2026

Personnel: Tarachand Kumawat (PI), Mahender Singh, Rejani Chandran, Kantharajan G., Jaspreet Singh and Vikash Sahu

Funding support: ICAR-NBFGR Corpus Fund

The study on the ecosystem dynamics and conservation strategies of the Saryu river was conducted along 6 stations, namely Elgin bridge, Barabanki; Demua Ghat bridge; Guptar ghat, Ayodhya; Nayaghat, Ayodhya; Dubaulia Khas, and Kalwari bridge, Tanda (Fig. 46) and described the river's physicochemical properties, fish biodiversity, and human impacts.

Fig. 46. Sampling sites along the Saryu river stretch (Elgin bridge, Barabanki; Demua Ghat bridge; Guptar ghat, Ayodhya; Nayaghat, Ayodhya; Dubaulia Khas, and Kalwari bridge, Tanda)

Fig. 47. Traditional wooden fishing vessel employed in the Saryu river with its full catch

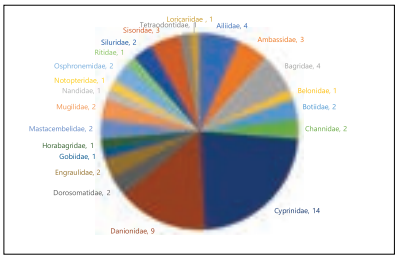


Fig. 48. Family-wise fish composition from the Saryu river

Traditional wooden fishing vessel was observed in the Saryu river (Fig. 47).

The study identified 61 fish species across 45 genera and 22 families, with the family Cyprinidae being the most diverse, contributing 14 species, followed by Danionidae and Bagridae (Fig. 48). The physicochemical analysis, revealed seasonal fluctuations in water temperature (ranging from 16.79°C to 28.9°C), pH (from 7.36 to 8.48), dissolved oxygen (4.93 to 10.3 mg/l), and other parameters (Table 2). The microplastic abundance was quantified in particles per litre (Fig. 49), revealed a dominance of fibres (43.07%), followed by pellets (18.46%) and films (16.92%). The microplastic samples collected across the river's sampling stations, varied in shape (fragments and beads), composition and colour characteristics (Fig. 50).

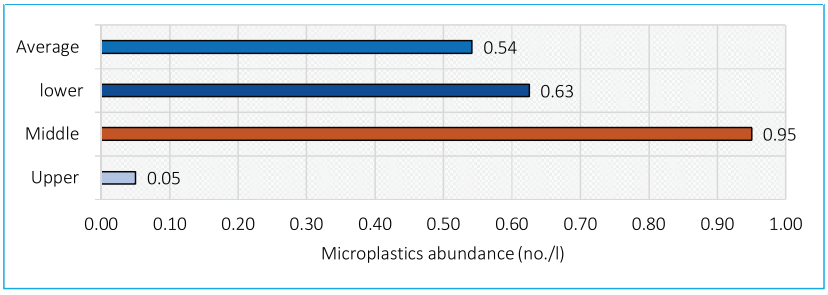


Fig. 49. Microplastic abundance (no./l) of the water samples from Saryu river stretch

Table 2. Seasonal physicochemical parameters of the Saryu river stretch

Parameter	Summer (Apr-May)	Monsoon (Aug-Sep)	Post Monsoon (Oct-Nov)	Winter (Dec-Jan)	Pre-summer (Feb-Mar)
Water Temp. (deg C)	23.71-28.9	26.48-27.86	23.37-26.8	16.79-23.56	24.15-26.86
pH	8.15-8.48	8.29-8.45	7.36-8.35	7.93-8.45	8.1-8.44
DO (mg/l)	6.43-8.45	4.93-5.91	6.79-9.9	7.54-10.3	5.93-7.41
Conductivity (mS/cm)	297-497	517-562	545-692	515-979	562-620
TDS (ppm)	149-248	260-345	274-246	299-490	281-310
ORP (mv)	117-226	67.1-147.7	21.9-149.3	47.6-110.4	8.3-64.2
Stream Depth (m)	1.9-4.6	0.9-13.1	1.0-12.1	2.7-6.3	1.2-6.0
Water flow (m/s)	0.1-0.4	0.1-0.6	0.2-0.7	0.1-0.5	0.1-0.4
Ammonia					
- NH_3^{-N}	0.0-0.29	0.04-0.13	0.0-0.1	0.04-0.18	0.04-8.39
- NH_4^+	0.0-0.37	0.05-0.16	0.0-0.11	0.05-0.23	0.06-10.76
- NH_3	0.0-0.35	0.05-0.16	0.0-0.08	0.05-0.21	0.05-10.15
Phosphorus					
- P	0.09-0.27	0.04-0.24	0.1-0.27	0.18-0.78	0.04-0.64
- P_2O_5	0.28-0.61	0.08-0.55	0.23-0.61	0.4-1.79	0.1-1.47
- PO_4^{3-}	0.27-0.82	0.11-0.74	0.31-0.82	0.54-2.39	0.13-1.97
Total Chloride (mg/l)	0.0-0.0	0.0-0.05	0.0-0.02	0.0-0.08	0.0-0.04
Copper (mg/l)	0.046-0.062	0.069-0.175	0.085-0.144	0.027-0.142	0.03-0.199

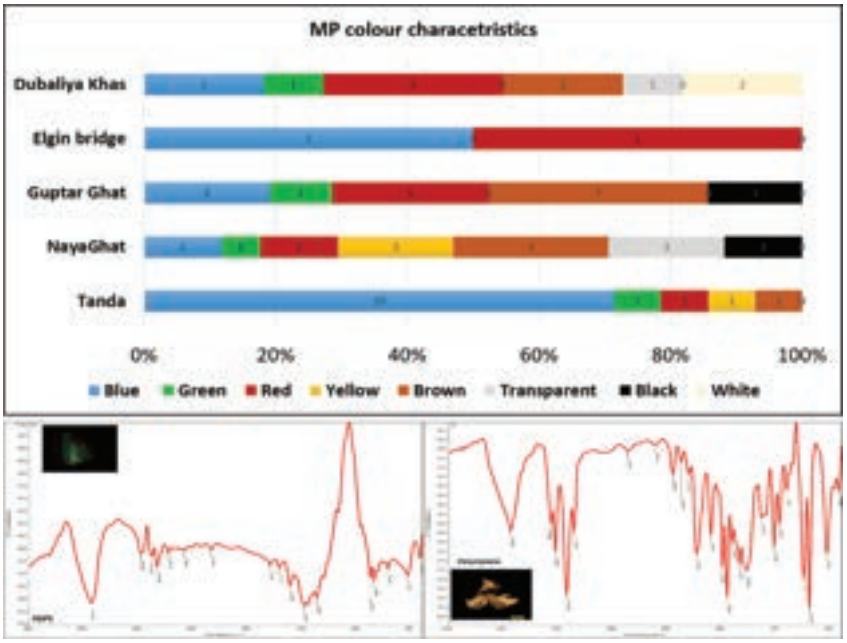
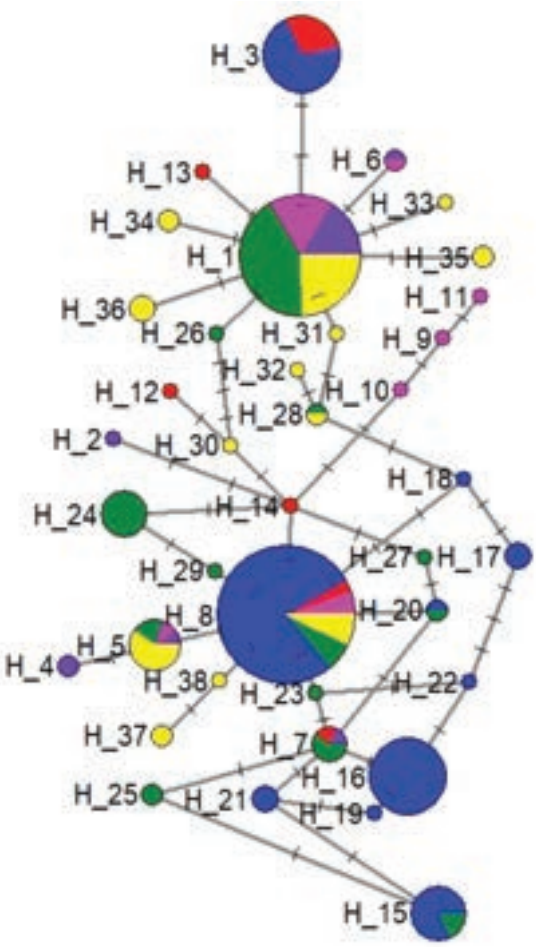


Fig. 50. Microplastics colour characteristics from various stations along the Saryu river stretch and attempted composition analysis

Characterization and Evaluation of Genetic Resources, Intra-specific Diversity and Genetic Stocks



Haplotype network for genetic characterisation studies

Characterization and evaluation of aquatic genetic resources is vital for sustainable aquatic resource management. Exploring intra-specific diversity is key to uncovering unique genetic traits, supporting biodiversity conservation, and enhancing species' adaptability to environmental changes. This understanding is crucial for addressing global challenges like food security, climate change, and ecosystem health, making genetic resource studies central to modern conservation efforts. ICAR-NBFGR is actively involved in characterizing phenotypic and genotypic traits of fish germplasm, with a focus on commercially important and prioritized indigenous species across diverse aquatic ecosystems. The institute also evaluates key fish species to support their domestication and sustainable use.

Project

CRP on Agrobiodiversity: Evaluation of fish germplasm from Indo-Gangetic rivers for their captive breeding, domestication, and conservation aquaculture (NBFGR HQ component)

Period: April, 2021 - March, 2026

Coordinator: Uttam Kumar Sarkar

Personnel: Aditya Kumar (PI), Rajeev Kumar Singh, Santosh Kumar, Raghvendra Singh, Monika Gupta and Ajay Kumar Singh (till October 31, 2024)

Funding Support: ICAR Plan Scheme

Agrobiodiversity is crucial for food security, sustainable agriculture, and ecosystem services. CRP-Agrobiodiversity aims to evaluate prioritized indigenous fish germplasm for conservation aquaculture and to develop protocols for captive culture of indigenous fish species to popularize and promote new species for aquaculture diversification and address region-specific problems.

Germplasm collection for performance evaluation

Live individuals of 8 fish species, namely *Rita rita* (n=164), *Ompok bimaculatus* (43), *Mystus bleekeri* (210), *M. tengra* (64), *Chitala chitala* (150), *Notopterus notopterus* (110), *Mastacembelus armatus* (8) and *Wallago attu* (27), were collected from Gomti river, Lucknow. Mixed riverine seed (1.5 Lakh) from Ganga river, Patna was also collected. Live fishes were transported and stocked at the fish germplasm resource centre of ICAR-NBFGR, Lucknow for raising as broodstock.

Fig. 51. Captive breeding of *Heteropneustes fossilis*

Captive breeding and larval rearing for on-farm evaluation

Heteropneustes fossilis

Multiple breeding trials of the catfish, *H. fossilis,* was conducted using approximately 100 pairs of broodstock. The young ones were reared in FRP tanks and about 23,000 advanced fingerlings were harvested (Fig. 51). Fingerlings were stocked in the ponds for on-farm evaluation under different systems (monoculture and polyculture).

The growth of *H. fossilis* was studied in polyculture and monoculture systems over 6 months in polyethylene-lined ponds. Four treatments in different stocking ratio of catla, rohu, mrigal, and singhi. IMC was stocked at 30/m^2 and singhi at 70/m^2. Fish were fed with pelleted feed at 3% body weight, daily, twice a day. Singhi performed best in T2, with the highest biomass and survival. Water quality parameters remained consistent across all treatments, except nitrite nitrogen, which was significantly higher in T2.

Clarias magur

Breeding of *C. magur* was conducted using 5 pairs of broodstock (Fig. 52). The young ones were reared in FRP tanks and approximately 700 advanced fingerlings were harvested. The fingerlings were stocked in the ponds for further broodstock development.

Fig. 52. Fingerlings of *Clarias magur*

Channa striata

C. striata individuals (n=110) were reared under captive condition in pond and concrete tanks. Three induced breeding trials were conducted during breeding season (Fig. 53). Further, natural spawning was also observed in concrete tanks and approximately, 10,000 nos. of fry was produced collectively. In induced breeding trials, FRP tanks with *Eichhornia* sp. were used. Fish were injected with synthetic hormone, ovatide. Male to female ratio was kept at 2:1. Latency period observed was 20-25 h with a fertilization rate of about 80-85%. Larvae were fed with mixed zooplankton along

Fig. 53. Induced breeding trial of *Channa striata*

with the powdered artificial diet 6 times a day. Four-day old larvae (140 individuals each) were reared under 4 treatment groups (T1-T4) with different combinations of stones, sand bed and *Eichhornia*. Continuous aeration was given in all the treatments with 30% water exchanged every 3rd day. The highest survival was in T2 group, followed by T4, T1 and T3.

Macrobrachium lamarrei

Mass breeding of small indigenous freshwater prawn, *M. lamarrei* was attempted in captivity. Prawns were collected from the Sharda Sahayak canal connected with Gomti river, and maintained in circular FRP tank with continuous aeration in a controlled environment for 2 weeks. Acclimatization was done to reduce stress and promote adaptation. Temperature was maintained at 30°C for maturation. Berried females were selected from the maturation tank and transferred to FRP hatching tank (Fig. 54).

a.

b.

c.

d.

e.

Fig. 54. Rearing of *Macrobrachium lamarrei*. a. Prawn collection site, b. Acclimatization under captive conditions, c. Breeding tank, d. Berried female, e. F_1 generation

Berried females released larvae in 2-3 batches at an interval of 18-48 h. The recorded average length and weight of newly hatched larvae were 4.25 mm and 0.04 g. A total of 850 larvae were produced, which were transferred to rearing tank containing greenwater with continuous aeration. Weaning with fine powdered supplementary commercial prawn feed continued for 30 days, followed by commercial prawn feed. After 1 month of rearing, average length and weight of larvae were 7.23 mm and 0.08 g with 45% survival rate. After 4 months of rearing, 320 prawns were produced with an average length and weight of 36 mm and 0.24 g.

Comparative assessment of genetic diversity in rohu

This work was undertaken to assess the changes in genetic diversity in hatchery rohu after crossing with cryopreserved milt from riverine stock (Fig. 55). The juveniles from Kash fisheries, Sangrampur, East Champaran, Bihar were brought to ICAR-NBFGR, Lucknow for rearing and growout. Individuals from both cross-fertilized and control groups will be individually tagged and growth monitored for comparative assessment of biological parameters.

Fig. 55. Fertilization of rohu ova using cryopreserved sperm

Project

CRP on agrobiodiversity Conservation aquaculture of endemic fish species from peninsular rivers through captive propagation and culture evaluation

Period: April, 2021 - March, 2026

Coordinator: Uttam Kumar Sarkar

Personnel: Charan Ravi (PI), Rekha M.U., T.T. Ajith Kumar and V.S. Basheer

Funding Support: ICAR Plan Scheme

The project aims to safeguard and augment the populations of native fish species from peninsular rivers, thus, contributing to biodiversity conservation and sustainable aquaculture practices.

Germplasm collection for performance evaluation

A new species, *Horabagrus obscurus,* was described from Chalakudy river, Kerala. Samples of *Clarias dussumieri* (n=150), *H. nigricollaris* (30), *Hemibagrus punctatus* (130), *Hypselobarbus carnaticus* (20) were collected from Cauvery river and maintained in cages at Kochi. Additionally, specimens of *Etroplus suratensis*, *Pseudetroplus maculatus*, and *Ompok bimaculatus* were *collected* and stocked in cages at Nagarjuna Sagar reservoir, Telangana, and monitored for growth and reproduction.

Captive breeding and larval rearing of indigenous fishes

Successful captive propagation of the newly described catfish, *H. obscurus,* was achieved with 5 breeding trials using females and males at 1:1 sex ratio. Ovulation and spermiation was induced with WOVA-FH. Fecundity ranged from 1800 to 2400, with 80–90% fertilization rate, 75–90% hatching rate, and 85–95% survival rate. Approximately 1500–1650 fingerlings were successfully reared.

Upscaling/ mass scale captive propagation of endangered fishes

- Ten breeding trials of *H. nigricollaris* were conducted using WOVA-FH with successful spawning in 5 trials, with 66–71% fertilization rate, 69–73% hatching rate and 84–91% larval survival (Fig. 56).
- Twelve breeding trials of *Hemibagrus punctatus* was conducted using WOVA-FH and spawning occurred in 3 trials, with 78% fertilization rate and 73.3% hatching rate.
- Three breeding trials were conducted in *Labeo dussumieri* and a total of 1.5 lakh hatchlings were produced.
- Twelve breeding trials were conducted in *Horabagrus brachysoma,* produced ~100,000 spawn and 2,000 fingerlings were released into Periyar river, Kerala. Anophthalmia (absence of eyes) was documented in hatchery-reared specimens.

Fig. 56. Captive raised fingerlings of *Horabagrus nigricollaris*

Fig. 57. Ranching of *Hemibagrus punctatus* at Shivanasamudra fish sanctuary, Cauvery river, Karnataka

- Twelve breeding trials were conducted in *Clarias dussumieri* from which 3,000 fingerlings were distributed to farmers and 2,000 fingerlings were released into the Periyar river in collaboration with the Kerala Forest Department.

Stock replenishment

- As a conservation effort, 2,000 juveniles (4 months old, >3 inches long) were released into the Cauvery river at Shivanasamudra Fish Sanctuary, in collaboration with WASI-India and Fisheries Department, Karnataka (Fig. 57).

Technology dissemination of endangered catfish captive breeding

- Breeding protocol of *Horabagrus nigricollaris* was disseminated to Mr. Lijoy, proprietor of Bio Organic World, Chalakudy, Kerala.
- On-field demonstration breeding of *H. brachysoma* was conducted at AQURA Fish Farm, showcasing farmer-driven aquaculture's potential.
- An MoU with ADAK, Kerala facilitated the dissemination of captive breeding technology for *C. dussumieri*, *Heteropneustes fossilis*, *H. brachysoma*, and *L. dussumieri* at Peechi Fish Farm, Thrissur.

Project

Development and characterization of anti-immunoglobulin antibodies (Anti-Ig Abs) against an indigenous aquaculture species

Period: July, 2021 - March, 2024

Personnel: Arun Sudhagar S. (PI) and Neeraj Sood

Funding Support: Institutional, ICAR-NBFGR

The work aims to develop anti-immunoglobulin antibodies against 2 native fishes, *Etroplus suratensis* and *Clarias dussumieri*. Immunoglobulins (Ig) were purified from the serum of *E. suratensis* and *C. dussumieri*. To develop monoclonal antibodies (anti-Ig Abs) against the purified Ig, BALB/c mice were immunized separately with 50 µg of purified Ig from each fish species, injected intraperitoneally along with an equal amount of Freund's Complete Adjuvant. The mice were subsequently boosted 3 times at two-week intervals with 50 µg of purified Ig mixed with Freund's Incomplete Adjuvant. On 60th day of immunization, blood was collected from the mice to evaluate the immune response using ELISA. Three days prior to fusion, 50 µg of purified Ig in phosphate-buffered saline was injected to enhance the immune response. On the day of fusion, the mice were euthanized to collect macrophages and spleen cells. The spleen cells were fused with myeloma cells (SP2/0) at a 1:5 ratio using polyethylene glycol. Macrophages were used as feeder cells and evenly distributed in 96-well plates. The fused cells were seeded onto the feeder cells in 96-well plates containing RPMI 1640 medium supplemented with hypoxanthine–aminopterin–thymidine. The plates were monitored for hybridoma growth, and the positive clones were screened using indirect ELISA. In the ELISA assay, positive clones were successfully identified for *C. dussumieri*, but not for *E. suratensis*. Therefore, subsequent downstream processes were conducted exclusively for *C. dussumieri*. The positive clones were subcloned using the limiting dilution method. One strongly reactive monoclonal antibody (MAb), designated G3, was characterized by western blotting to assess its reactivity against the Ig of *C. dussumieri*. The MAb class

was determined using a mouse monoclonal antibody isotyping kit, which identified the antibody as type -2a$_K$. The MAb showed binding to the heavy chain of both the purified Ig and the whole serum of *C. dussumieri*. Competitive ELISA was performed to evaluate antigenic relatedness among different species, such as *C. batrachus, C. gariepinus, Heteropneustes fossilis*, and *Channa striata*. Furthermore, flow cytometry was used to quantify Ig-positive cells in peripheral blood mononuclear cells of *C. dussumieri*. Indirect ELISA was conducted to detect *Edwardsiella tarda*-specific antibodies in the serum of immunized *C. dussumieri*. The results demonstrated an elevated immune response to *E. tarda* in immunized fish compared to non-immunized fish.

Project

Development of novel microsatellite markers for genetic and adaptive divergence in natural populations of selected fish species

Period: April, 2023 - March, 2025

Personnel: Rajeev K. Singh (PI), Vindhya Mohindra and L. Mog Chowdhury

Funding Support: Institutional, ICAR-NBFGR

The project aims to develop novel microsatellite markers for determining genetic and adaptive divergence in natural populations *Heteropneustes fossilis* and *Labeo bata*.

Sample collection

Tissue samples of two important species, *H. fossilis.* and *L. bata*, were collected from different riverine sites/ localities (Table 3) for genetic diversity studies.

Genome-wide mining of SSR in *Heteropneustes fossilis*

Low depth genome sequencing of *H. fossilis* yielded 141.8 million trimmed reads (150 bp read size). The reads were assembled, and MISA was used to identify SSRs from 951,639 contigs (718.06 Mb, 40.76% GC) of the genome. Primarily, the SSRs belonging to genes linked to environmental information processing pathways (1338) were screened. A total of 100 such primers were designed and custom synthesized.

Screening for polymorphism

A total of 66 primers yielded good and consistent amplification. These primers were subsequently checked for polymorphism of 24 samples. Initial checking of polymorphism was done on polyacrylamide gel electrophoresis, followed by silver staining. Alleles were designated according to PCR product size, and calculated relative to a molecular marker (pBR322DNA/MspI digest). Over 50% of the primers (36 SSRs) exhibited polymorphism.

The primers cover a broad range of gene types, including those involved in cell signalling, transport, metabolism, protein phosphorylation, and development. The expected PCR product sizes were small to moderate (ranging from 108 bp to 245 bp) (Fig. 58). The primer melting temperatures (T_a) ranged from 50°C to 57°C.

Fluorescent labelling and genotyping

Individual genotype data for all the polymorphic microsatellite loci was done. For this,fluorescent labelling was done, and the primers were custom synthesized. These labelled primers were used for genotyping, and stock characterization. based on gene coding SSR marker and population studies.

The identified loci represent 34 genes, mainly involved in environmental information processing pathways, signal transduction pathways (MAPK signaling pathway, mTOR signaling pathway, Wnt signaling pathway, cAMP signaling pathway, PI3K-Akt signaling pathway, AMPK signaling pathway, Hippo signaling pathway, FoxO signaling pathway, Calcium signaling pathway), ECM-receptor interaction etc. The main target of these primers might be a variety of genes involved in different biological functions, *viz*. CACNA1D (CAV1.3): Voltage-dependent calcium channel, involved in calcium

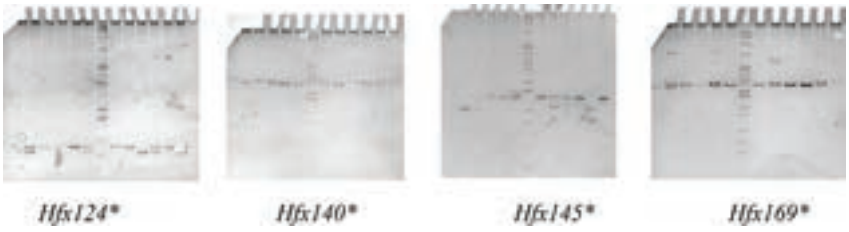


Fig. 58. Amplification of microsatellite loci in *Heteropneustes fossilis*

Table 3. Fish sampling location sites

River/Location	*H. fossilis*	*L. bata*
Brahmaputra river, Guwahati	30	27
Teesta river, Siliguri	45	-
Gomti river, Lucknow	30	14
Ghaghra (Indira Canal), Lucknow	10	23
Bakhira Wildlife Sanctuary, Sant Kabir Nagar	67	-
Sharda Canal, Lucknow	04	45
Hooghly river, Nischintapur	06	35

ion transport, ABCG5: ATP-binding cassette transporter involved in sterol metabolism, ABCB1 (MDR1): ATP-binding cassette transporter involved in multidrug resistance and ITGA10: Integrin receptor, that plays a role in cellular adhesion and signal transduction.

Genome sequencing for microsatellite loci identification in *Labeo bata*

High quality DNA of *L. bata* was isolated for custom low-depth genome sequencing on Illumina platform, with a 150 bp paired-end library. A total of 28.379 Gb of high-quality data, with 91.61% of bases achieving a Q30 score and a mean quality score of 35.5 was generated. De novo assembly was performed using MaSuRCA version 3.2.4, which estimated the genome size to be approximately 906,046,389 bp. The final assembly resulted in 176,874 scaffolds, with a total assembled genome of 952,061,765 bp. The longest scaffold obtained measured 143,882 bp. The screening of genome data for identifying microsatellites is under progress.

Project:

Nanofibre and Biocomposite development from fish waste resource for circular economy

Period: April, 2023 – March, 2026

Personnel, ICAR-NBFGR: Poonam Jayant Singh (PI), A.K. Pathak, A. Kathirvelpandian, Mahendar Singh, S.K. Srivastava and Ravi Kumar

Personnel, ICAR-CIRCOT: GTV Prabhu (PI) and Senthil Kumar

Personnel, ICAR-IISR: Manoj Kumar Srivastava (PI)

Funding Support: Institutional, ICAR-NBFGR

Fish waste is a global problem arising from discards, causing environment problems. The aim of the work is valorization and upcycling of fish biowaste for creating bio-composites, nanoparticles and nanofiber for potential commercial applications catering to SDG # 12 (Responsible consumption and production) for bringing waste discards near zero to enhance bio economy and utilize green synthesis.

Calcination of fish scales and oyster shells

Fish scales and shells of oyster were crushed and calcined at temperature range from 200°C to 1200°C for synthesis of biogenic hydroxyapatite (HAP) powder (Fig. 59). FTIR, EDS and SEM analysis was used for characterization of HAP and nanohydroxyapatite (nHAP). The scales, shells and bioactive peptides have potential as a biomaterial to be used in bioimaging with application in medical sciences.

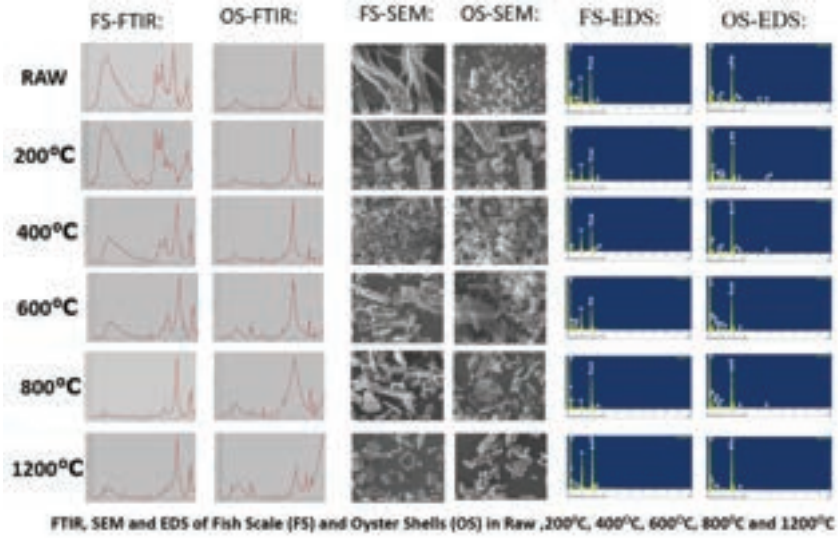


Fig. 59. FTIR, SEM and EDS of fish scales and oyster shells

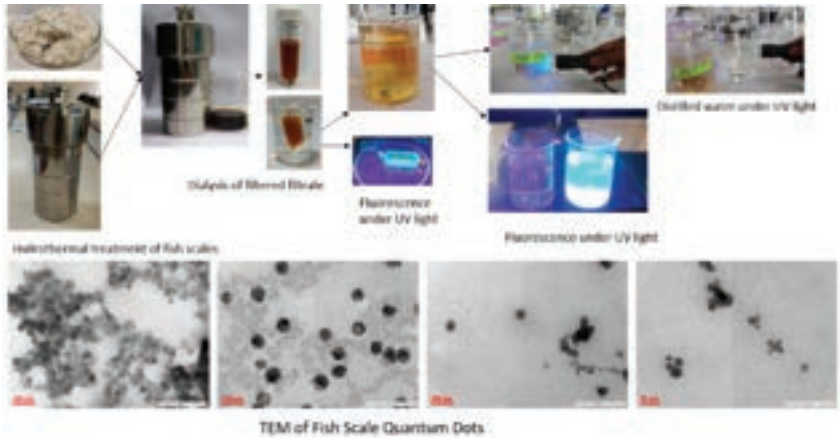


Fig. 60. Fish scale quantum dots

Fish scale quantum dots (FSQDs)

Green biosynthesis method was used for FSQD, where fish scale rich in collagen and hydroxyapatite were used to produce carbon quantum dots by hydrothermal treatment at 1800°C. The samples were filtered and centrifuged, followed by dialysis. Post dialysis, fluorescence was observed under UV condition. Quantum dots were analysed by TEM (Fig. 60).

Bio-fabrication of silver nanoparticle-conjugated quantum dots (AgNPs-FSQDs)

Green biosynthesis method was used for producing AgNPs-FSQDs, using sugarcane leaf extract. Sugarcane leaves were utilized to produce silver nanoparticles through green synthesis. Fish scale was used to produce carbon quantum dots by hydrothermal treatment at 1800°C. The samples were filtered and centrifuged followed by dialysis. Post dialysis fluorescence was observed under UV condition. The UV spectra of AgNPs-FSQDs shows synthesis of quantum dots conjugated with silver. AgNPs-FSQDs exhibited fluorescence under UV-VIS spectrophotometer (Fig. 61). Stability and biocompatibility for application in biomedical imaging, drug delivery, environmental sensing, and catalysis needs to be do analyzed.

Electrospinning PVA infused nanofibre matrix from collagen and chitosan

Nano electrospinning is used for fabricating nanoscale materials from polymeric solutions, to create fine surface enhanced nanofibers with controlled morphology. Using this approach, nanofibers composed of chitosan and collagen have successfully been prepared by blending with 33% and 7.5% polyvinyl alcohol (PVA), respectively (Fig. 62). The extracted collagen from fish scale will be incorporated to the nanofibre matrix and assessed for wound healing properties. The collagen matrix with PVA has applications as a scaffold for studying cell adhesion properties. These nanofibers exhibit excellent biocompatibility and

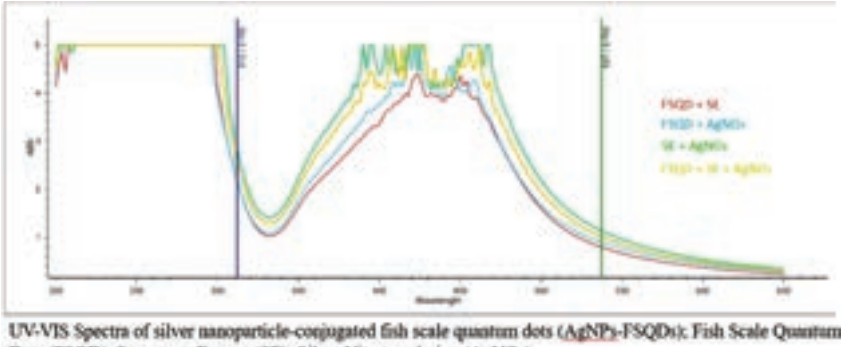


Fig. 61. UV-VIS spectra of bio-fabrication of silver nanoparticle conjugated fish scale quantum dots

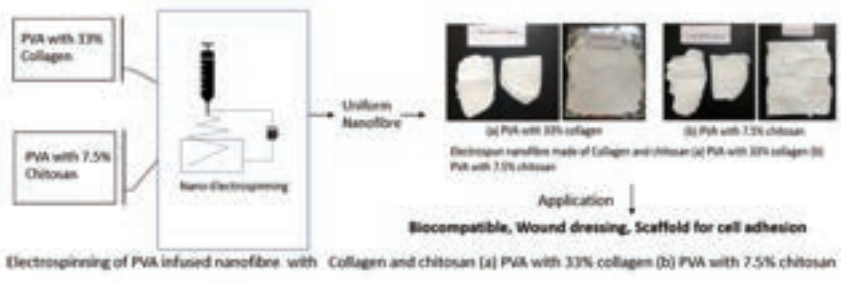


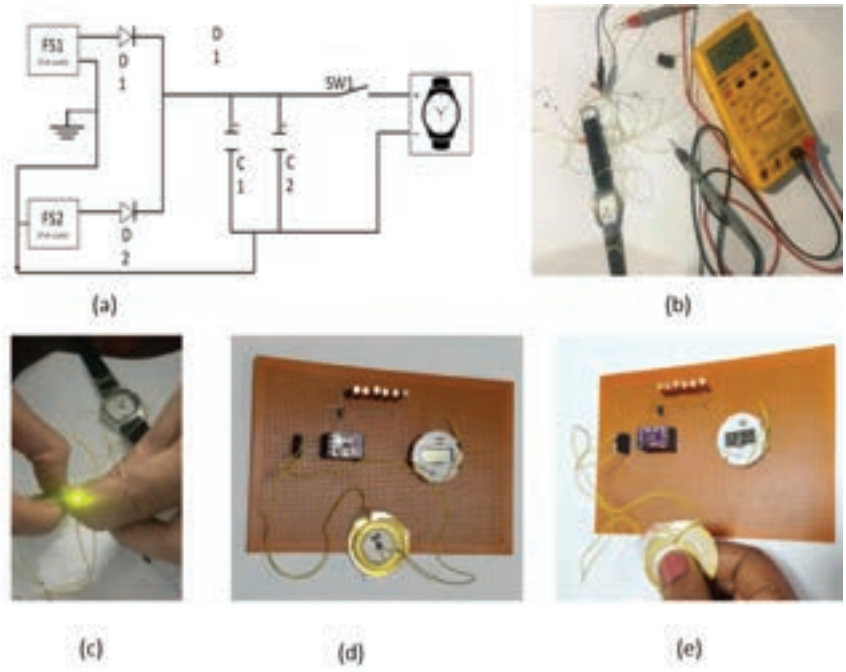
Fig. 62. PVA infused nanofibre matrix from collagen and chitosan

structural properties, making them ideal for applications in biomedical engineering, including tissue scaffolds, wound dressings, and drug delivery systems.

Valorizing fish scale biomaterials

The valorization of fish scales aligns with the principles of sustainability and circular economy by converting bio-waste into valuable materials for energy harvesting and sensor technologies. This approach not only reduces environmental pollution but also provides a cost-effective pathway to advance green energy innovations. The alignment of collagen fibrils and hydroxyapatite crystals enhances surface charge retention and electron transfer efficiency. The inherent sustainability, abundance, and cost-effectiveness of fish scales make them a superior alternative to synthetic or rare triboelectric materials.

Piezoelectric energy harvesting from fish scales for low-power devices



Utilising Fish Scale to run a watch and light LED bulb (a) circuit, (b) watch (c) LED, (d-e) Gold plated Aluminium sheet with Fish scale

Fig. 63. Harnessing fish scale piezoelectricity for clean green energy

Piezoelectric energy generation apparatus was setup, which utilizes fish scales (FS1 and FS2) to produce alternating current (AC) when subjected to mechanical stress. Diodes (D1 and D2) function as half-wave rectifiers, converting the AC voltage into direct current (DC). The rectified energy is then stored in polarized capacitors (C1 and C2), each with a capacity of 10 µF/63V. A switch was incorporated into the circuit, connecting the stored energy to a quartz watch.

Oscilloscope waveform without fish scale and with fish scale tapping (a)Oscilloscope waveform without fish scale connected (b) Oscilloscope parameters 20mv/division with Time period : 5ms Probe setting 1x Coupling: DC

Fig. 64. Testing of waveform without and with fish scale with oscilloscope

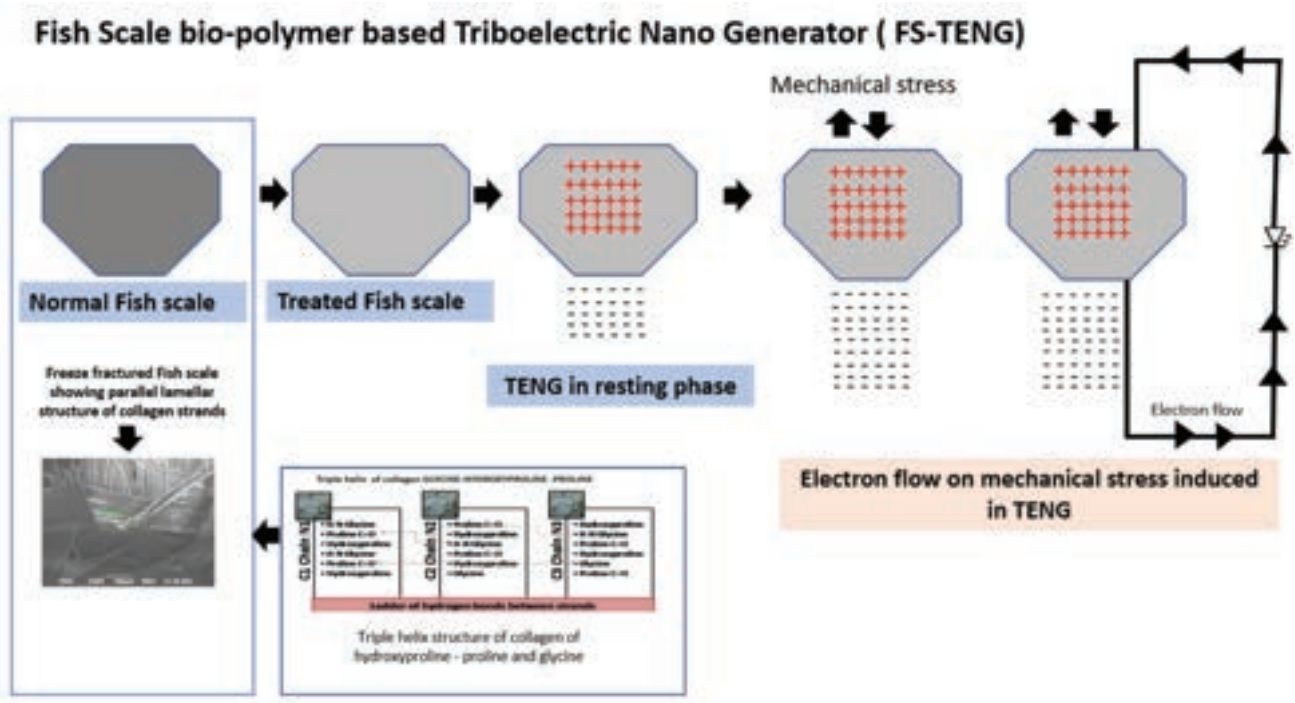


Fig. 65. Fish scale based TENG (FS-TENG)

The switch remains open until the voltage exceeds 1200 mV, ensuring the watch, which operates at a voltage above 1100 mV, receives sufficient power. Although the current generated by this setup is less than 10 µA, it is sufficient to power the quartz watch, which requires only 1.5 volts and 1.5 µA. that was tested with oscilloscope (Figs. 63, 64). While the low current output limits its use for devices needing higher current, the setup effectively powers low-energy devices.

Fish scale based Triboelectric Nanogenerators (FS-TENGs)

Triboelectric nanogenerators (TENGs) convert mechanical energy from the environment into electrical energy. TENGs provide a sustainable, low-cost approach to harvest ambient energy sources, such as vibrations, motion, and pressure, making them ideal for powering small-scale devices and sensors. Fish scales was used to create TENG, based on the principle that when two materials with different tendencies (gain or lose electrons) come into contact and are separated, an exchange of electrons occurs between their surfaces, which creates a build-up of opposite charge on the two materials due to the triboelectric effect. Discarded fish scale has application in the field of green energy and sensor applications in the field of IOT and medical devices. In the first experiment, a fish scale collagen-based earth-connected TENG was developed (Fig. 65). The treated fish scale TENG, when exposed to external mechanical vibration and pressure, caused the electrons in the TENG to be transferred on to its surface, thus, generating a current flow whose potential difference varied between 0-2V. This generated potential difference was then used to drive a mechanical quartz watch and to momentarily drive a light emitting diode. This experiment was conducted to determine the output current type and to verify its practical usage for energy generation as well as its use in sensor applications.

3D Bio-printing with polylactic acid

Polylactic Acid (PLA) is a bio-sourced, biodegradable, bioabsorbable, and compostable polymer derived from renewable resources such as corn starch and sugarcane that serves as a sustainable alternative to petrochemical-based plastics, aligning with efforts to reduce fossil fuel dependency and environmental pollution. PLA's excellent biocompatibility,

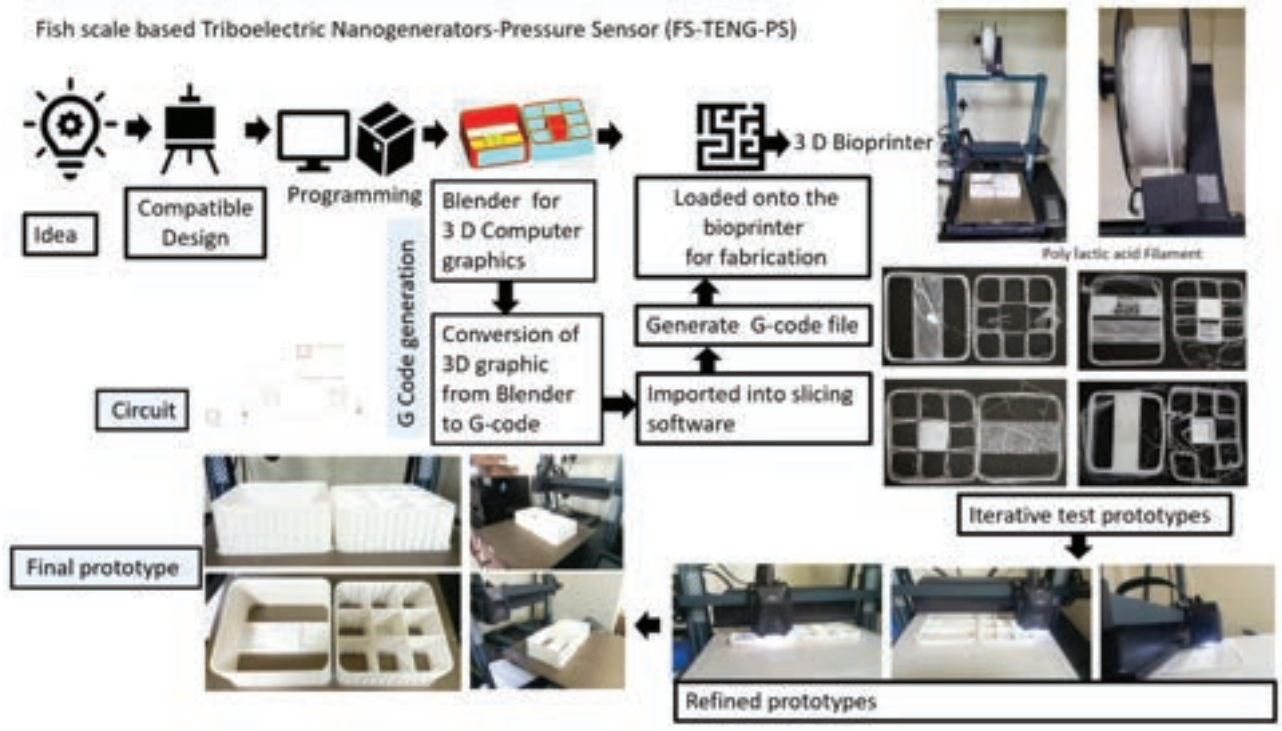


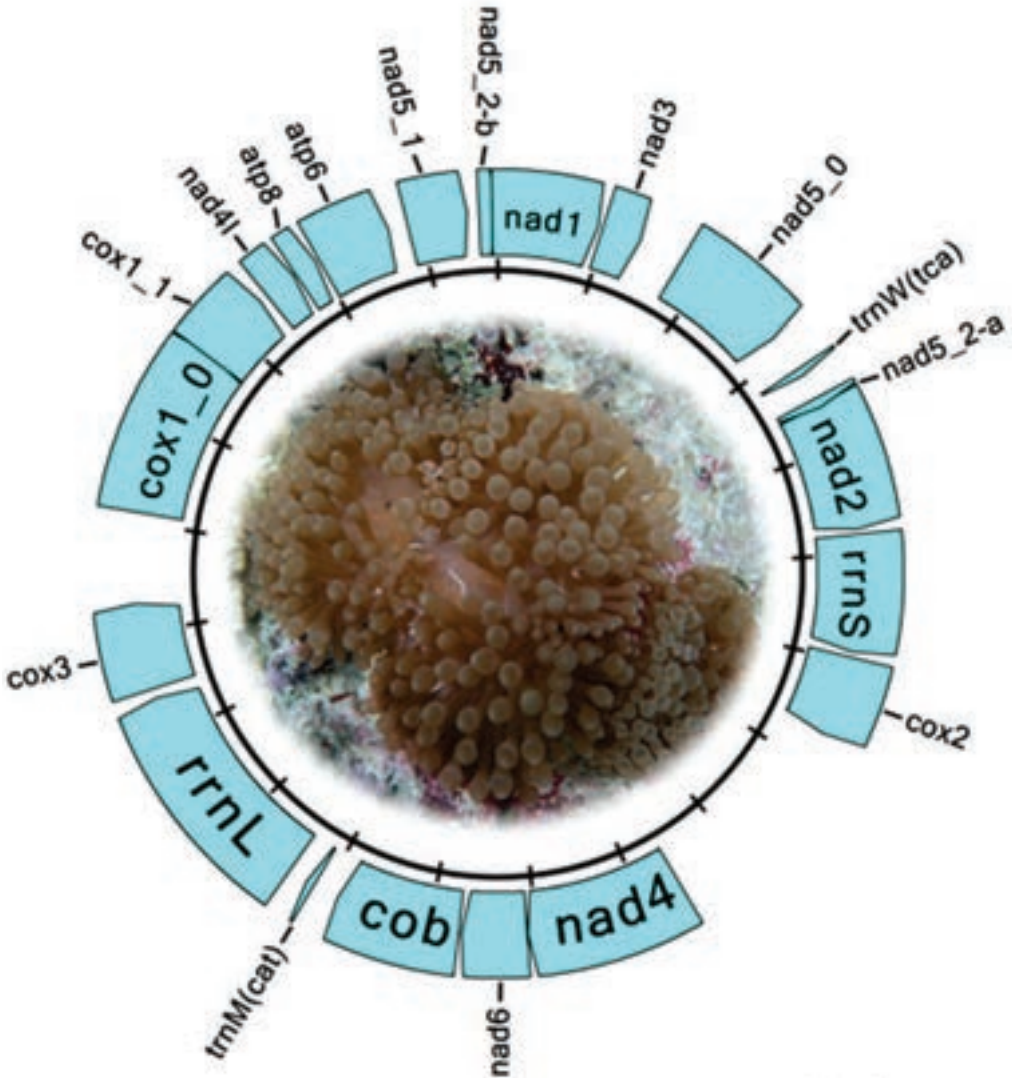
Fig. 66. Designing fish scale based Triboelectric Nanogenerators-pressure sensor by bioprinting

mechanical properties, and printability make it ideal for the fabrication of TENGs. PLA enables the creation of customized lightweight, durable structures. PLA's utilization directly supports multiple UN SDGs, like, SDG # 7 (Affordable and clean energy) through renewable energy generation, SDG# 12 (Responsible consumption and production) by reducing reliance on petrochemicals, SDG# 13 (Climate action) via lower greenhouse gas emissions, SDG# 14 (Life below water) and SDG# 15 (Life on land) by mitigating plastic waste pollution in ecosystems. 3D Bioprinter with PLA was used for designing an enclosure where the fish scale TENG was held between two halves of the enclosure and any weight being put on the top side of the enclosure will induce a pressure on the fish scale TENG which causes a change in the potential difference across the two electrodes made of gold-plated aluminium sheet (Fig. 65). This changes in potential difference is measured after rectification through the analogue to digital converter of the microcontroller ATMEGA328P-PU. A 3D model was first designed using BLENDER, an open source 3D designing software. The model was then exported into standard G Code format to be used on 3D printer (Fig. 66).

Fish scale based Triboelectric Nanogenerators-Pressure Sensor (FS-TENG-PS)

FS-TENG-PS apparatus was designed and tested to demonstrate the use of fish scale collagen based TENG as a pressure sensor. The basic setup was designed consisting of a 3D printed enclosure to work as a gravity-assisted pressure sensor where the weight/force is applied on the top side, which is then transferred to the fish scale sandwiched between the top and bottom portion of the enclosure. The pressure applied to the fish scale TENG causes a change in the amplitude of the waveform generated from the fish scale TENG, which is basically an alternating current. This waveform is then transferred to the LTC3588 circuit. The work is under progress for assembly.

Genomic Resources for Important Fishes



Mitogenome of *Entacmaea quadricolor*

ICAR-NBFGR has been at the forefront of developing genomic and bioinformatics resources for the Indian fisheries sector. As the lead centre of the ICAR-Consortium Research Project on Genomics and a domain partner in the Network Project on Agricultural Bioinformatics and Computational Biology, the institute plays a central role in advancing fish genomics. Genomic research provides critical insights into fish evolution and enables innovative solutions in aquaculture, disease control, seafood safety, and conservation biology, ultimately aiding in the improvement, management, and preservation of valuable fish germplasm resources.

Project

CRP on Genomics: Structural and functional characterization of *Clarias dussumieri, Chitala chitala* and *Catla catla* genomes and transcriptomes

Period: April, 2023 - March, 2026

Coordinator: J. K. Jena, Deputy Director General (Fisheries Science), ICAR, New Delhi

Personnel: Vindhya Mohindra (PI), Basdeo Kushwaha, Rajeev K. Singh, L. Mog Chowdhury, Tanwy Dasmandal (April, 2024 onwards)

Funding Support: ICAR Plan Scheme, New Delhi

CRP on Genomics aims to conduct basic research on structural and functional genomics of commercially important agro-biodiverse species to discover variants of genes from hitherto unexplored germplasm.

Whole genome sequencing and assembly

Chitala chitala: Long read genome sequencing was done using PacBio Revio platform generating 108.7 Gb data with 7.3 million reads. The assembly resulted in 162 scaffolds with an N50 of 32.18 Mb. Hi-C reads of 108.530 Gb was also generated from Illumina Omni data. The percentage of bases with a quality score ≥Q30 was 89.01%, indicating high base call accuracy, with a mean quality score of 35.02, suggesting overall high-quality data.

Heteropneustes fossilis: The genome sequencing performed using PacBio Revio platform generated 95.03 Gb data, with 7.8 million reads. The high-quality assembly resulted in 212 scaffolds, with an N50 value of 24.35 MB, indicating a relatively high level of continuity in the genome assembly.

Neolissochilus pnar, world's largest cave fish: The genome sequencing was done through long reads technology (PacBio Sequel II) and high-quality draft genome assembly of 1.56 Gb in size and 1,423 contigs were generated, which showed 99% genome coverage (Fig. 67). The draft genome assembly contained 44.30% repeats, 1,416,376 SSRs and 36,333 functionally annotated genes.

Functional analysis of immune related genes in *Catla catla* kidney tissue

Out of total differentially expressed genes (DEGs), 73 genes were found to have immune related function, of which, 62 belongs to innate immune category (8 genes under chemokine, 13 under complement system, 4 under cytokines, 8 under interferon, 2 under lectin family member, 5 under tumour necrosis factor, 1 under Rig-I like receptor (RAG), 12 under NOD like receptor (NLR), 9 under interleukin) and 11 belongs to adaptive immune category (5 genes under immunoglobulin, 4 under MHC class I and 2 under MHC class II). These genes were associated with 20 GO terms (13 biological process, 4 cellular component and 3 molecular function). Molecular pathway analysis of these DEGs revealed genes involved in immune system category with 8 genes under cytokine-cytokine receptor interaction and 3 under MAPK signalling pathway, regulation of actin cytoskeleton and intestinal immune network for IgA production and 2 under NOD-like receptor signalling pathway, RIG-I-like receptor signalling pathway and Toll-like receptor signalling pathway.

Differentially expressed genes and functional enrichment analysis for *Catla catla* brain tissue

DESeq2 analysis of brain tissues from *Catla catla* at

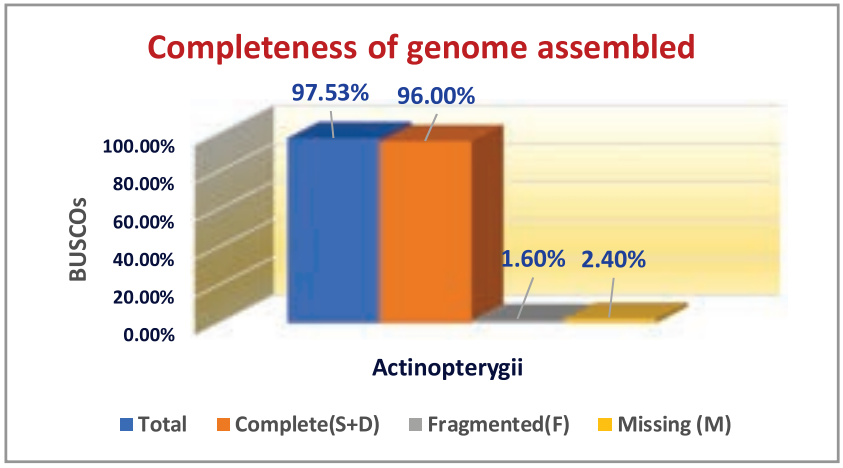


Fig. 67. Completeness of *Neolissochilus pnar* genome

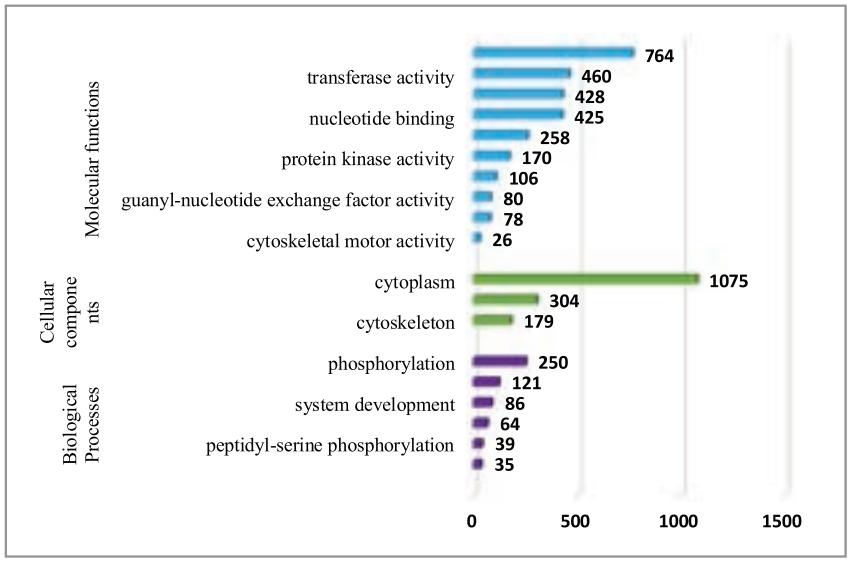


Fig. 68. Top 20 GO terms for differentially expressed genes in *Catla catla* brain tissue under 20°C and 30°C temperatures

two temperatures (20°C and 30°C) revealed 5,925 DEGs (4,281 upregulated and 1,644 downregulated). The functional characterization of these DEGs identified GO terms with broad range of biological processes, the most prominent being phosphorylation (GO:0016310) (250 genes) and lipid metabolic processes (GO:0006629) (121 genes). For cellular components, number of genes related to the cytoplasm (GO:0005737) and cytosol (GO:0005829) were 1,075 and 304 respectively. Under molecular functions, metal ion binding (GO:0046872) (764 genes) and transferase activity (GO:0016740) (460 genes) were prominent. KAAS molecular pathways analysis showed 4,455 genes involved in pathways, with development and regeneration (57 genes), endocrine system (47 genes), and signal transduction (75 genes). Involvement of gene in nucleotide metabolism (24 genes) and carbohydrate metabolism (22 genes) reflected a potentially higher level of metabolic activity. Further, 56 genes were involved in transport and catabolism process. Additionally, 50 brain specific genes were identified in *C. catla*, as analysed from mapZebrain and human protein atlas (Fig. 68).

Identification of immune related genes and associated SSRs from kidney transcriptome of *Cyprinus carpio*

The 10 cDNA libraries yielded a total of 528.6 million raw reads and 1,275,165 transcripts. Gene prediction using Augustus resulted in 133,419 functional transcripts. Immune gene classification identified 1,355 genes, out of which 1,056 were innate immune, 239 adaptive immune and 60 genes under negative regulator of immune.

SSR identification in immune genes identified 212 (35.04%) di, followed by 74 (12.23%) tri, and 12 (1.98%) tetra repeats (Fig. 69). The most abundant repeat motif in di-nucleotides repeats were AC/GT 138 (22.81%) and AG/CT 46 (7.60%) and among tri-nucleotides repeats were ATC/ATG 17 (2.81%), followed by AAC/GTT 14 (2.31%) (Fig. 70).

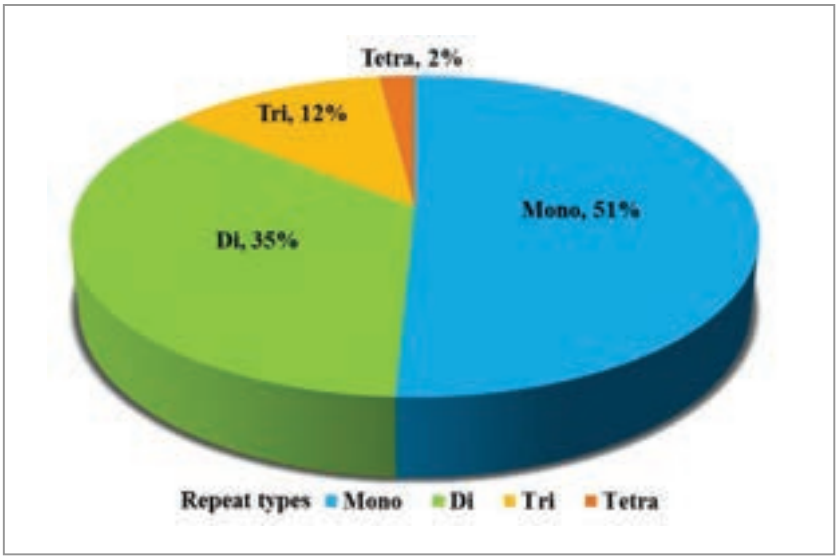


Fig. 69. Distribution of SSRs in immune genes of *Cyprinus carpio*

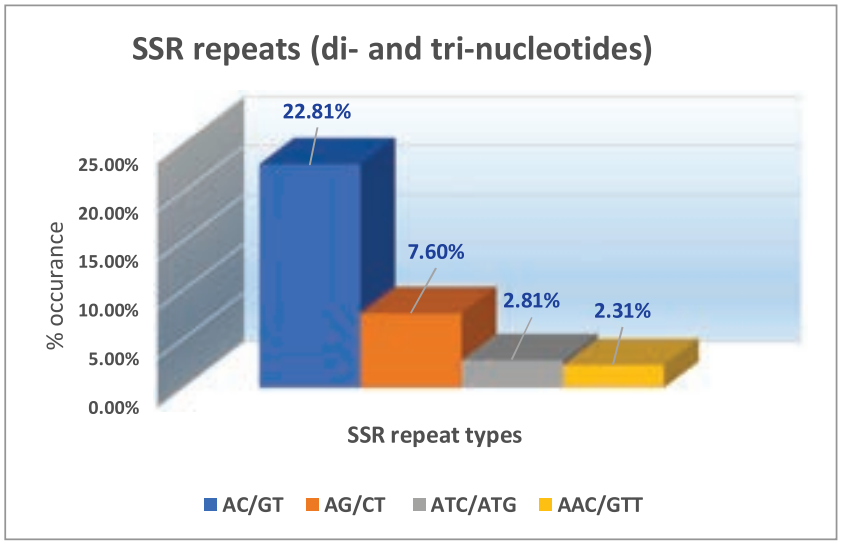


Fig. 70. SSR repeat motifs in immune genes of *Cyprinus carpio*

Analytical pipeline for repeat identification from genomes

In genomics, the identification of repetitive sequences (like microsatellites, minisatellites, LINEs, SINEs, LTRs and so on) within the genome is crucial for understanding genome structure and function. Various tools are available for identification of different types of repeats. However, a single platform that can identify all kinds of repeats can facilitate genomics studies. Therefore, a beta web server that integrates different repeat identification tools for providing comprehensive result for each repeat class was developed using Apache HTTP server. A user-friendly web interface was designed and implemented to serve as the platform's front-end. This interface enables users to upload their FASTA sequence files and to select and execute various repeat identification tools integrated into the server system. A backend database was established using MySQL to manage metadata associated with user submissions. Three bioinformatics tools, i.e. RepeatScout, MISA and RepeatModeler, were integrated. The user can choose to run all integrated or specific tools available on the server based on their preferences.

Identification of male-specific marker and development of rapid loop-mediated isothermal amplification assay in *Labeo rohita*

To address the challenge of an optimal female-to-male ratio for brooders, the current study developed a molecular marker and LAMP assay for early gender determination, which can identify gender of rohu individuals, even at the fingerling stage. This marker would enable the hatchery professionals and farmers to maintain an appropriate number of males and females from the initial stage, which would facilitate better broodstock management, minimize inbreeding and enhance seed quality and quantity, ultimately benefitting aquaculture industry.

Development of databases on genomic resources

HilsaTranscriptSSRdb, a searchable online database of SSRs based on transcriptomes of Hilsa shad, was developed from five tissues, namely muscle, kidney, liver, testis and ovary (Fig. 71).

CatlaTranscriptSSRdb, a searchable online database of SSRs was developed based on transcriptomes of *Catla catla* generated from four tissues (Fig. 72).

Fig. 71. Homepage of HilsaTranscriptSSRdb database

Fig. 72. Homepage of CatlaTranscriptSSRdb database

Project

Network project on agricultural bioinformatics and computational biology

Subproject: Understanding genomic factors responsible for growth performance in *Clarias magur*

Period: July, 2020 - March, 2026

Personnel: Ravindra Kumar (PI), Basdeo Kushwaha, Murali S., Tanwy Dasmandal and Santosh Kumar

Funding Support: CABin Scheme of ICAR, implemented through ICAR-IASRI, New Delhi

Growth is one of the most important economic traits for aquaculture selection, but genetic selection for many aquaculture species in India is still evolving and most of the species are usually collected from the wild for culture. The present study aims to identify growth genes and to interpret the molecular processes involved in the growth of *Clarias magur*.

Collection of magur stock

A survey and collection of *Clarias magur* (magur) specimens was undertaken in Malda, West Bengal and adjoining areas during April-May, 2024. Total 14 specimens and brought to ICAR-NBFGR, Lucknow. The species was confirmed using morpho-metric keys and mitochondrial COI gene region sequencing. Breeding was done in July, 2024 and 8 half-sib families were generated for molecular data generation.

miRNA analysis

MicroRNAs (miRNAs) play a critical role in regulating protein expression at post-transcriptional stage and has the potential to influence a variety of physiological functions. Hence, miRNA analysis

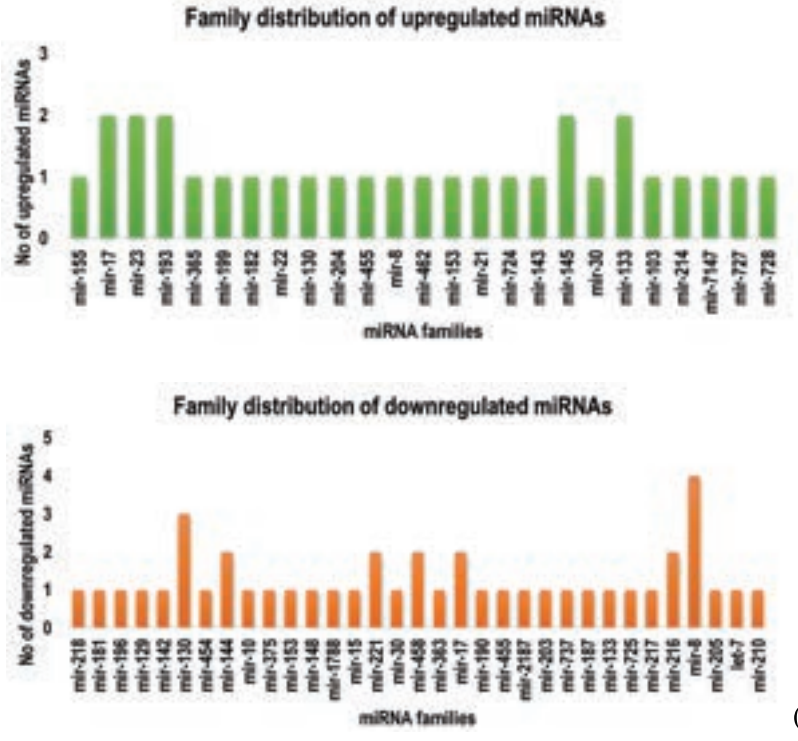
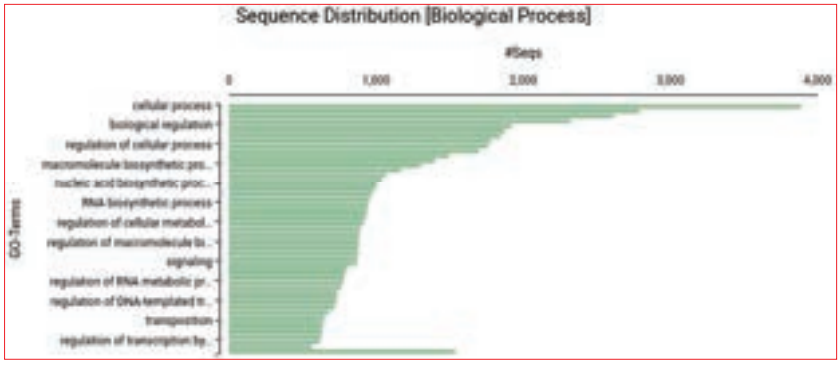
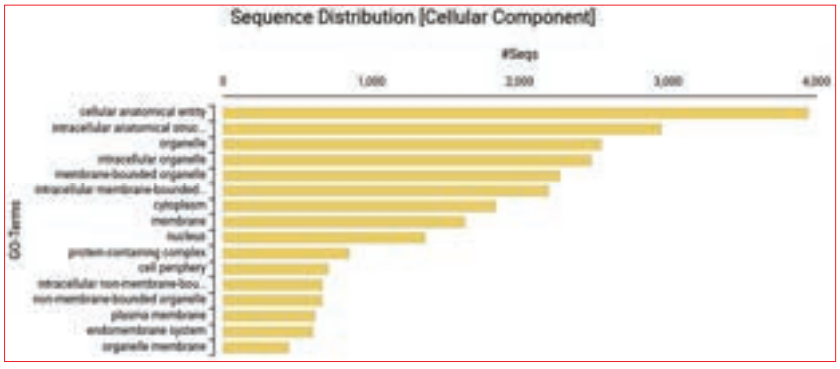


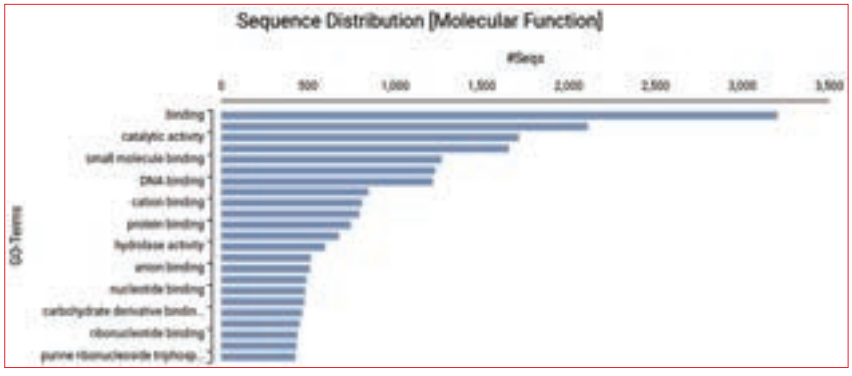
Fig. 73. Distribution of *Clarias magur* miRNAs: (a) upregulated, (b) downregulated.



(a)



(b)



(c)

Fig. 74. Annotation of *Clarias magur* miRNA targets as per their (a) biological process, (b) Cellular component and (c) molecular function.

was performed between fast- and slow-growing individuals from Gumla (Ranchi, Jharkhand) stock, which were bred in August, 2022 and sequenced on NGS in the year 2023 at 1-year of age. A total of 20 million reads per sample (150 bp read length) was generated. FastQC was used to evaluate data quality and reads were trimmed to 50 bp using Fastp tool. A specific NGS pipeline was used to align the trimmed fastq files against the miRNA sequences to identify them. The annotations downloaded from the miRBase (version 22.1) for zebrafish (*Danio rerio*) were used, as *C. magur* annotations are not available.

A total of 557 miRNAs could be identified in *C. magur*, where few were found to have multiple occurrences, thus, total 368 unique miRNAs were detected. These miRNAs were classified into 101 families, where miR-10 was the most abundant family. The maximum number of miRNAs (130 miRNAs) were found that belonged to miR-430 family. Total 77 miRNAs were found differentially expressed (DEmiRNAs) (Figs. 73a, b), which belong to 51 miRNA families with the most abundant family being miR-8, followed by miR-17 and miR-130.

These DEmiRNAs were found to target 19,493 genes in zebrafish. Comparative analysis resulted in the identification of 6,265 genes in *C. magur.* GO enrichment analysis of these 6,265 target genes was performed for three main categories, *viz*. biological processes (BP), cellular components (CC) and molecular functions (MF) (Figs. 74a-c).

In the BP, DNA repair (GO:0006281) has the highest strength of association with target gene set with fold enrichment value of 1.94 and FDR 1.58E-04, whereas cell differentiation (GO:0030154) was the most assigned with 132 target genes; in CC, catalytic step 2 spliceosome (GO:0071013) was with highest fold enrichment value of 2.25 (FDR 0.001) and nucleus (GO:0005634) with 1313 target genes and in MF, ATP-dependent chromatin remodeler activity (GO:0140658) being the most associated GO-term, whereas metal ion binding (GO:0046872) was the most prominent with 585 target genes. Functional annotation of the target genes against the KEGG database identified 14 KEGG pathways (FDR

< 0.05) involving 415 genes, of which maximum number of genes (82 genes) were involved in cell cycle, followed by biosynthesis of cofactors (76 genes), carbon metabolism (67 genes), ubiquitin mediated proteolysis (67 genes), peroxisome (44 genes) and fatty acid metabolism (36 genes). Among the key upstream regulators of the cell cycle pathway, the MAPK signaling cascade was prominent, where core cyclin-dependent kinases were identified as miRNA targets. Another key regulator identified was Polo-like kinase 1 (PLK1), which was found to be targeted by three miRNA families namely, mir-1788, 181, and 737 that were observed to be downregulated in high growth fish individuals. The gene Proliferating Cell Nuclear Antigen (PCNA), involved in DNA replication as well as DNA repair was also found to be targeted by miR-190, which was significantly downregulated in high-growth individuals of Clarias magur. Additionally, the Tricarboxylic Acid (TCA) cycle also emerged as another key metabolic pathway targeted by multiple miRNAs like mir-725 targeting dldh gene, mir-144, 218, etc targeting idh gene and mir-133, 144, 210, etc targeting mdh gene.

Growth gene analysis

A few genes, reported in literature that may have role in growth of the fish, were analysed *in silico*. One such gene, *i.e.* Myosin light-chain kinase-4 (*MYLK4*), was undertaken that plays several important roles in biological processes, such as Ca^{2+}/ calmodulin-regulation, actin and myosin interaction by phosphorylation etc. It has additionally been reported to influence or regulate slow/fast muscle fibers in zebrafish and Atlantic salmon. The *MYLK4* gene

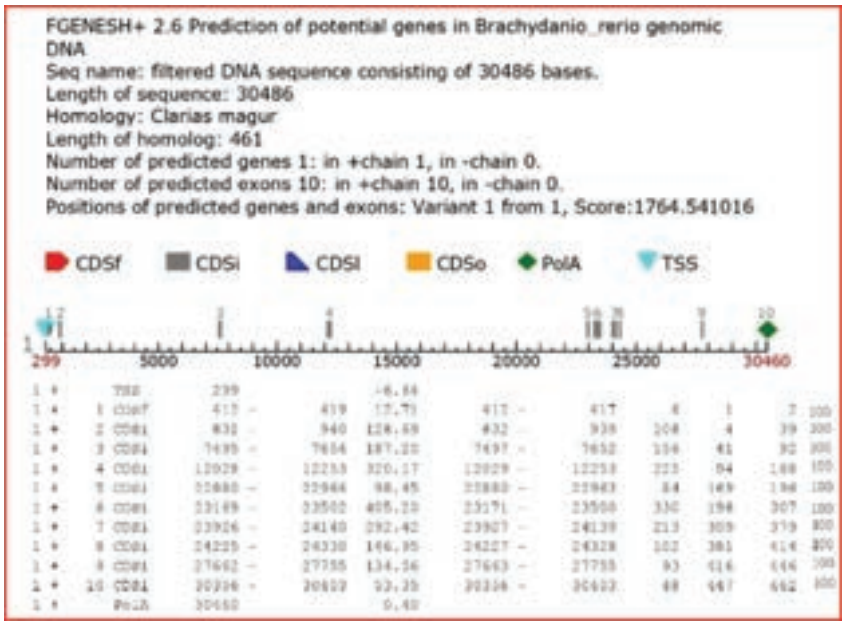


Fig. 75. Annotation of MYLK gene in *Clarias magur*

was mined from the *C. magur* genome and *in silico* characterz using channel catfish and zebrafish genomes, as references. *In silico* mining, *in vitro* primer validation, phylogenetic analysis, molecular marker identification, mylk protein structure prediction and protein-protein network analysis along with RT-PCR validation was done. The *MYLK* gene was estimated to be 30,386 bp long, which included 10 exons between 295 to 30,286 bp and one TSS (Fig. 75). A total of 53 SSRs could be identified in the intronic region and 442 SNPs were found both in exonic as well as intronic regions. These SSRs and SNPs identified in the DNA sequence of six individuals could be used to study magur populations. In our study, there was no significant influence or differences in MYLK gene expression between fast and slow-growing magur specimens using RNA-Seq and qRT-PCR studies. Muscle growth is a complex economic trait that is probably governed by the effect of many genes, thus, needs further investigation.

PPI analysis of MYLK gene

A Protein-Protein Interaction (PPI) analysis was conducted to investigate the functions of the MYLK4 protein, incorporating 80 genes with the *MYLK* gene of magur. Highly confident interactions were considered for constructing a PPI network (Fig. 76), which was visualized using Cytoscape

Table 4. Genomic database updation status (January-December, 2024)

Sl. No.	Database name	Existing records	New records	Total records
1.	FBIS	45,227	482	45,709
2.	Fish Karyome	1,549	153	1,702
3.	FishMicrosat	66,134	699	66,833
4.	FMiR	3,061	809	3,870

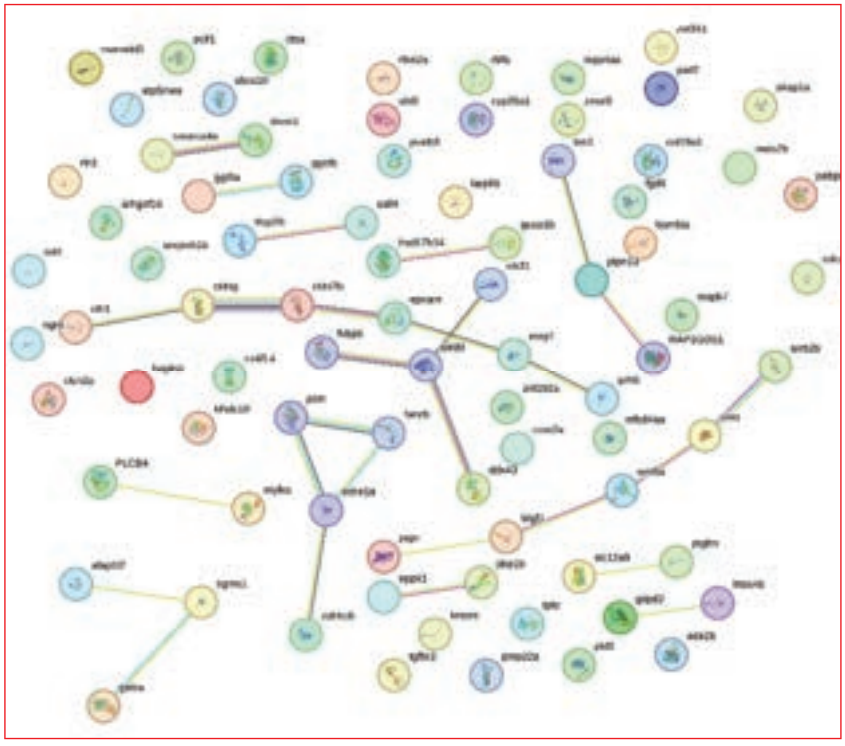


Fig. 76. PPI network among the selected genes of *Clarias magur*.

v3.10.1 to integrate gene expression profile. The resulting PPI network comprised 76 nodes and 26 edges, with a significant enrichment value (p-value = 8.55e-08). This analysis aimed to uncover functional connections between the genes or proteins in biological processes, such as reproduction in *C. magur*.

Updation of genomic resource databases

Genomic resource databases were maintained and regularly updated with the addition of new records available in the public domain (Table 4). FisOmics web portal, hosting and maintaining FBIS, FMiR, FishMicrosat, Fish Karyome and HRGFish genomic resource databases, was visited by people from more than 60 countries.

Project

Mining and characterization of bioactive compounds for insights into sea anemone ecological adaptation

Period: April, 2022 - March, 2025

Personnel: Murali S. (PI), Ravindra Kumar, Basdeo Kushwaha and A. Kathirvelpandian

Funding Support: Institutional, ICAR-NBFGR

Sea anemones are among the oldest surviving order of venomous animals that lack a central nervous system. As a primitive metazoa, they are rich in various bioactive compounds, like neurotoxins. These bioactive compounds are reported to exhibit hemolytic, lethal and antimicrobial activities. The present study aims to decipher the whole genome sequence information, including mitogenome, and mine potential bioactive compounds from an important sea anemone, *Entacmaea quadricolor* (bubble-tip anemone) of Actinaria order, collected from Lakshadweep Islands.

The mitogenome sequence was assembled from the whole genome (121.1 million reads) generated from pooled *E. quadricolor* tentacle and column muscle tissue through Illumina NovaSeq 6000 NGS platform. Fastp tool was used for quality check and read filtering (Fig. 77). Mitoz tool was used for *de novo* mitogenome assembly. Mitoz, Mfannot and MITOS2 tools were used for annotation and CircularMT tool used for visualization. The mitogenome size of *E. quadricolor* was estimated to be 20,720 bp (Fig. 78).

Unlike human, sea anemone mitogenomes differ considerably presumably due to primitive evolutionary position of the anemones. Their mitogenome possesses only 2 tRNA genes, unlike commonly observed 22 tRNAs. In sea anemone, 13 protein coding genes (PCGs), 2 tRNA genes, 2 rRNA genes were predicted along with 5 ORFs and an intron in ND5 gene (Table 5). All the genes were encoded on the heavy chain. This is the first report of *E. quadricolor* mitogenome and whole genome from India.

Genome annotation and toxin mining

Gene prediction and annotation was carried out using Augustus, specifying metazoa gene model

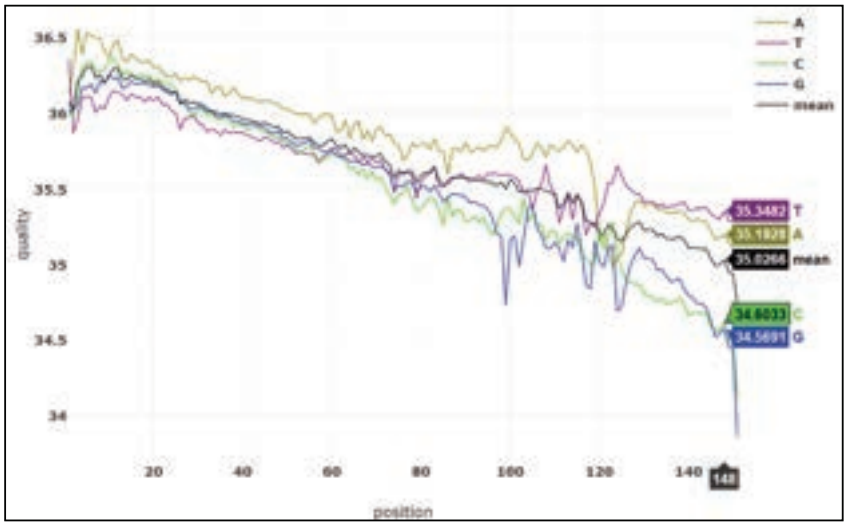


Fig. 77. Read quality after adapter removal, trimming and bad read filtering

and using *Nematostella vectensis*, starlet sea anemone as a reference. A total of 27,857 genes was predicted. OmicsBox V3.2 software was used for annotation and gene ontology (GO) analysis and KEGG was used for pathway analysis. GO terms could be obtained for 15,011 genes with 2,350 enzyme code annotations. Maximum GO terms were associated with metabolic process in biological process category, small molecule binding in molecular function and membrane-linked in cellular processes category (Fig. 79). A total of 324 pathways linked to 4,764 genes were identified through KEGG analysis. Maximum genes were related to metabolism, organismal systems, environmental information processing, cellular processes and genetic information processing pathways.

Based on genome mining and comparative analysis of Cnidarian toxins, the putative toxin types (Acrorhagin I, actinoporin, Phospholipase A2, actinoporin Cjtox I, U-actitoxin-Ugr1c etc.) were identified.

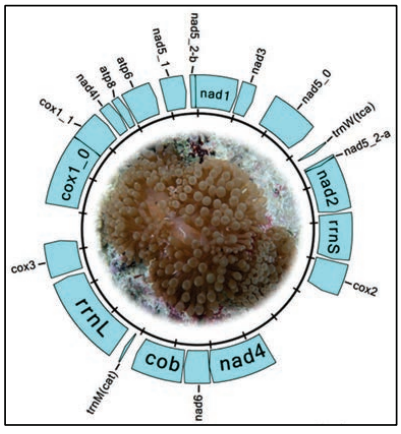


Fig. 78. Circular map showing mitochondrial genome of *Entacmaea quadricolor*

Table 5. Structure of the *Entacmaea quadricolor* mitogenome

No.	Type	Name	Product
1.	CDS	ND3	NADH dehydrogenase subunit 3
2.	tRNA	trnW	tRNA-Trp
3.	CDS	ND2	NADH dehydrogenase subunit 2
4.	rRNA	s-rRNA	12S ribosomal RNA
5.	CDS	COX2	Cytochrome c oxidase subunit II
6.	CDS	ND4	NADH dehydrogenase subunit 4
7.	CDS	ND6	NADH dehydrogenase subunit 6
8.	CDS	Cytb	Cytochrome b
9.	tRNA	TrnM	tRNA-Met
10.	rRNA	1-rRNA	16S ribosomal RNA
11.	CDS	COX3	Cytochrome c oxidase subunit 3
12.	CDS	COX1	Cytochrome c oxidase subunit 1
13.	CDS	ND4l	NADH dehydrogenase subunit 4 L
14.	CDS	ATP8	ATP synthase F0 subunit 8
15.	CDS	ATP6	ATP synthase F0 subunit 6
16.	CDS	ND5	NADH dehydrogenase subunit 5
17.	CDS	ND1	NADH dehydrogenase subunit 1

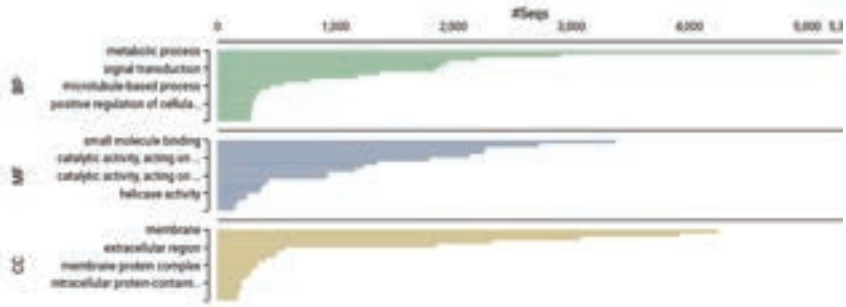


Fig. 79. Top 20 GO terms associated with *Entacmaea quadricolor* genome

Project

Identification of conotoxins from the selected cone snails from Indian waters using transcriptome sequencing

Period: April, 2022 - March, 2025

Personnel: A. Kathirvelpandian (PI), Arun Sudhagar S. and Murali S.

Funding Support: Institutional, ICAR-NBFGR

This project aims to unveil the molecular diversity of conotoxins by employing transcriptome analysis. Cone snails were collected from 8 landing centers of Kerala (Kalamukku and Sakthikulangara), Tamil Nadu (Cuddalore, Mudassalodai, Theruspuram, Vellapatty, Kayalpattinam and Parangipettai) and visited Kashimedu, Nagapattinam (Akkarapettai), Punnakayal of Tamil Nadu and Thykkal, Munambam of Kerala. Twelve species were identified and 22 sequences of mitochondrial gene (COI) were generated. The transcriptome for *Conus inscriptus* and *Conus monile* species were generated using Illumina platform and novel conotoxin genes for *C. inscriptus* were successfully identified. In *de-novo* assembly analysis of *C. inscriptus*, a total of 259,828 transcripts were identified. The average length of these transcripts is 1,143.95 bp, with the longest transcript being 29,867 bp and the shortest being 300 bp. The transcriptome data was submitted to NCBI SRA Bioproject: Transcriptomic study on *Conus inscriptus*, Accession no.: PRJNA1181646 BioSample

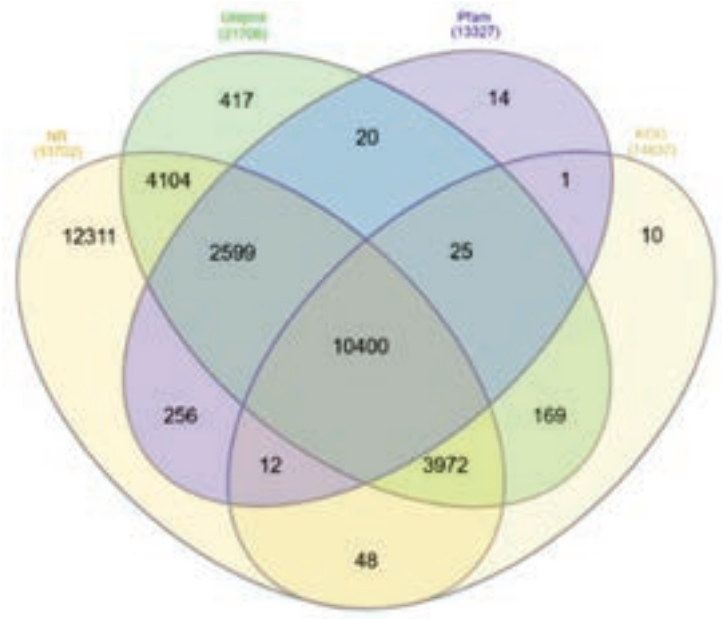


Fig. 80. Venn diagram showing alignment of 9,714 genes and predicted proteins

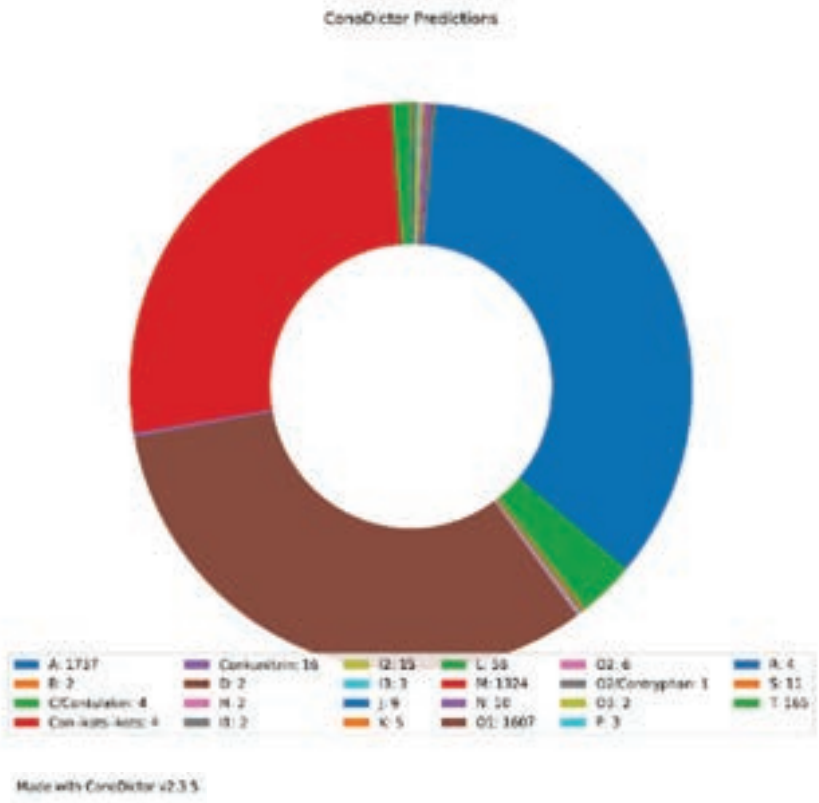


Fig. 81. Conotoxins superfamily identified in *Conus inscriptus*

accessions SAMN44567475, SAMN44567476, SAMN44567477.

Next-generation sequencing was used to sequence the transcriptomes of the venom ducts and venom bulbs from *C. inscriptus* specimens and a total of 259,828 transcripts were identified using Trinity. From the 75366 transcripts, BLAST hits returned 33,702 transcripts from NCBI-NR, 13,327 from Pfam, 21,706 from UniProt and 14,637 from KOG databases as Coding Domain Sequences. Analysis with Conodictor 2 resulted in identification of 6,066 unigenes coding for 23 super families of conotoxin and 1,046 genes coding for unknown conopeptides (Figs. 80, 81).

Project

Part A: Developing adaptive markers in freshwater fishes for temperature stress

Period: April, 2022 - March, 2025
Personnel: Satish K. Srivastava (PI), Poonam J. Singh and Akhilesh Kumar Mishra

Funding Support: Institutional, ICAR-NBFGR

The project aims to estimate critical limits of temperature and investigate the biochemical changes occurring due to stress in fish species and understand the development of adaptive mechanisms towards thermal stress.

Specimens of *Channa striata* were collected from the market. The temperature tolerance limit *of C. striata* was estimated. Fishes were exposed to sublethal high temperature for 45 days in temperature controlled recirculatory system and their blood biochemical profiles were analyzed from control and experimental fishes.

Part B: Proteome profiling of cultivable fresh water fishes and bioprospecting for bioactive peptides and regulatory factors through integrative approach

Period: April, 2022 - March, 2025
Personnel: Poonam Jayant Singh (PI), Satish K. Srivastava and Akhilesh Kumar Mishra

Funding Support: Institutional, ICAR-NBFGR

Bioactive peptides: Five bioactive peptides with anticancer potential were custom synthesized for assessing *in vitro* toxicity and anti-cancer effect on Human skin cancer cell line A431. The study is in progress. The anti-cancer peptides are a part of repertoire of 232 bioactive peptides extracted from muscle of *Clarias magur* extracted through LC MS/MS having anti-cancer, ACE inhibitor, antimicrobial, anti-fungal and anti-viral properties

LC MS/MS Profiling: Protein extracted from control and experimental samples of muscle from *Rita rita* was submitted for LCMSMS data generation.

Project

Genome editing of *Labeo rohita* and *Trichogaster chuna* for enhancement of economic traits

Period: April, 2023 - March, 2026
Coordinator: U.K. Sarkar (Coordinator)
Personnel: L. Mog Chowdhury (PI), Vindhya Mohindra, Mahender Singh, Aditya Kumar, Murali S. and Dandadhar Sarma (Gauhati University)

Funding Support: ICAR NEH Component

Genome assembly of *Trichogaster chuna*

Genome assembly and scaffolding using HiFi data resulted in a primary contig-level assembly of 571.0 Mb, comprising 223 contigs with an N50 length of 10.8 Mb. The assembly underwent contamination screening against the UniVec database using NCBI Blastn, which effectively removed vector, adapter, linker, and primer sequences. Subsequently, a reference-based chromosome-level assembly was generated, aligning to *Maylandia zebra* (Cichlid), yielding a 571.01 Mb genome assembly with improved contig N50 sizes averaging 23.27 Mb. Evaluation using BUSCO analysis indicated a high completeness of 98.1% (97.0% single-copy and 1.1% duplicated genes) against the vertebrata dataset and 97.1% (94.8% single-copy and 2.3% duplicated genes) against Actinopterygii. The assembly was further scaffolded into 22 largest scaffolds comprising 534.5 Mb (93.6% of genome).

Genome-wide repeat prediction

RepeatModeler and RepeatMasker were employed to identify and classify repetitive elements, masking approximately 32.73% of the genome (186,903,932 bp). Among these, interspersed repeats constituted 29.68% of the genome, with LINEs (4.58%) and DNA elements (2.58%) being the most prevalent subcategories. Additionally, microsatellites (SSRs) were revealing 439,092 SSRs, predominantly di-nucleotide repeats (138,531).

Gene prediction

Gene prediction for the assembled *T. chuna* genome utilized the GenSAS module pipeline. Multiple tools were employed to generate consensus gene models. In total, 61,734 genes were predicted by Augustus, 55,743 by GeneMarkES, and 72,840 by SNAP. These predictions were consolidated into 46,508 consensus gene models by EVidenceModeler. Homology-based annotation was conducted using Blastp against the NR database, including SwissProt and RefSeq. The InterProscan module in OmicsBox was utilized for protein domain and orthology-based annotations, revealing predominant Blastp hits with *Betta splendens* and *Anabas testudineus*. In enzyme classification, Oxidoreductases were the major enzyme group followed by Tranferase, Hydolsase, Lyase, Isomerase, Ligase and Translocase.

KAAS annotation and pathway analysis

The annotation of *T. chuna* genome reveals a comprehensive spectrum of biological functions across major categories. In terms of cellular processes, these genes are involved in fundamental activities, such as cell growth (959 genes), motility (388 genes), and interactions within cellular communities, both among eukaryotes (700 genes). Transport and catabolism genes (1,134) highlight the mechanisms of substance movement and breakdown. Environmental information processing encompasses a significant portion, with genes (4,466) dedicated to how cells perceive and respond to external signals. This includes membrane transport (40 genes) and signal transduction (3,822 genes), crucial for cellular communication and adaptation. Genetic information processing genes (1,536) cover essential functions related to genetic material, including replication and repair (248 genes), transcription (175 genes), and translation (402 genes). These processes are fundamental for maintaining and expressing genetic information. In terms of metabolism, the genome annotation includes genes (2,962) involved in diverse biochemical pathways such as amino acid metabolism (458 genes), carbohydrate metabolism (571 genes), energy metabolism (186 genes), lipid metabolism (530 genes), and the biosynthesis of cofactors and vitamins (240 genes). Organismal systems genes (6,962) highlight functions at the level of whole organisms, encompassing

Table 6. KAAS Pathway of *Trichogaster chuna* genome

Row Labels	KO_Id
Cellular Processes	3181
Cell growth and death	959
Cell motility	388
Cellular community - eukaryotes	700
Transport and catabolism	1134
Environmental Information Processing	4466
Membrane transport	40
Signal transduction	3822
Signaling molecules and interaction	604
Genetic Information Processing	1536
Chromosome	179
Folding, sorting and degradation	455
Information processing in viruses	77
Replication and repair	248
Transcription	175
Translation	402
Metabolism	2962
Amino acid metabolism	458
Biosynthesis of other secondary metabolites	73
Carbohydrate metabolism	571
Energy metabolism	186
Glycan biosynthesis and metabolism	360
Lipid metabolism	530
Metabolism of cofactors and vitamins	240
Metabolism of other amino acids	145
Metabolism of terpenoids and polyketides	45
Not included in regular maps	1
Nucleotide metabolism	189
Xenobiotics biodegradation and metabolism	164
Organismal Systems	6962
Aging	221
Circulatory system	341
Development and regeneration	414
Digestive system	594
Endocrine system	2008
Environmental adaptation	354
Excretory system	181
Immune system	1630
Nervous system	977
Sensory system	242
Total	19107

aging (221 genes), circulatory (341 genes), digestive (594 genes), endocrine (2,008 genes), and immune systems (1,630 genes). These annotations provide a comprehensive view of how the *T. chuna* genome supports various biological processes essential for its survival and function within its environment (Table 6).

Orthology analysis

Conserved and single copy ortholog genes in *T. chuna* were identified through Orthofinder. The orthologous groups were identified using complete protein sequences of 18 ornamental fishes, covering across different genera and family, to determine the phylogenetic position of *T. chuna.* Phylogenetic species tree was constructed based on the 112 single copy ortholog sequence using Orthofinder and visualised using FigTree (Fig. 82). The phylogenetic tree revealed that *T. chuna* is evolutionarily related to other species.

Gene selection and gRNA designing and synthesis

For gene editing, specific genes were chosen based on their reported roles in different species. These genes include runx2b and bmp6, which are associated with intermuscular bones. For *T. chuna*, two genes selected were Oca2, for red coloration, and slc45a2, for pigmentation.

For sgRNA template designing, the cDNA and protein sequences of these genes from zebrafish were aligned to the assembled genome of *Labeo rohita*, that was crucial to identify orthologous genes in *L. rohita* and *T. Chuna*. Specific genomic regions were identified where the target genes bmp6 and runx2b are located within the *L. rohita* genome assembly. For bmp6, two coding sequences, bmp6_CDS1 and CDS2 were identified and for runx2b a single coding sequence, runx2b CDS1 was identified. For knockout editing, five target sites were chosen for each coding sequence (CDS).

In *T. Chuna*, Oca2 and slc45a2 genes were derived from the genome assembly based on the gene prediction and annotation against the SwissProt and RefSeq databse. The target sequences were selected in the coding region and template for sgRNA were designed. Five target sequence in CDS for each gene were selected for designing of DNA template (Fig. 83).

The CRISPR RNA (crRNA) oligos, essential for guiding the Cas9 enzyme to the target sites, were selected using the CHOPCHOP tool. Each crRNA was adequately examined using CRISPR Direct.

In vitro transcription of sgRNA (runx2b and slc45a2)

It was performed following an optimized amplification protocol. After amplification, the PCR product was checked on a 2% agarose gel and was taken as template. The sgRNA PCR template, transcription buffer, T7 polymerase mix, and RNase free water were combined in a 200-µl PCR tube, and the reaction mix was put in a preheated thermal cycler at 37°C for 4 hours and stored at 4°C. The transcribed sgRNA was purified.

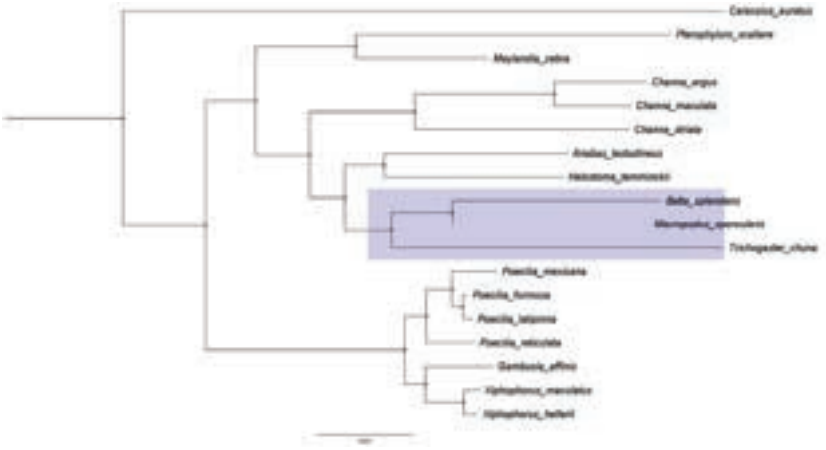


Fig. 82. Phylogenetic tree of *Trichogaster chuna* based on 112 single copy orthologs sequence

Fig. 83. Designing of DNA template for sgRNA

Project

NNP (Agri-genomic repository and intelligent analytical system) of ICAR-Indian Agricultural Statistics Research Institute, New Delhi

Period: September, 2024 - September, 2029

Personnel: Murali S. (PI) and Basdeo Kushwaha

Funding Support: Department of Biotechnology (DBT)

Bioinformatics and computational tools are required to integrate ever-increasing large genomic databases, software & tools, genome browsers with high-end computational support under one wrapper. Therefore, it is required to develop efficient biological genome browsers, data repositories, analytics tools and intelligent analytical solutions. Genomic information of a few Indian species are now available. Genome data of two important Indian fishes, Indian catfish, magur (*Clarias magur*) and Indian major carp, rohu (*Labeo rohita*) generated by ICAR-NBFGR, Lucknow in earlier DBT projects was collected and downloaded from NCBI for developing genome browser and integrating it with functional tools for data analysis and facilitating effective visualization (Table 7).

Fig. 84. View of magur genome browser showing the scaffold information

Fig. 85. View of magur genome browser loaded with gene annotation tracks

Fig. 86. View of selected sequence information in magur genome browser

Table 7. Details of fish genomes collected for developing genome browsers

Fish Species	NCBI Genome Accession Number	Genome size	No. of genes
Clarias magur	GCA_013621035.1	941.3 Mb	23,712
Labeo rohita	GCA_004120215.1	1.5 Gb	37,462

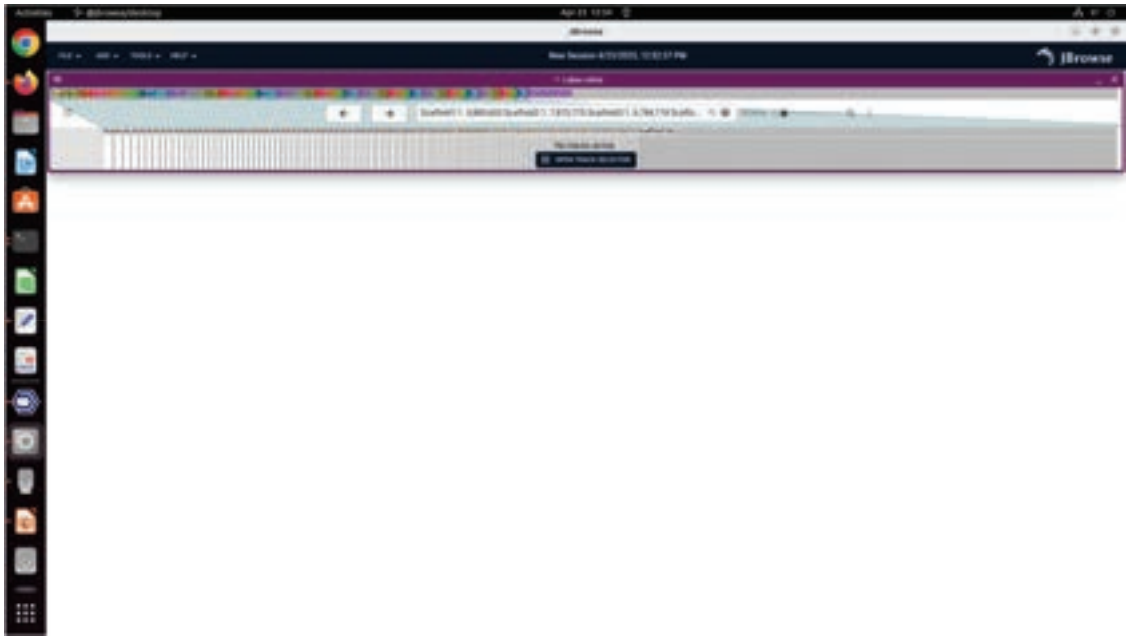


Fig. 87. View of rohu genome browser

Fig. 88. View of rohu genome browser showing the scaffold information

Development of web resources/genome browser

For the front end, a system with Linux Ubuntu (version 22) was set up and J-Browse desktop and J-Browse web in local host was configured for *C. magur* and *L. rohita* genomes. The genome browser provides visual depiction of genomes with zoom function in a linear fashion with gene annotation track associated with it for detailed analysis of genes (Figs. 84-88). Back end support to the browser was provided with php, html and custom perl scripts.

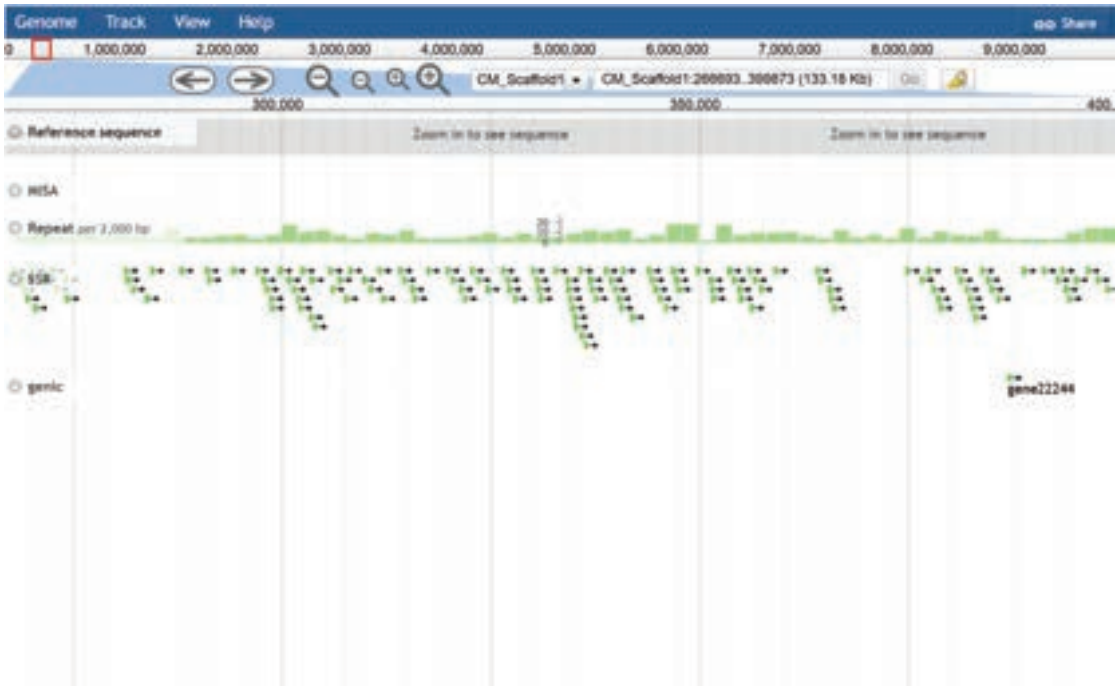


Fig. 89. View of magur SSR repeats

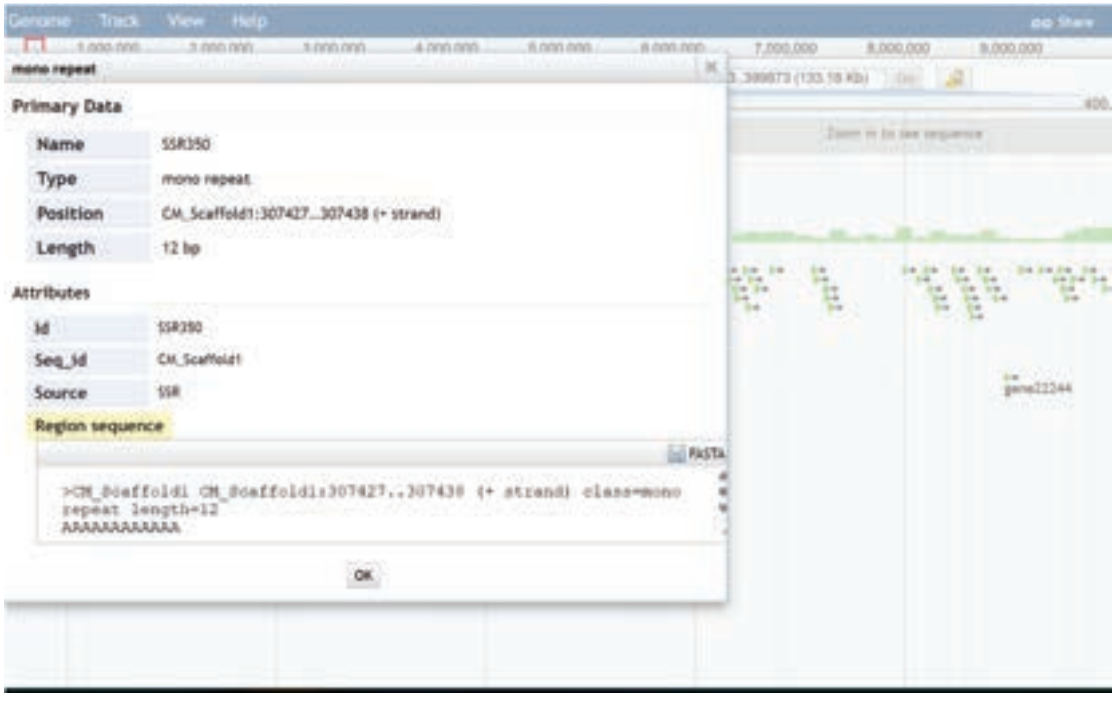


Fig. 90. View of mono SSR repeat information in magur genome browser

Development and configuration of analysis tools like repeat identification, primer designing tools for genome analysis and display of other genomes are in progress. Simple sequence repeats (SSRs) from magur genome was identified using MISA tool and is being incorporated in the magur genome browser (Figs. 89, 90).

Ex situ and *In situ* Conservation

Ranching activities at Cauvery river, Karnataka by Dr. S. Ayyappan

ICAR-NBFGR, through targeted projects, is committed to conserve and sustainably utilize aquatic resources while addressing socio-economic challenges and supporting community livelihoods. Efforts range from promoting freshwater aquaculture among marginalized communities to developing fish cell lines for long-term genetic preservation. Key innovations include fish milt cryopreservation, selective breeding programs, and establishment of brood banks. Community-centric projects such as, aquaculture development in Lakshadweep and marine ornamental fish villages in Maharashtra and Tamil Nadu, integrate conservation with livelihood enhancement.

Project:

Fish milt cryopreservation for broodstock development and quality seed production

Period: April, 2023 – March, 2025

Coordinator: Uttam Kumar Sarkar

Personnel: Santosh Kumar (PI), Charan R., Aditya Kumar, Raghvendra Singh, Lalit Kumar Tyagi, Monika Gupta, Ajay K. Singh, R.S. Sah, Basheer V.S. and A. Kathirvelpandian

Funding Support: Institutional, ICAR-NBFGR

The project envisages the application of cryopreservation for commercial seed production of carp and the establishment of cryobanks for assisted reproduction in fishes. For field validation of sperm cryopreservation as tool of germplasm exchange and crossbreeding in carp hatcheries, approximately 500 vials of 2 ml capacity were cryopreserved. Cryopreserved milt (560 ml) was supplied to 3 hatcheries situated in the 2 states of India and approximately 25 lakhs spawn was produced (Table 8).

Table 8. Details of cryopreserved milt of Indian Major Carps (IMC) supplied to hatcheries

Hatchery	Cryomilt of IMC supplied (ml)	No. of eggs fertilized (lakhs)	No. of spawn produced (lakhs)
Kash Fisheries, Sangrampur, East Champaran, Bihar	240	20.0	12.0
New Patel Hatchery Chhauradano, East Champaran, Bihar	180	15.0	8.5
Konch Hatchery, UP Matsya Vikas Nigam, Jalaun, UP	140	12.0	4.5
Total (3)	560	47.0	25.0

The outbred progenies are being reared separately and will be developed as brooder for commercial seed production in the hatcheries. These yearlings will be sampled for growth in subsequent months.

Development of species-specific milt cryopreservation protocol

Efforts were made for developing species-specific milt cryopreservation protocol for *Labeo bata*, *Systomus sarana sarana*, and *L. calbasu*. The extenders were optimised. Initial fertility trials were carried out and the 25-30% hatching were observed. Fertility trials of *L. calbasu*, *L. bata* and *S. sarana sarana* will be repeated breeding season.

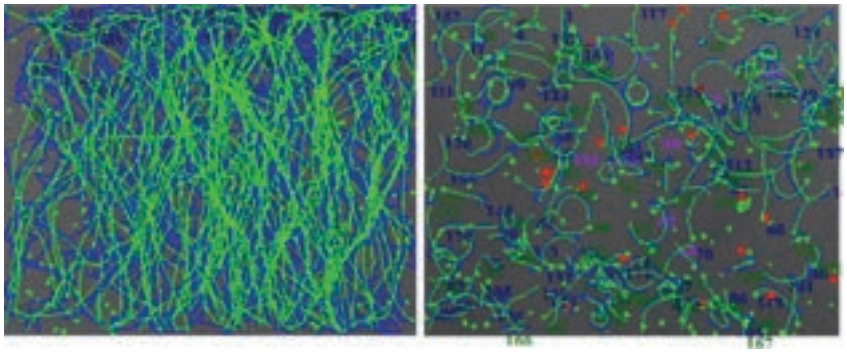


Fig. 91. Illustration of sperm motility

Variation in sperm quality and hatching

To explore the possibility of repeated use of milters, 10 rohu males from riverine stock were individually tagged and maintained in cement cistern ponds under standard feeding regime. Milt was collected at monthly interval after 4 hrs of hormone administration. From every individual, milt was collected in first week of June, July and August. Sperm motility parameters were estimated using Biovis CASA (Expert Vision Labs Pvt. Ltd, Mumbai). In early breeding season, spermatozoa followed linear path, however in late season, path was more of curvilinear (Fig. 91). Cryopreserved milt from all three months were preserved and stored. Fertility trial was conducted in third week of August and hatching was compared with the fresh milt (Table 9).

Effect of thawing temperature on hatching

In order to have commercial level seed production using cryopreserved milt, the upscaling of fertilization using bigger cryovials is needed. For large scale fertilization, bigger cryovials 2, 5, 10 and 12 ml were used. It was observed that

Fig. 92. Different steps in cryopreservation and fertility trials in rainbow trout

Table 9. Monthly variation in sperm quality and its effect on hatching

Month	Motility in fresh	Post thaw motility	Sperm:egg ratio	Hatching (%)
June	96	52	1,96,000	67.7
July	93	46	1,61,000	53.2
August	79	40	1,55,000	55.0

12 ml vials (5 Nos) were sufficient for the fertilization of 5 lakh eggs. Within one hour a total of 60-70 lakh eggs could be fertilized.

Cryopreservation of rainbow trout milt and fertility trial at farmer's field

Rainbow trout milt cryopreserved at Bairangna and Lavani hatchery of Uttarakhand, using two extenders E3 & 9C with 10% DMSO as cryoprotectant. Total 50 vials of 5 ml each were cryopreserved. The same cryopreserved milt was used to fertilize eggs from different hatcheries in Rudraprayag to address non-availability of mature males due to biased sex ratio. Successful breeding was achieved with 95% fertilization rate in farmers field through cryopreserved milt. Asynchrony of maturation was addressed using cryomilt of rainbow trout (Fig. 92).

Capacity building using cryomilt in trout farms

Hands-on training and demonstration on 'Trout milt cryopreservation and commercial seed production using cryopreserved milt' was given to the officials of Uttarakhand fisheries department and trout farmers (Fig. 93). The team visited various trout hatcheries and farms *viz*. Bairangna, Lavani, Ladholi (Chamoli) and Trout Broodbank, Dharkudi, Rudraprayag and demonstrated milt cryopreservation of trout and seed production using cryopreserved milt. Using species-specific protocol for rainbow trout, milt was preserved and transported in cryocans to different farms. Fertilized eggs were incubated in flow-through system.

Fig. 93. Capacity building using cryomilt in trout farms

Project

Livelihood improvement through freshwater aquaculture human resource development for the Scheduled Caste of the Government of India prioritized selected districts of Uttar Pradesh

Period: April, 2020 – March, 2024

Personnel: Sharad K. Singh (PI), Lalit Kumar Tyagi, Achal Singh, Aditya Kumar, Raghvendra Singh, Amit Singh Bisht and Sanjay Kumar Singh

Funding Support: Institutional, SCSP component

Capacity building of marginalized fish farmers is important to develop skills at the grassroots level for livelihood development. Training and awareness programmes were conducted in the area of fish culture for their livelihood enhancement.

Fig. 94. Common carp seed production at beneficiary site

Common carp seed production at beneficiary site

FRP carp hatchery has been used for producing common carp seed by the beneficiary farmer during March, 2024. Old plastic bag sheet was used as substrate for fertilized eggs. Fertilization and hatching of eggs were observed in the range of 94% & 86%, respectively. Five lakh common carp spawns were obtained (Fig. 94). Circulation of the water in the hatching tank was maintained properly.

Capacity development through residential skill development programme

(a) Capacity development of 30 scheduled caste (SC) members of fish farmer producer organization (FFPO) Barabanki have been given residential training following pedagogical and androgogical tools through farmer-scientist physical interaction mode during January, 2024 at Aquaculture Research and Training Unit (ARTU), Chinhat, Lucknow (Fig. 95).

(b) Residential training programme on capacity development of SC farmers on sustainable freshwater fish farming was organized in collaboration with Kalyan Matsya Jiwi Sahkari Federation and FFPO, Varanasi and Abhinav Matsya Jiwi Sahkari Federation and FFPO, Barabanki. Training was given to 30 SC farmers through physical mode during March, 2024 at ARTU, Chinhat, Lucknow (Fig. 95).

Fig. 95. Glimpses of the capacity development programme organized for SC farmers

Project

Establishment of brood bank of pearlspot through selective breeding at brackish water fish farm, Ayiramthengu in Kollam District

Period: November, 2021 – March, 2025

Personnel: Divya P.R (PI), Rekha M.U. and Santosh Kumar

Funding Support: Aquaculture Development Authority of Kerala (ADAK), Govt of Kerala

Pearlspot, *Etroplus suratensis*, the state fish of Kerala, is a valuable food and ornamental fish with high domestic demand. The ADAK has collaborated with ICAR-NBFGR to examine the techno-economic feasibility of establishing a brood bank and genetic resource maintenance centre for pearlspot at a brackish water fish farm in Aiyramthengu, Kollam, under the PMMSY scheme. As a part of this collaboration, ADAK has agreed to evaluate the intra-species genetic variability among pearlspot stocks and to establish a brood bank for the species.

Pearlspot samples were collected from 10 locations along the Indian coast, *viz*. Vembanad (n=61), Ashtamudi (n=88), Kadinamkulam (n=65), Marakkanam (n=120), Nagarjuna Sagar (n=60), Kavvayi (n=60), Ponnani (n=60), Kayamkulam (n=60), Pichavaram (n=72) and Dapoli, Ratnagiri (n=45). These locations span approximately 3,000 km, extending from Kavvayi on the West Coast to Nagarjuna Sagar on the East. Genomic DNA was extracted from fin. The cytochrome b gene of mitochondrial DNA was amplified and sequenced from 174 samples collected from nine distinct locations within Indian waters. Different haplotypes were submitted in GenBank with accession numbers PP105367-PP105459, PQ037869- PQ037949.

A total of 73 distinct cyt b mtDNA haplotypes were identified in 9 stocks of pearlspot. Genetic analysis showed haplotype diversity (h) to be high in case of Marakkanam (0.963) and low in Nagarjuna Sagar (0.462). Similarly, nucleotide diversity (p) varied from 0.001 (Nagarjuna Sagar) to 0.004 (Ponnani). AMOVA analysis showed that only 36.75% of the total variation was attributed to stock differences; however, 63.25% was attributed to differentiation within the stock, and stock structuring revealed a significant F_{ST} value of 0.367 ($p<0.05$), indicating high genetic heterogeneity among the stocks.

Apart from mitochondrial markers, nuclear microsatellite markers were also used to identify the genetic stock of pearlspot. Genotyping of samples from additional four locations, *viz*. Nagarjuna sagar, Ponnani, Pichavaram and Dapoli, using 15 polymorphic markers was also done to assess the genetic variability in the stocks and understand the demographic history of pearlspot. Taxonomic ambiguity among the samples from Kadinamkulam and Neyyar were also ruled out, using both morphological and molecular tools.

Project

Setting up of marine ornamental fish village at Maharashtra: Way forward to promote livelihood to mangrove dwellers

Period: October, 2021 – September, 2024

Personnel: T. T. Ajith Kumar (PI) and Raghvendra Singh

Funding Support: UNDP - Mangrove Foundation & Mangrove Cell, Government of Maharashtra

This project aims to establish a marine ornamental fish village in Maharashtra and advancing efforts to enhance the livelihoods of coastal community while concurrently promoting biodiversity conservation. The facility for marine ornamental fishes is being maintained in the premises of the Coastal and Marine Biodiversity Centre (CMBC), Dept. of Forest,

Fig. 96. F3 generation of the hybrids obtained from *Amphiprion percula* and *A. ocellaris*

Govt. of Maharashtra, Airoli, Mumbai.

As per the beneficiary's request and market demand, production for *Amphiprion akallopisos*, *A. perideraion* and *Premnas biaculeatus* have been upscaled and seeds were supplied. Besides, the seeds of *A. ocellaris*, *A. percula* and *A. frenatus* were also produced and provided to the cluster mode rearing units in three districts for further marketing by them. F2 crossbreed were developed from *A. ocellaris* (M) & *A. percula* (F) and the F3 generation were supplied to the beneficiaries, which got much attention among the beneficiaries and hobbyists (Fig. 96). During the reporting period, 10 rearing units were under operational at Sindhudurg, Ratnagiri and Palghar districts. Over 8,000 clownfish seeds were supplied to the beneficiaries for further rearing in cluster mode approach and marketing. 86 beneficiaries obtained Rs. 23,000 to 25,000/- during seven-month (3 cycles) rearing periods.

Project

Establishment of marine ornamental species hub in Pitchavaram Region, Tamil Nadu for sustainable livelihood development of local SC fisher folks

Period: June, 2022 – May, 2025

Personnel: T. T. Ajith Kumar (PI) and A. Kathirvelpandian

Funding Support: Department of Science and Technology (DST)

Fig. 97. Indigenous filtration setup developed in the hatchery facility

Broodstock were developed for 14 indigenous clownfish species from the stock collected from Gulf of Mannar, Lakshadweep and Andaman Islands. Among them, juvenile production is being continued for 5 species (*Amphiprion percula*, *A. ocellaris*, *A. sebae*, *A. clarkii* and *A. nigripes*). Successful production is being continued with 22 ppt salinity.

Training has been imparted to 25 beneficiaries, where 10 women started rearing clownfish juveniles on the premises of ICAR-NBFGR & DST facility at Faculty of Marine Sciences, Annamalai University (Fig. 97).

Project

Mainstreaming marine ornamental shrimp diversity for actions to enhance livelihood and gender empowerment opportunities among native Lakshadweep communities

Period: May, 2022 – April, 2025

Personnel: T. T. Ajith Kumar (PI) and Rejani Chandran

Funding Support: Centre for Marine Living Resources and Ecology (CMLRE, MoES)

The aim of this project is to integrate marine ornamental shrimp diversity into mainstream activities, fostering initiatives to elevate livelihoods and promote gender empowerment within

Fig. 98. Open water exploration in Kadmat island and a newly collected *Alpheus* shrimp

Fig. 99. Beneficiaries rearing bifurcated sea anemones in community aquaculture unit

the indigenous communities of Lakshadweep. Exploratory surveys were conducted in 3 new islands that yielded 134 shrimps, and the same were shifted to the hatchery facility at Agatti (Fig. 98). Seed production of *Thor hainanensis* and *Ancylocaris brevicarpalis* is being continued for the supply to the women beneficiaries, besides the bifurcated anemone was also given on trial (Fig. 99). A total of 45 beneficiaries attached with 4 community aquaculture units have earned Rs. 2,500 – 3,000 / person / month through shrimp and fish sale in 8 months period. Production of shrimp, *Cuapetes purushothanmani*, has been upscaled. Additionally, experimental successes obtained with another shrimp, *Stenopus hispidus*.

Project

Development of fish cell lines from prioritized endemic fish species for conservation and *in vitro* applications

Period: April, 2023 – March, 2026

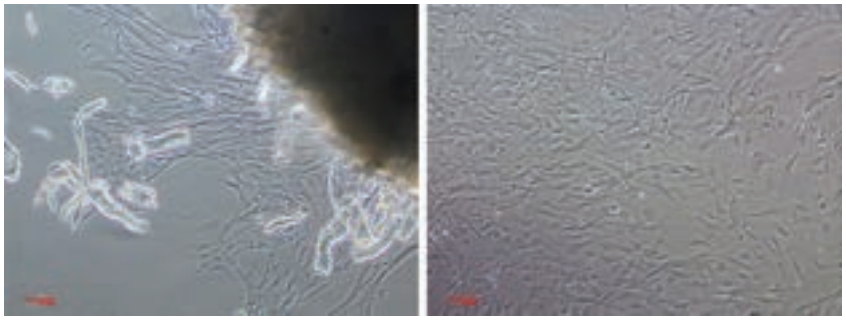
Personnel: Basdeo Kushwaha (PI), Ravindra Kumar, Murali S. and Vijay Kumar Singh

Funding Support: Institutional, ICAR-NBFGR

Fish cell lines have traditionally been recognized as one of the best alternatives for biological research on whole animals. They have been widely employed in research involving fish disease diagnosis and virus isolation; cytogenetic and genotoxicity screening studies; toxicology and gene expression studies; biobanking and cryopreservation studies, cellular agriculture etc. The project aims to develop fish cell lines from some of the important aquaculture and endemic fish species of India and evaluate them for various in vitro applications.

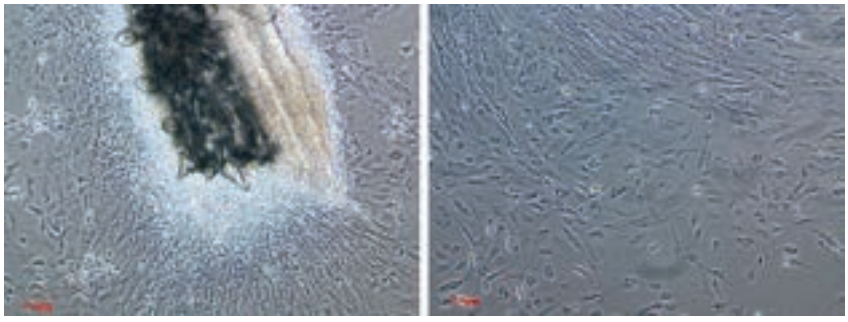
Primary culture of cells

Attempts were made for primary culture from explant culture and subsequent cell line development from several tissues (like muscle, gill, liver) of 3 fish species, *viz*. *Chitala chitala*, *Osteobrama belangeri*, and *Heteropneustes fossilis*, was undertaken.



(a) (b)

Fig. 100. *Chitala chitala* muscle tissue: a) cell radiation from explant, (b) cells after passage 4



(a) (b)

Fig. 101. *Chitala chitala* gill tissue: a) cell radiation from the explant, (b) cells after passage 2

Chitala chitala

C. chitala, the state fish of Uttar Pradesh, belongs to the Notopteridae family with good aquaculture potential. Primary culture was initiated from different tissues like muscle, fin, gill, heart and liver using explant culture. In the first trial, muscle explant culture grew well and was sub cultured for 4-5 days, but the cells became senescence and were lost. Hence, trials were set up again and radiation was observed in muscle, gills, fin and heart. The cultured cells were maintained in Leibovitz-15 medium supplemented with 20% FBS, penicillin, streptomycin, and amphotericin B. The media was changed every 3-4 days. The muscle (Fig. 100) and gill (Fig. 101) cultures have been sub cultured 5 and 2 times, while the heart (Fig. 102) and fin (Fig. 103) explant cultures are being grown.

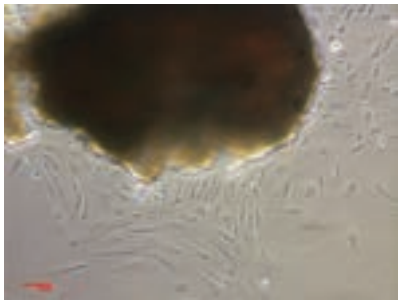


Fig. 102. Radiation of cells from *Chitala chitala* heart tissue explants

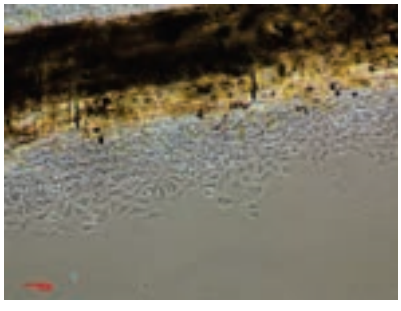
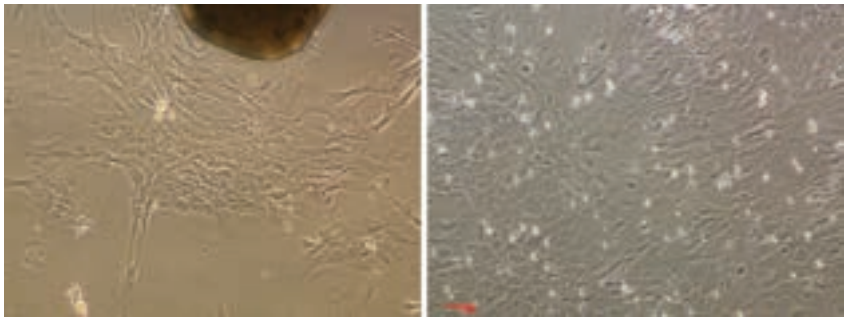


Fig. 103. Radiation of cells from the *Chitala chitala* fin tissue explants



a) (b)

Fig. 104. *Osteobrama belangeri* muscle tissue: a) cell radiation from the explants, (b) monolayer after passage 9

Osteobrama belangeri

O. belangeri, the state fish of Manipur, commonly called Pengba, is a minor carp with good aquaculture and ornamental potential. There has been a substantial decline in the natural population of the species with IUCN listing it in the Near Threatened Red List category. Primary culture was initiated from muscle tissue and cell radiation was seen in 3 days. The cultured cells were maintained in Leibovitz-15 medium supplemented with 20% FBS, penicillin, streptomycin, and amphotericin B. Cell culture media was changed every 3-4 days and the muscle culture has been passaged over 10 times (Fig. 104).

Heteropneustes fossilis

H. fossilis, commonly called singhi or stinging catfish, is an important catfish species. Primary culture was initiated from muscle tissue two times using explant method. The explants were observed for 2 weeks in several attempts, but no cell radiation was seen and the explant remained live without cells decay (Fig. 105). Future experiments with few modifications, like enzymatic digestion and using growth factors, will be conducted to explore the possibility of developing primary culture in this important species.

Channa punctata and *Labeo rohita*

Though the primary cultures developed from *C. punctata* and *L. rohita* muscle tissues last year did not sustain, but fin primary cell cultures were passaged for multiple times and cryopreserved. The cryopreserved cells of these species will further be revived and continued for passaging followed by their characterization and confirmation of its origin using mitochondrial COI sequencing.

Cell line acquisition, distribution and HRD

NRFC repository was enriched with the addition of two new cell line accessions (NRFC082: insect- tiger shrimp hybrid cell line, PmLyO-Sf9, received from Cochin University of Science and Technology, Kochi, and NRFC083: *Carassius auratus* gill cell line, FtGG, received from PAGR Centre of ICAR-NBFGR. A cell line from *Astronotus ocellatus* kidney (AOK), received from PAGR Centre of ICAR-NBFGR for deposition, has been passaged multiple times and will be provided NRFC accession number soon.

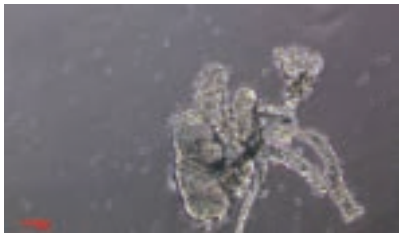


Fig. 105. *Heteropneustes fossilis* muscle tissue explants

Cell line maintenance activities, like revival and cryopreservation, were carried out for 10 fish cell lines. During the reporting period, a total of 8 fish cell lines were distributed for R&D purposes to Fisheries College and Research Institute, Thoothukudi; CUSAT, Kochi; and Sathyabama Institute of Science and Technology, Chennai.

Project

Network Project on Ornamental Fish Breeding and Culture (NPOFBC)

Period: April, 2018–March, 2026

Personnel: V. S. Basheer (PI), Charan R., Rekha, M.U. and Monika Gupta, Aditya Kumar and Raghvendra Singh

Funding: Institutional, ICAR-NBFGR

The project aims to unlock the vast potential of indigenous ornamental fish for the aquaculture.

Breeding of *Pethia sethnai*

Different sex ratios of *P. sethnai* were tested to optimize spawning efficiency, without using hormone. The fecundity of 100-120 eggs; 70-80% fertilization rate and 80-85% hatching rate was documented. A total production of around 800 young fish across multiple trials was achieved. Pigmentation in fry began after 4 weeks and reached marketable size within 10 weeks (Fig. 106).

Fig. 106. *Pethia sethnai* (adults and young ones)

Breeding of *Dawkinsia arulius*

Reproductive performance demonstrated fecundity of 220-280 eggs per female, fertilization rates of 75-80%, and hatching rates of 70-75%. A total of approximately 1000 young ones produced from 7 trials. Pigmentation began after 4 weeks, and reached marketable size within 10 weeks.

Breeding of *Dawkinsia tambraparniei*

Simple spawning techniques was employed for captive breeding without inducing hormones (Fig. 107). Eggs were observed 24h after introducing the fish to the aquarium. Hatching occurred within 12-15h. Fecundity averaged 220 eggs, with a fertilization rate of 90% and a hatching rate of 85%.

Breeding of *Halduria fasciata*

Breeding trails of *H. fasciata* resulted in hatching within 15-18h. Successful breeding achieved with fecundity ranging from 130 to 190 eggs, fertilization rates of 75-80% and hatching rates of 72-78%. Each trial yielded an average of 180-350 fry, resulting in approximately 1100 young ones from 7 breeding attempts. Induced captive breeding was achieved through a hormone

Fig. 107. *Dawkinsia tambraparniei* (adults and young ones)

A B C

Fig. 108. F1 generation produced in 2023 from A. Kohaku, B. Showa, and C. Platinum ogon

injection using WOVA-FH at a dosage of 0.5 µg/g of body weight. Eggs were observed approximately 16h post-injection, with hatching occurring within 15-16 hours after spawning. The fecundity of the females varied between 80 and 110 eggs each.

Strengthen germplasm resource center of koi carp

Germplasm resource center of koi carp was strengthen with brooders of different variables (*Kohaku, Hi Utsuri, Ki Utsuri, Shiro Utsuri, Tancho showa, Yamabuki ogon and Shushui*). Individuals of *Kohaku*, *Showa* and *Platinum ogon* variants selectedfor breeding. Breeding trails were also conducted with developed brooders of Kohaku, Orangi Ogon and Platinum ogon and young ones were maintained in green water system (Fig. 108). After 6 months of rearing, the fingerlings were sold to stakeholders and entrepreneurs. Seeds were also distributed to fish farmers and women beneficiaries during the different training programs under SCSP for promoting the high value koi carp as a livelihood option for the farmers.

Shiro utsuri variant were also bred successfully and growth performance has been evaluated of the different variants produced and it was observed that *Platinum ogon* has highest growth and *Utsuri* has lowest growth among produced variants.

Project:

Community aquaculture for livelihood and conservation: Economic upliftment to the local population at Lakshadweep, utilizing indigenous fish genetic resources

Period: July, 2021–June, 2024

Personnel: Rekha M.U. (PI) and T. T. Ajith Kumar

Funding Support: Institutional, ICAR-NBFGR

The project aims to conserve the genetic resources of indigenous

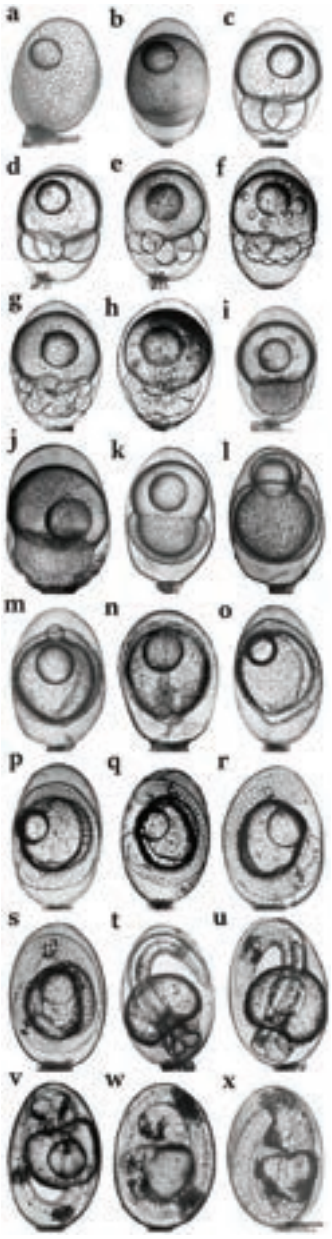


Fig. 109. Embryonic development of *Chromis viridis*: a. spawned egg, b. 1-cell stage, c. 2-cell stage, d. 4-cell stage, e. 8-cell stage, f. 16-cell stage, g. 32-cell stage, h. 64-cell stage, i. high-cell stage, j. dome stage, k. 30% epiboly, l. 75% epiboly, m. 90% epiboly, n. 100% epiboly, o. embryonic bud formation, p. 3-somite stage, q. 6-somite stage, r. 15-somite stage, s. 21-somite stage, t. heartbeat appeared, u. optic vesicle and median fin fold appeared, v. mid-brain and hind-brain formed, w. stellate-shaped melanophores appeared on the yolk sac and body trunk, x. before hatching. Scale bar: 250 µm

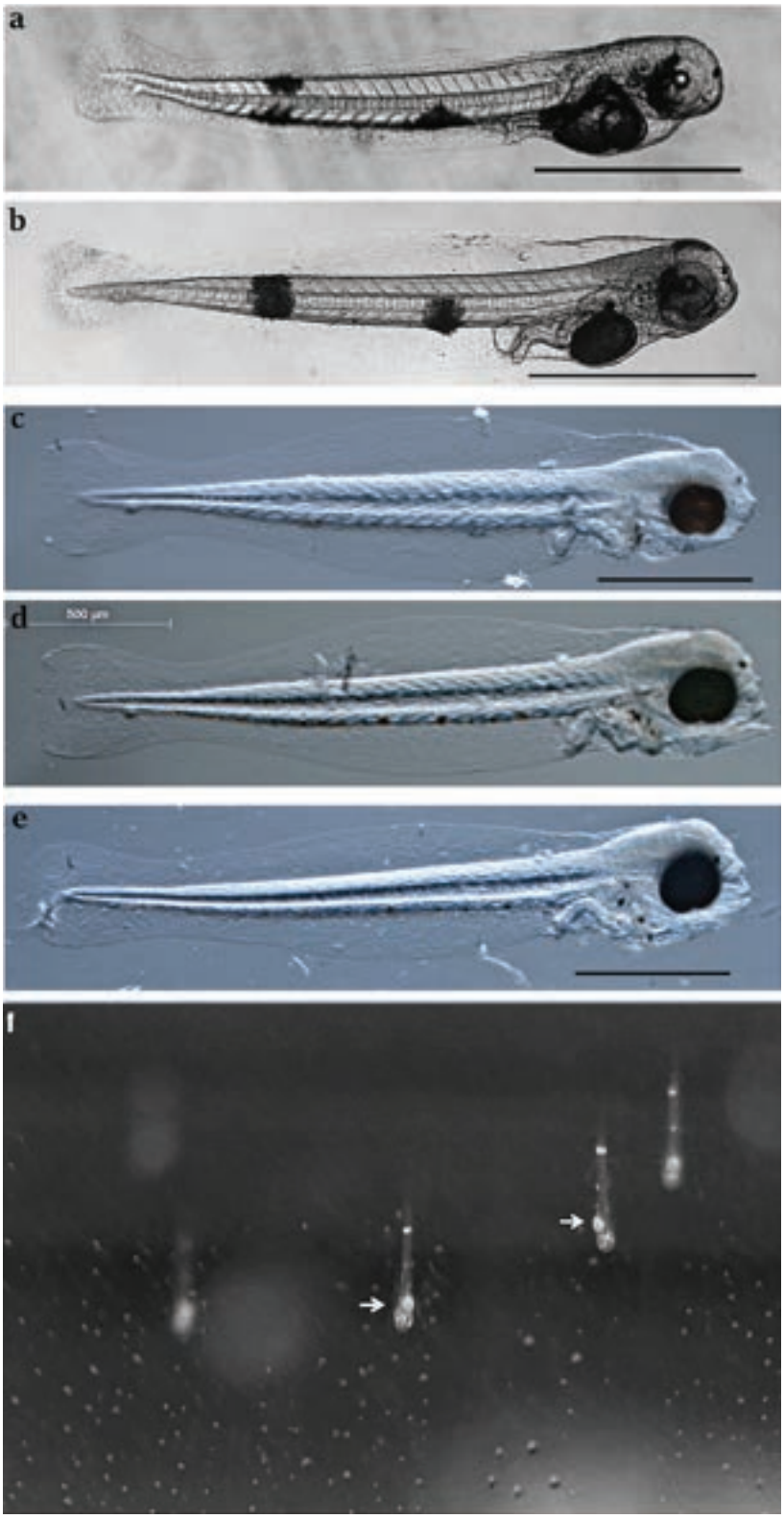


Fig. 110. Development of larvae of *Chromis viridis*: a. newly hatched larva, b. 1-day post-hatching (DPH), c. 2 DPH, d. 3 DPH, e. 4 DPH, f. newly hatched larvae (arrow) in the water column. Scale bar: 500 µm

marine fishes while promoting local economic development in Lakshadweep through community-based aquaculture. It facilitated the breeding and rearing of *Amphiprion nigripes* and *A. clarkii*, with juveniles distributed to beneficiaries for grow-out in community-managed aquaculture units. Additionally, the project focused on standardizing captive breeding protocols for *Chromis viridis*, a species with high demand in the marine ornamental trade.

Captive breeding standardization of *Chromis viridis*

Captive breeding protocols were standardized using various tank configurations and substrates, resulting in 51 successful spawnings from June, 2023 to June, 2024, averaging 4.25 events per month. Observations included detailed records of sexual dimorphism, spawning frequency, colour changes during courtship, embryonic development (Fig. 109) and early larval development as well as behaviour (Fig. 110). Successful breeding protocols established marks a crucial breakthrough, laying a strong foundation for future improvements in the aquaculture of this valuable species.

Community aquaculture implementation and progress

In the first year, exploratory surveys were carried out at Agatti, Bangaram, and Kavaratti islands to assess the availability of high-value marine ornamental species, such as clownfish and damselfish. Hatchery operations at ICAR-NBFGR, Agatti, initiated larval rearing of indigenous clownfish species using greenwater techniques, thus, successfully increasing survival rates from 40% to 80%. Juvenile clownfish were distributed to 46 women beneficiaries across 4 eco-friendly community aquaculture units, constructed using locally sourced materials (Fig. 111). Breeding programs utilized wild-caught and F1 generation broodstock at the germplasm center, while F2 juveniles were reared in community units and sold after 2.5 to 3 months. Each beneficiary earned an average income of Rs. 2,750 per production cycle through the sale of ornamental fishes. A Memorandum of Understanding (MoU) with M/s Cosmos Aquatics streamlined market access and trade of ornamental organisms.

Fig. 111. Women beneficiaries of community aquaculture unit

Project:

Physiological insights into the reproductive mechanism of *Clarias dussumieri*

Period: April, 2021-March, 2025

Personnel: Charan Ravi (PI), Aditya Kumar and Rekha M.U.

Funding support: ICAR-NBFGR Corpus Fund

Clarias dussumieri, an endemic and Near Threatened catfish of the Western Ghats, has experienced significant population declines, despite once being abundant in Kerala's wetlands. Unlike other clariids that require male sacrifice for milt extraction, this species exhibits unique reproductive traits, including captive breeding viability, and multiple spawning events. However, the lack of foundational studies on its reproductive physiology limits conservation and aquaculture development. Understanding its

a. b.

Fig. 112. Early maturing stage in: a. Ovary, and b. testis

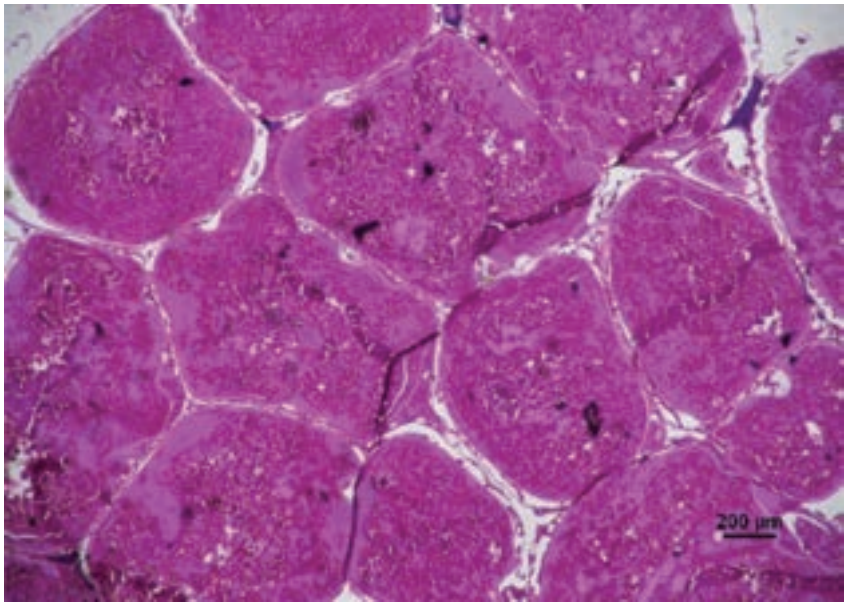


Fig. 113. Histology of female gonad mature phase

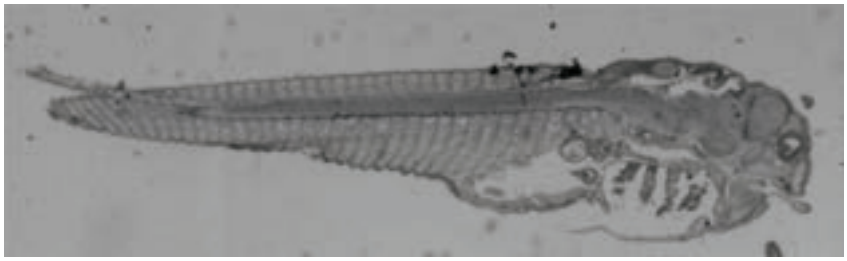


Fig. 114. Larval ontogeny of *Clarias dussumieri*

gonadal development, hormonal regulation, and spawning behaviour is essential for sustainable management and commercial-scale breeding. This study aims to elucidate reproductive physiology to enable sustainable captive breeding, aiding conservation and aquaculture potential of *C. dussumieri*.

Length-weight relationship of *C. dussumieri* revealed negative allometric growth (b<3.0), where unit weight gain was slower than the length in both the sexes. Gonadosomatic Index (GSI) patterns confirmed multiple spawning events, with females peaking in July (10.91) and October (10.00), while males showed maximum GSI in November (2.40) (Figs. 112a, b). Hepatosomatic Index (HSI) fluctuations aligned with reproductive cycles, rising pre-spawning due to energy storage and declining post-spawning from metabolic depletion.

Histological studies of the testes identified early-stage spermatogonia dominance from January to March, transitioning to mature spermatozoa by June–July, indicating peak reproductive readiness. Ovarian development progressed to vitellogenic oocytes by May–July, coinciding with active spawning (Fig. 113). Additionally, larval development studies tracked digestive organ formation over 18 days post-hatching, thus, identifying critical milestones in stomach, liver, and pancreas development (Fig. 114).

Project:

Unravelling the genetic diversity and population structure of *Chromis viridis* in Indian waters

Period: February, 2024-March, 2025

Personnel: Rekha M.U. (PI), Teena Jayakumar T. K. and Rejani Chandran

Funding support: ICAR-NBFGR Corpus Fund

This research is expected to provide novel insights into the genetic diversity, divergence, and phylogenetic relationships of *Chromis viridis* populations, thereby, supporting the development of stock-specific conservation strategies.

Genetic structure of *Chromis viridis* in Indian waters

Comprehensive genetic analyses using mitochondrial control region sequences were conducted to assess the population structure of *C. viridis* across Indian waters. Samples were collected from multiple sites in the Lakshadweep Islands, North Bay Island (Andaman and Nicobar Islands), and the Gulf of Mannar. Hierarchical AMOVA revealed low, but significant genetic differentiation (Φ_{ST} = 0.02342, p< 0.001), thus, grouping populations into 5 distinct gene pools. Phylogenetic (Fig. 115) and haplotype network analysis identified 2 clades in Indian waters: Clade A, widely distributed with high gene flow; and Clade B, indicating localized lineage variation and potential genetic isolation.

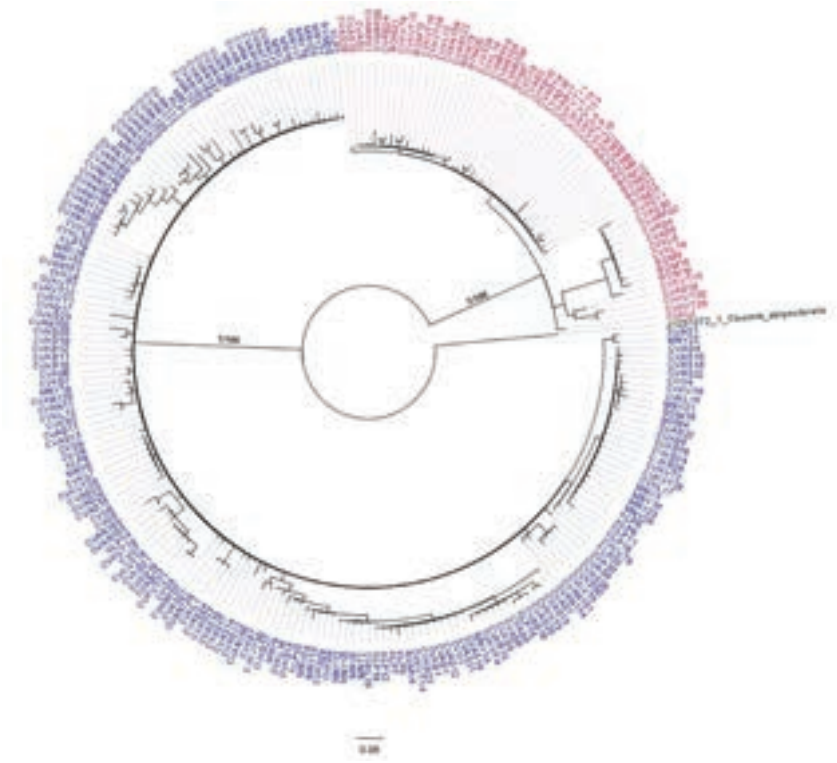


Fig. 115. Bayesian phylogenetic tree based on mitochondrial control region marker depicting Clade A (blue) and Clade B (red). Node values are presented only for those with bootstrap scores >90% majority rule for maximum likelihood and >90% majority probabilities for Bayesian probability values (BI/ML).

Transoceanic genetic structure of *Chromis viridis*

Mitochondrial cytochrome *b (Cyto b)* and nuclear RAG2 markers were analyzed in *C. viridis* populations, collected from Agatti and Minicoy (Lakshadweep), North Bay Island (Andamans) and Gulf of Mannar. Haplotypes were compared with published sequences to facilitate transoceanic analysis. Cyto b analysis revealed low but statistically significant genetic differentiation across the Indo-Pacific and Red Sea regions (Φ_{ST} = 0.04415, p< 0.001), while grouping populations into above 2 geographic regions. Haplotype network analysis further identified 2 distinct Indo-Pacific clades (Fig. 116). Similarly, RAG2 analysis indicated significant genetic structuring (Φ_{ST} = 0.01747, p< 0.001), with notable differentiation between the Andaman population and those from other Indian sites (Φ_{ST} = 0.01741, p< 0.001). Phylogenetic and haplotype network analyses further confirmed the presence of cryptic lineages and substantial unrecognized genetic diversity, emphasizing the need for precise lineage delineation.

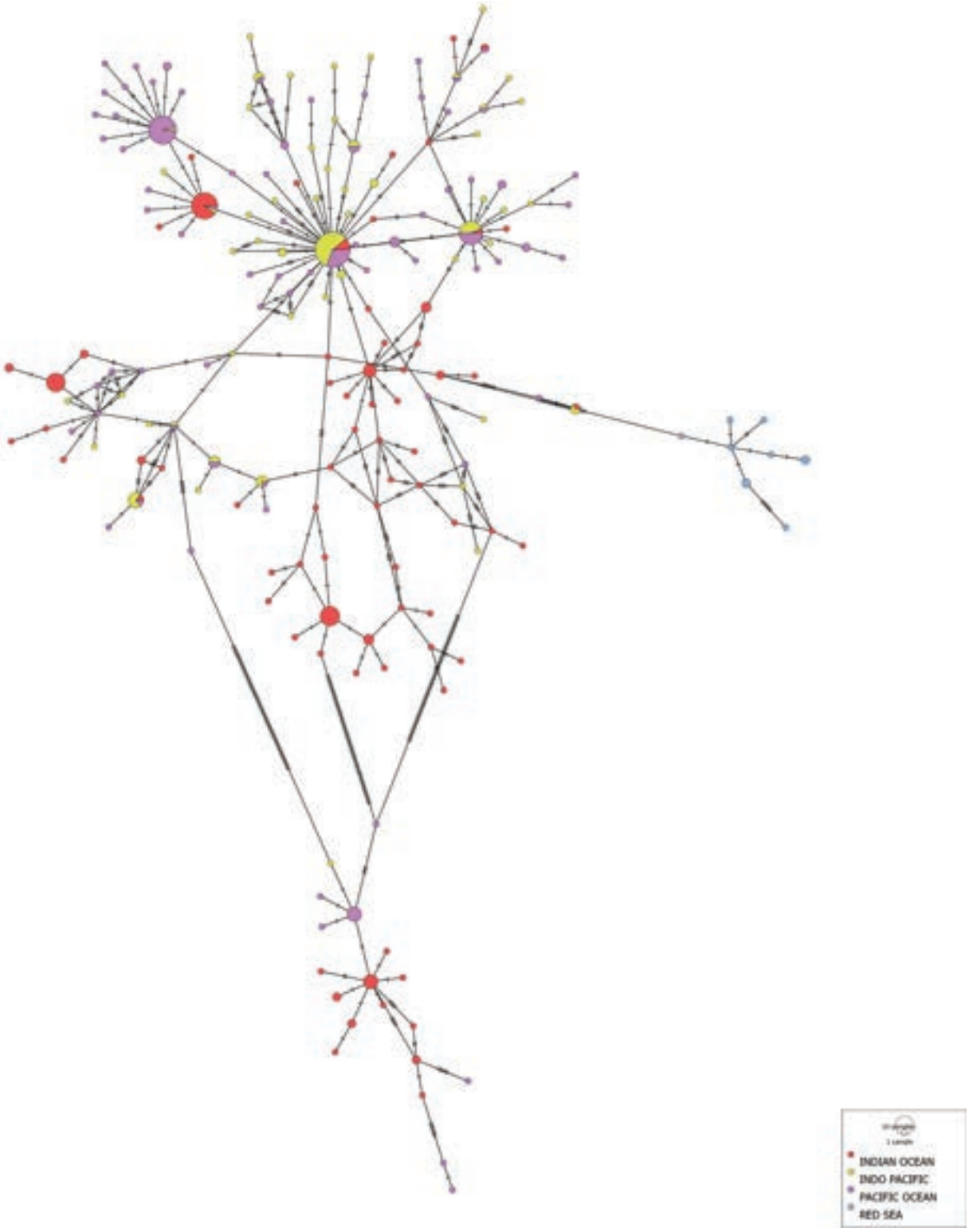


Fig. 116. Minimum spanning network (MSN) of Cyto b sequences of transoceanic populations of *Chromis viridis*

Documentation of Fish Genetic Resources

Documenting stakeholder perception at Teesta basin

Documenting and profiling this ichthyofaunal diversity is essential for effective conservation planning and sustainable use. ICAR-NBFGR is actively documenting the country's Aquatic Genetic Resources (AqGR) and presenting these information through web-interactive databases, supporting Digital India initiative and fulfilling international treaty obligations. Additionally, tracking changes in fish diversity under climate change and identifying vulnerability indicators are crucial for assessing ecosystem resilience and formulating effective mitigation strategies. These databases cover a wide range of topics including

taxonomy, biology, genomics, exotic species, and aquatic diseases related to finfish and shellfish. Through its focus on database development and maintenance, the Bureau supports the conservation and sustainable management of AqGR.

Project

Information system of selected commercially important shellfish resources from prioritized Indian aquatic ecosystem

Period: July, 2020–March, 2024

Personnel: Ajey Kumar Pathak (PI), A. Kathirvelpandian, Teena Jayakumar T. K., Ravi Kumar and Vikas Kumar

Funding Support: Institutional, ICAR-NBFGR

The information system developed for crustacean resources was updated for species of shrimps, prawns, crabs and lobsters and presently its covers 527 species of shrimps and prawns, 946 species of crabs and 23 species of lobsters from Indian waters. The information system details on their taxonomy, conservation status, habitat, population status, synonymy, common name, biology, occurrence, general information, diagnostic character and type specimen. The present information is running on restructured database featured with data management by the registered users and database/ web administrator. The system is accessible at URL: https:// shellfishris.nbfgr.res.in and is being maintained and updated regularly.

Project

Intellectual Property Management and Transfer/ Commercialization of Agricultural Technology Scheme (Up-scaling existing components i.e. Intellectual Property Right)

Period: October, 2022– March, 2026

Personnel: Poonam J. Singh (PI), Mahender Singh and Arun Sudhagar S. (since January 2024)

Funding Support: External, National Agriculture Innovation Fund (NAIF), ICAR

The NAIF-IPR project promotes creativity and innovation by strengthening institutional mechanisms to protect innovations and building capacity in Intellectual Property Rights (IPRs) and Technology Commercialization. It empowers farmers and self-help group (SHG) women through stakeholder networks, fostering entrepreneurship and product innovation via systemic design interventions. Aligned with the WTO's TRIPS agreement, the project highlights the critical role of IPRs in research and development across agriculture, fisheries, and therapeutics sectors, where technologies with significant economic and societal potential can be safeguarded. By enabling innovation and IP protection, the project drives sustainable development and supports national progress in vital sectors.

Prior art search

Patent landscape reports for technologically relevant areas of the institute were comprehensively analyzed using prior art searches to identify existing technologies within specific domains. These searches focused on key innovations, including bioactive peptides, fish antifreeze proteins, bioink applications in agriculture and fisheries, and *C. magur* identification technologies. The resulting technology landscape report serves as a vital resource, offering critical insights and information not typically available in research papers, thereby enhancing strategic decision-making and innovation potential.

Patent landscape reports

An analysis of antifreeze protein (AFP) patents (2014-2024) utilizing tools, like the International Patent Classification IPC (Fig. 117), semantic enrichment, and natural language processing, reveals its potential in cryopreservation and cold-resistant applications, which were derived from the aquatic organisms, like shrimp and grass carp. These proteins inhibit ice formation, offering solutions for biological preservation and cryosurgery. Additionally, bioactive peptides, from marine and freshwater organisms, with properties, like antibacterial and anticancer activities, show significant promise in pharmaceuticals and biotechnology (Fig. 118). A patent landscape analysis highlights the growing commercial potential (5,283 to 10,570 patents from the year 2000 to 2024), while valorizing marine by-products like collagen and fatty acids offers sustainable bioactive solutions (Fig. 119).

Fig. 117. The International Patent Classification (IPC) Code for antifreeze proteins from fish and marine sources

Fig. 118. Patents for bioactive peptide from fish in therapeutics sector

Assessment of technologies for commercialization

Three meetings of the ITMC were held in April, May and June, 2024, to evaluate and certify products, technologies, processes, methodologies, models, protocols, and policies for Phase III certification by ICAR. The primary objective was to review and recommend high-potential innovations to ICAR. A total of 135 technologies, spanning from 2010 to 2024, were thoroughly screened. Following exhaustive assessment, 38 technologies and 25 new species were selected for certification, marking a significant milestone in advancing commercialization and enabling broader industry application of these innovations.

Fig. 119. The patent documents over time for bioactive peptide from fish and marine sources

Fostering innovation and knowledge transfer through upcoming technology manual

A meeting of Institute Technology Management Committee (ITMC) members was held in October, 2024 to evaluate technologies and products associated with ICAR-NBFGR, Lucknow, for the preparation of a comprehensive technology manual.

A Techno-Commercial Assessment Committee (TCAC) meeting was held virtually in October, 2024 to discuss the commercialization and to finalize the domestic licensing terms for the Oonil formulation. This formulation, a key innovation in ICAR-NBFGR's fish health management portfolio, is being commercialized in collaboration with Agrinnovate India (AgIn).

IP protection through patent filing

In November, 2024, the ITMC meeting was convened to evaluate the patent filing for an innovative technology developed by scientist at ICAR-NBFGR. Following thorough assessment, formal approval granted for patent filing and subsequently the patent was officially filed for the technology in December, 2024, marking a significant step forward in protecting and advancing the innovation.

Celebration of World Intellectual Property Day

The ITMU of ICAR-NBFGR, under the National Agricultural Innovation Fund (NAIF), hosted a

seminar on 'Intellectual Property Rights, Inclusivity, Creativity, and Innovation' from April 24-26, 2024, aligned with the World Intellectual Property Day theme on 'IP and SDGs' (Fig. 120). The seminar focused on driving innovation to achieve Sustainable Development Goals (SDGs). A lecture on 'Paradigm Shift Through Ideation, Creative Synthesis, and Innovative Thinking,' was delivered by OIC ITMU highlighting the resilience in research through 'Fox-Hedgehog Encounter' story. The seminar generated numerous innovative ideas, including integrating sensors into fish and applying artificial intelligence (AI) in fisheries management. It emphasized the need to foster a culture of out-of-the-box thinking and harness nature's wisdom to drive impactful advancements in research and development.

Happy innovation hour for Intellectual Property awareness

On April 25, 2024, ITMU hosted the 'Happy Innovation Hour for Intellectual Property Awareness' at Upper Primary School Kalli Paschim, Lucknow, aimed at inspiring creativity and raising awareness about intellectual property rights among school children (Fig. 121). The event engaged young participants in interactive sessions covering copyright, design, trademarks, and patents, encouraging innovative thinking through problem-solving activities. Children were rewarded with caps, along with jute pouches filled with stationery and snacks crafted by the local SHG. The event also featured impromptu performances creating a lively atmosphere, while nurturing a culture of innovation and empowering creators and innovators.

Fig. 121. Happy innovation hour for Intellectual Property awareness among school kids

Fig. 120. Celebration of World Intellectual Property Day at ICAR-NBFGR

Empowering women led micro-entrepreneurs

An innovative model for market linkage and sustainable aqua-entrepreneurship was introduced in Dhankutti Village, Barabanki, Uttar Pradesh, involving rural women nurturing ornamental fishes in mini ponds and connecting them to urban markets through AquaWorld, with infrastructure support provided by the Hi-Tech Fisheries and Farmer Knowledge Centre. Women from the SHG successfully expanded their home aquarium setups to larger ponds and over 600 ornamental fishes were sold in 5 months (programs conducted in February, March, June, July and November, 2024) (Fig. 122).

ICAR-NBFGR adopted a second village at KVK, Sitapur to expand the Mission Navshakti 2.0 initiative, empowering women-led micro-entrepreneurs (Fig. 123) through ornamental fish farming in collaboration with AquaWorld and Hi-Tech Fish Farming. Women from Sitapur's Chhi, Katia, and Pratappur

Fig. 122. Glimpses of programs organized and ornamental fishes

villages were trained in ornamental fish keeping, rearing, maintenance, and aquarium fabrication, supported by a centralized Fish Bank at KVK Sitapur.

Women-led micro-entrepreneurs in Barabanki scaled their businesses from 4 fish to >400 in just 9 months. The initiative ensures a steady supply of species, like molly and guppy, boosting local production and reducing transportation costs. Participants received essential startup kits iceboxes, solar lights, and weighing machines improving market readiness, operational efficiency, and hygiene.

ICAR-NBFGR expanded Mission Navshakti 2.0 to KVK, Unnao, establishing it as the third model after successful implementations in Barabanki and Sitapur. This initiative, focused on empowering rural women through ornamental fish farming, integrates the hub-and-spoke model to create sustainable livelihoods. The Unnao model strengthens Mission Navshakti 2.0's vision of fostering women-led micro-enterprises, demonstrating how grassroots initiatives can transform rural communities and empower women with sustainable income opportunities.

In June 2024, ICAR-NBFGR, in collaboration with Safai Karamchari Andolan and AquaWorld, hosted a skill development session for 60 students at Lavkush Nagar Basti under Mission Navshakti. The session focused on aquarium design, fostering creativity and potential business skills (Fig. 124). Participants also received essential items like solar lamps, water bottles, and jute bags to support their studies and address power challenges.

Fig. 123. Women-led micro-entrepreneurs at KVK, Sitapur

Fig. 124. Aquarium design session at Lavkush Nagar, Lucknow

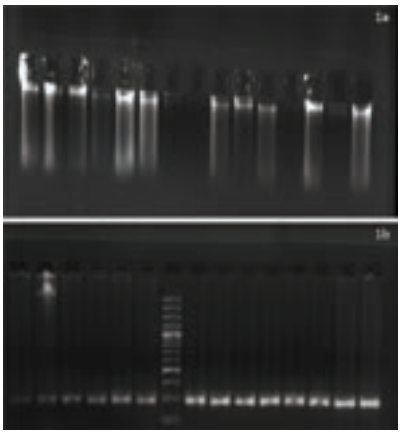


Fig. 125. a. eDNA on 0.7% agarose gel, b. PCR amplicons of COI on 2% agarose gel

Project

Development of molecular system for identification of fishes

Period: April, 2023 – March, 2026

Personnel: Mahender Singh, Poonam Jayant Singh, Santosh Kumar, Jaspreet Singh, Tanwy Dasmandal and Deva Narayan

Funding support: Institutional, ICAR-NBFGR

The project is envisaged to develop eDNA based molecular system for the identification of fish species. For metabarcoding from eDNA, water samples were collected from Gomti river, filtered by vacuum filtration assembly with filter paper and used filtrate for eDNA extraction (Fig. 125a). Primer sets of 12S rRNA were used to amplify 230 bp region from eDNA. The amplicons from 3 sampling locations were pooled and sequenced on Illumina platform (2*150bp). Newly designed forward primer and reverse primer successfully amplified 292 bp region of 12S rRNA. As nucleotide sequences of COI are abundant for reference, so a new primer set was designed for 289 bp COI region (part of standard barcode region of 655 bp), amplified successfully and samples were pooled in 1 for NGS (3GB) (Fig. 125b). DNA Barcoding of 75 fish individuals of 23 species was completed. A deformed specimen of *Mystus* species from the Gomti river was analyzed and compared with normal specimen. No marked differences are observed in meristic characters, except for lack of caudal fin and radiographic examinations.

As there is constant threat of invasive alien species *Clarias gariepinus* to the native species *C. magur* in India, these is need to curb the spread of *C. gariepinus* and ultimately remove it from the Indian waters. It is usually difficult to differentiate these two species at juvenile stages, like fry or fingerlings, where the morphomeristic characters are least developed. Hence, identification of species based on traditional

Fig. 126. Removal of testes for captive breeding of *Clarias* species

Fig. 127. Stripping of females for captive breeding of *Clarias* species

Fig. 128. Rearing of hybrid individuals of *Clarias* species

taxonomy is quite difficult and sometimes even impossible. A DNA based method is developed to differentiate *C. magur* from *C. gariepinus* based on newly designed primer pair for the selected common region of both the species. Amplicon size with the primer pair differ by 65 base pairs in *C. magur* and *C. gariepinus*, so we can differentiate them from fry, fingerling, larva, fish fillets etc. in 24 hours. As the menace is not only from *C. gariepinus*, but also from hybrids of *C. magur* and *C. gariepinus*, as illegally imported in India from neighboring country. Therefore, hybrids were produced between *C. magur* (♀) x *C. gariepinus* (♂) and *C. gariepinus* (♀) x *C. magur* (♂) in the closed system at ICAR-NBFGR (Figs. 126, 127).

The dead larvae were collected in 95% ethanol and live juveniles were reared in closed condition. DNA was isolated from parents and hybrid juveniles. The PCR reactions were setup with newly designed primers for parental individuals and hybrid juveniles. The parental individuals include, three individuals of *C. magur* (♀), three individuals of *C. magur* (♂), three individuals of *C. gariepinus* (♀), and three individuals of *C. gariepinus* (♂). The hybrid offsprings were produced from *C. magur* ♀ x *C. gariepinus* ♂ cross and *C. gariepinus* ♀ x *C. magur* ♂ cross and reared in closed conditions (Fig. 128).

The muscle/ fin clips from hybrid offspring and parents were

Fig. 129. Chromosome preparation of hybrid individuals of *Clarias* species

Fig. 130. Mucus collection for analysis of proteome and metabolites of *Clarias* species

used for DNA isolation and PCR amplification with newly designed primers. With this single primer pair, the PCR product in *C. magur* is smaller than *C. gariepinus*. In both types of hybrids, the PCR products of both sizes are amplified. A patent was filed in Indian Patent Office (reference no. 202411099622 dated Dec. 16, 2024). Chromosomes were prepared from the hybrid individuals of *C. magur* (♀) x *C. gariepinus* (♂) and the diploid chromosome number (2N) for the hybrid offsprings is 53 (Fig. 130), mean of 2N of parents *C. magur* (50) and *C. gariepinus* (56).

For onsite identification of *C. magur* and *C. gariepinus* by DNA aptamer, analysis of proteome and metabolites of 12 mucus samples is being carried out by taking three individuals each of *C. magur*, *C. gariepinus*, hybrid progenies (*C. magur* ♀ x *C. gariepinus* ♂) and reverse hybrid progenies (*C. gariepinus* ♀ x *C. magur* ♂) (Fig. 131).

Project

Assessment of fish diversity, vulnerability indicators, and ecosystem services in the coastal ecosystems of the East Coast of India

Period: April, 2023 - March, 2025

Coordinator: Uttam Kumar Sarkar

Personnel: A. Kathirvelpandian (PI), T. T. Ajith Kumar, Ajey Kumar Pathak, Poonam Jayant Singh, Teena Jayakumar T. K. and Kantharajan G.

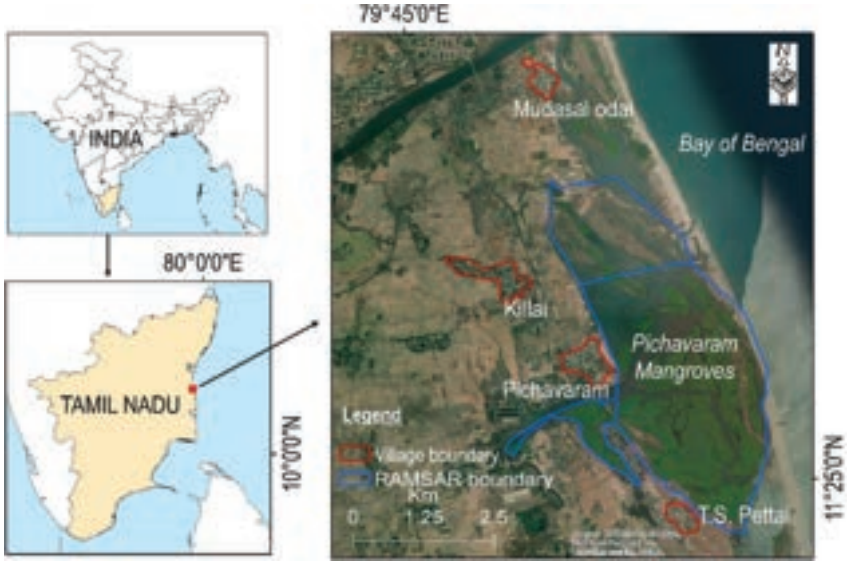


Fig. 132. Map representing the study area along the Pichavaram region

Funding Support: Institutional, ICAR-NBFGR

Climate-change induced vulnerability assessment

Pichavaram region

A detailed stakeholder-based survey was conducted in 4 selected villages surrounding Pichavaram mangrove wetlands, namely Mudasalodai, Killai, Pichavaram, and Thandavarayan Sozhan Pettai (T.S. Pettai) in Cuddalore District, Tamil Nadu, India (Fig. 132). The questionnaire was prepared to capture the holistic perspectives of the climate change–induced vulnerability of the fishers, including a total of 22 vulnerability indicators under 7 categories, *viz*. health (3), subsistence (3), community (4), nutritional security (3), ecology (2), resources (4), and its users (3). Apart from these, the personal details of the interviewee and general habitat and fisheries information about the wetland were also collected. A total of 240 stakeholders (190 men and 50 women) were interviewed.

The vulnerabilities faced by the fishers of the Pichavaram region in various aspects were ranked based on the socio-economic survey records. The results revealed a considerably high vulnerability in various criteria, which necessitate emphasizing mitigation and adoption strategies to bring change in fishers' livelihood. Vulnerability related to climate change and health serves as a baseline for predicting disease risks and helps to monitor and nullify the measures. Furthermore, the migration of fishers from fishing due to low income may be avoided by diversifying the income sources through creating alternative livelihood options.

The following mitigation measures were suggested to lessen the impact of climate change in the region:

- Better healthcare facilities including timely medical attention and medications

- Supply and demonstration of life-saving appliances.
- Providing skill development training on various alternative livelihood opportunities including ornamental fish culture, seaweed cultivation, and crab fattening will mitigate subsistence vulnerability.
- Better social networking scenarios and developing more socializing units may reduce the social vulnerabilities faced by fishers
- Awareness about healthy diets, government schemes, and health insurance schemes
- Promoting sustainable aquaculture with recent technologies and bio-security measures
- Promoting ecotourism to supports the livelihood of the native community
- Funding research schemes for devising sustainable management plans and strategies
- The usage of a more sustainable gear will reduce bycatch and overfishing; Reduction in CPUE can be mitigated by deploying artificial reefs along the coastal area and fish aggregating devices.
- Ranching of threatened and vulnerable commercial fish species may be initiated for natural stock enhancement

Fig. 133. Glimpses of stakeholder perception surveys in Sundarban region

Fig. 134. Fishes recorded during the field surveys in Sundarban region

To ascertain the perception of the respondents on climate change in the Pichavaram region, the climatic variables data, *viz.* rainfall (mm), temperature-max (°C), and temperature-min (°C), were extracted for the period 1951–2021 (71 years) from the Indian Meteorological Department (IMD) for the trend analysis. The analyses revealed an insignificant increase in the annual rainfall, while a statistically significant increasing trend ($p < 0.05$) was observed for both mean annual T_{max} and T_{min} in the Pichavaram region.

Sundarban region

During the reporting period, the stakeholder perception survey was conducted in June and September, 2024 in the Sundarban region covering villages of Gosaba, Basanti, Namkhana, Sagar blocks.

A total of 180 stakeholders were interviewed via random sampling (Fig. 133). The information regarding aquatic genetic resources, fishing, aquaculture, influence of natural calamities on aquatic ecosystems and livelihood, threats and mitigation measures and gender role in mitigating the climate change were collected during the surveys. The data entry and detailed analysis is in progress.

The fish diversity data were collected from the rivers, estuarine and coastal habitats in the Sundarban region from multiple places including Jharkhali, Bakkhali, Sagar Island, Nischintapur, Namkhana and Fraserganj. The occurrence and richness data were collected through experimental fishing and market surveys. The preliminary assessment revealed the occurrence of 64 fish species (Fig. 134) under 23 families in the sampling locations.

Project

Exploring potential of traditional knowledge associated with aquatic genetic resources for access and benefit sharing under Nagoya protocol and BBNJ for food and agriculture for sustainable empowerment and conservation

Period: April, 2023 - March, 2025

Personnel: Poonam Jayant Singh (PI) Ajey Kumar Pathak, A. Kathirvelpandian and Ravi Kumar

Funding Support: Institutional, ICAR-NBFGR

Access and Benefit Sharing (ABS) for aquatic genetic resources

The Genetic Resources and Associated Traditional Knowledge (GRATK) Treaty represents bridging the divide addressing IP and biodiversity, thereby, balancing biodiversity poor, developed countries and biodiversity rich developing countries, ensuring disclosure of origin along with access and benefit sharing (ABS). The ABS was recognized by CBD and Nagoya Protocol, but was not a part of TRIPS. Another agreement which brought traditional knowledge (TK) associated with genetic resources and indigenous communities into foray is the United Nations Convention on the Law of the Sea (UNCLOS) for the conservation and sustainable use of marine biological diversity for areas covered in Biodiversity Beyond National Jurisdiction (BBNJ) agreement. TRIPS neglects community rights, while CBD and Nagoya Protocol only explicitly recognizes TK for benefit-sharing agreements, but its scope is limited to territorial jurisdiction

Incorporating digital data governance issues in AqGRISI

The BBNJ agreement introduces provisions to address digital databases and repositories for genetic resources and associated data, including Digital Sequence Information (DSI) through Articles 12(6) and 12(7). Article 14 ensures that marine genetic resources (MGRs) and DSI on MGRs of areas beyond national jurisdiction, together with 'BBNJ' standardized batch identifiers, are publicly accessible in repositories and databases through digital tools as blockchain or certificate of origin for DSI tracking. This provides impetus to already existing database AqGRISI, which will be attuned to integrate information from digital sequences from proteome and genomic sequences from MGRs and associated TK from BBNJ. AqGRISI already has information on patents, and the scope will be extended to store and manage information on MGRs, including patents, protein sequences and genomic information along with associated TK of indigenous community to be a future ready repository of information that will ensure safeguarding for equitable benefit sharing.

Issues related to aquatic genetic resources in EEZ and BBNJ

The MGRs within Exclusive Economic Zones (EEZs) present a complex governance issues for India, with zone spanning over 2.3 million square kilometres. The UNCLOS grants sovereign rights

Fig. 135. Plastic pollution in Rameshwaram

over resources within the EEZ, jurisdictional ambiguities arise when marine organisms migrate between EEZs and the high seas, complicating ownership and benefit-sharing arrangements. India's EEZ remains underexplored, with insufficient mapping hindering the identification and sustainable use of genetic resources. Neighboring countries, *viz*. Pakistan, Maldives, Sri Lanka, Bangladesh, Myanmar, Thailand and Indonesia, share transboundary ecosystems potentially leading to disputes over resource access. The aquatic genetic resources under BBNJ present unique challenges for biodiversity conservation due to their status as global commons. Clearing House Mechanism (CHM) of BBNJ will promote transparency, facilitate equitable ABS, and foster capacity building for developing nations. By integrating regional cooperation and fair governance, the BBNJ framework can help to address the gaps in conserving marine biodiversity in areas beyond national jurisdiction.

Exploring marine conservation through traditional knowledge and community ecotourism

Field visit of Rameshwaram was undertaken to explore the environmental challenges impacting MGRs within the EEZ and assess their implications for BBNJ conservation frameworks. Rameshwaram's proximity to Krusadai Island, a biodiversity hotspot, and its rich marine ecosystems made it an ideal site for studying transboundary ecological challenges and opportunities for sustainable development. Though Krusadai, one of the 21 islands, started ecotourism with community participation, plastic could be found along the coastline (Fig. 135) that negatively affects marine habitats including coral refs.

Fig. 136. Handmade raft for shell harvesting flappers made of Aluminium plates

Interactions with fishermen, local environmental activists, and representatives of community-based organizations was carried out. These interactions revealed the community's deep knowledge of marine ecosystems and their aspirations for economic growth through sustainable tourism and fisheries. The potentials of leveraging international frameworks like, BBNJ, and local initiatives to strengthen conservation efforts was also discussed.

During field visit to Rameshwaram, local adoption of frugal innovations to address challenges in marine resource utilization and conservation was observed. An innovator from Olakudda village was identified, who crafted handmade raft from local material and flappers for feet out of

aluminium plates (Fig. 136) for shell harvesting. This simple yet effective design allowed shell harvesters to identify and collect shells selectively, minimizing habitat disruption.

Policy briefs

Policy briefs was drafted on issues and challenges associated with governance and protection of biodiversity in Areas Within National Jurisdiction (AWNJ) and Areas Beyond National Jurisdiction (ABNJ), bioprospecting, biopiracy, DSI, patenting and disclosure of origin of biological resources ABS from BBNJ.

Project

Impact assessment of the technological interventions of ICAR-NBFGR in livelihood development and achieving the SDG goals

Period: April, 2023 March, 2025

Coordinator: U.K. Sarkar

Personnel:

Headquarters: L. K. Tyagi (PI), Sharad Kumar Singh, Poonam Jayant Singh, Raghavendra Singh; Anutosh Paria, Aditya Kumar, Monika Gupta, Tarachand Kumawat and K.K. Singh

PAGR Centre, Kochi: A. Kathirvelpandian (PI), T.T. Ajith Kumar, V.S. Basheer, Charan Ravi and Rekha M.U.

Funding Support: Institutional, ICAR-NBFGR

Capacity development activities were undertaken by technical support through imparting focused training / awareness programs, technological demonstrations, support through provision of technological infrastructure facilities and supply of required inputs, through various schemes/ components of the institute.

Major capacity building and outreach programs organized

State/ locality	Major Activities	No. of participants
Uttar Pradesh (Renukoot, Sonbhadra, Barabanki, Sitapur, Varanasi Districts)	• Input distribution-cum-awareness program organized on National Fish Farmers Day at Lucknow	50 SC farmers
	• Capacity building-cum-awareness program on 'Improved aquaculture for fish conservation and livelihood development' at KVK, Kallipur, Varanasi	50 SC farmers
	• Awareness program on fish farming, fish health testing, and reducing antimicrobial resistance in aquaculture in the Sonbhadra district of Vindhya region for Scheduled Tribes of Renukoot at Kataundhi village	50 ST farmers
	• Skill development training program on ornamental fish resources for livelihood and income generation for women Self Help Group (SHG) members and farmers conducted at KVK Sitapur, Uttar Pradesh, under Mission Navshakti 2.0 of Scheduled Caste Sub Plan	66 SC SHG women
	• Program for establishing market linkage and sustainable aqua-entrepreneurship organized in Dhankutti Village, Barabanki, UP for empowering rural SC women to manage ornamental fish rearing enterprises through skill development.	50 SC SHG women
	• Skill and entrepreneurship development program at Krishi Vigyan Kendra, Katia, Sitapur.	25 SC SHG women
	• Input distribution and entrepreneurship development program to build sustainable supply chain and empower women entrepreneurs in the ornamental fish sector at Krishi Vigyan Kendra, Katia, Sitapur.	50 SC women and fish farmers
	• Training programme on conservation of ornamental fish genetic resources and their sustainable utilization for livelihood.	31 fish farmers

	• Impact of the interventions undertaken for socio-economic upliftment of selected tribal farmers in Sonbhadra district of Uttar Pradesh during previous years was assessed for two years (2023-24 and 2024-25).	10 tribal farmers
West Bengal	• A two-day skill development training-cum-demonstration and input distribution program for community empowerment of fish farmers organized on 'Breeding techniques of fishes for conservation and livelihood development' and an input distribution program in collaboration with Dhaanyaganga KVK, Sargachhi	70 SC farmers
	• A stakeholder meet-cum-awareness program for livelihood support of fish farmers organized at Gangasagar	100 fish farmers
	• A two-day stakeholder meet-cum-awareness program for community empowerment through sensitization, capacity development, and technology demonstrations organized at Kalyani	Over 150 participants
	• Capacity building and fisheries input benefit distribution programme by ICAR-NBFGR: Empowering Marginal Fish Farmers in Sundarbans at Kultali.	50 farmers
	• Capacity development, technology demonstration and fisheries input distribution program at Sonarpur	50 farmers
NE Region (Umiam, Meghalaya; Guwahati, Assam; Gangtok & Mangan, Sikkim; Durganagar, Tripura)	• An Awareness-cum-input distribution program for livelihood enhancement of fisherfolk organized at ICAR Research Complex for NEH Region, Umiam, Shillong.	30 fish farmers
	• Capacity development and fishery inputs distribution program for livelihood improvement of fish farmers in Sikkim.	50 fish farmers
	• Capacity building program for fish farmers at Gauhati University.	40 fish farmers
	• Awareness cum input distribution program to enhance livelihood of fisherfolk through demonstration of conservation aquaculture in Gangtok, Sikkim	60 fish farmers
	• Field day on Awareness cum Demonstration of diversified aquaculture for livelihood improvement at Durganagar village, West Tripura	85 fish farmers
	• One day awareness cum input distribution program to enhance livelihood of fisherfolk through demonstration of conservation aquaculture in Mangan, Sikkim	60 fish farmers
Jharkhand (Ranchi)	• Awareness-cum-input distribution program was organized for community empowerment through sensitization, technology demonstration and capacity development of fish farmers at Ranchi, Jharkhand	100 Tribal farmers
Tamil Nadu	• Marine Ornamental Fish Rearing RAS (MORR) facility was established at St. Devasahayam Institute of Fisheries Science & Technology, Kilkulam, Kanyakumari, for cultivation of clownfish, and to train the fisherwomen of the region for livelihood development and creation of awareness among the students	100 students and fisherwomen

Impact of the interventions undertaken for tribal farmers in Sonbhadra district of Uttar Pradesh

S.N.	Name	Village	Ornamental fishes provided (2022-23)	Achievements in 18 months		
				No. of ornamental fishes sold	No. of ornamental fishes in stock	Revenue (Rs.)
1.	Mrs. Poonam Devi	Katauli	Black molly, White molly, Golden guppy (45-50 nos.)	10,000 @ Rs 5	1000	55,000
2.	Mrs. Phoolmati	Tooradeeh	Black molly, White molly, Koi carp, Goldfish (45-50 nos.)	1600 @ Rs 10	4000	56,000
3.	Mrs. Rajmati	Tooradeeh	Black molly, White molly, Koi carp, Goldfish (45-50 nos.)	1600 @ Rs 10	3900	55,000
4.	Km. Arti	Tooradeeh	Black molly, Koi carp, Goldfish (45-50 nos.)	240 @ Rs 5	--	1200
5.	Mr. Shiv Sharan	Kataundhi	Black molly, Koi carp, Goldfish (45-50 nos.)	8000 @ Rs 5	1100	45,500
6.	Mrs. Lakhpatiya Devi	Kataundhi	Black molly, Koi carp, Goldfish (45-50 nos.)	4500 @ Rs 8	400	39,200
7.	Phoolwati	Kataundhi	White molly, Black molly (45-50 nos.).	2600 @ Rs 5	--	13,000
8.	Mr. Shiv Narain	Kataundhi	Black molly, Koi carp, Goldfish (45-50 nos.)	160 @ Rs 5	--	800
9.	Mrs. Sunita Devi	Mahuriya	Black molly, Koi carp (45-50 nos.)	200 @ Rs 5	--	1000

Project:

Atlas of freshwater bony fish otolith of Uttar Pradesh, India

Period: May, 2024 – May, 2026

Personnel: Farah Bano (PI)

Mentor: Uttam Kumar Sarkar

Funding Support: DST-SERB-National Post-Doctoral fellowship (N-PDF)

Collection of fishes and otolith characterization

A total 100 freshwater fish species were collected from river Ganga and its tributaries at Uttar Pradesh region (Lucknow, Raebareli,

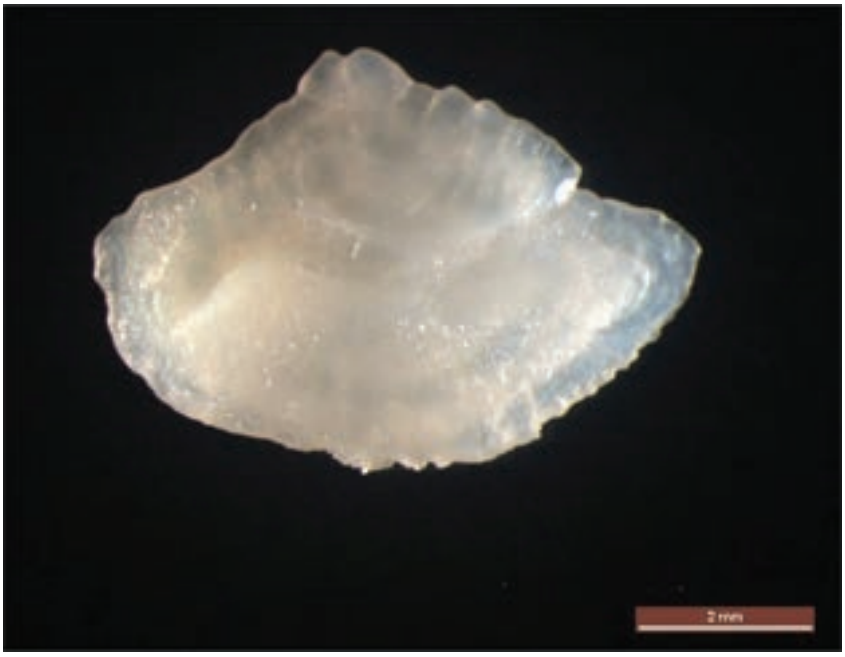


Fig 137. Image of *Channa punctata* otolith

Fig. 138. Indigenous fishes recorded during the field sampling in Ken river

Kanpur, Prayagraj, Ghazipur, Gorakhpur, Meerut and Aligarh). The otoliths were extracted and photographs taken (Fig. 137). The crystallization in few abnormal otoliths was studied. The otolith and sulcus shape were species-specific in fishes of river Ganga, but the margins may fluctuate from smooth, sinuate, crenate and dentate. In the study abnormal otoliths were reported for the first time in a specimen of *Rhinomugil corsula* and *Trichogaster bejeus* collected from the Ganga and Gomti rivers. The crystalline appearance was found on distal surfaces of otolith in one specimen of *Channa marulius* and *Sperata seenghala* collected from river Ganga at Kanpur region. Asymmetry was found in otolith weight and length in *Rhinomugil corsula* (5 out of 43), *Notopterus notopterus* (7 out of 73).

Project

Assessment of climate change impact in the waterbodies of Uttar Pradesh and developing climate resilient strategies for sustainable fisheries management

Period: January, 2024 - January, 2027

Personnel: Kantharajan G. (PI), Lalit Kumar Tyagi, Ajey Kumar Pathak, Santosh Kumar, Rejani Chandran and Tarachand Kumawat

Funding Support: Council of Science & Technology, U. P

This project is aimed at ascertaining the spatio-temporal variation in fish diversity of the rivers and wetlands in Uttar Pradesh, assess the vulnerability of the selected riverine fishes and aquatic ecosystem to develop climate resilient adaptation models for sustainable fisheries and biodiversity conservation.

Exploratory surveys

Multiple seasonal field surveys were conducted in selected sites in Uttar Pradesh to collect habitat and fish diversity data on the Ganga, Ghaghra, Yamuna, Betwa, and Ken rivers (Fig. 138). The primary survey and compiled information from published literature revealed that over 170 species were reported from freshwater ecosystems in Uttar Pradesh. Cypriniformes dominated the species richness, followed by Siluriformes (Fig. 139). Highest fish diversity was recorded in Ganga (>125 species) followed by Yamuna (>95) and Sone (>75)

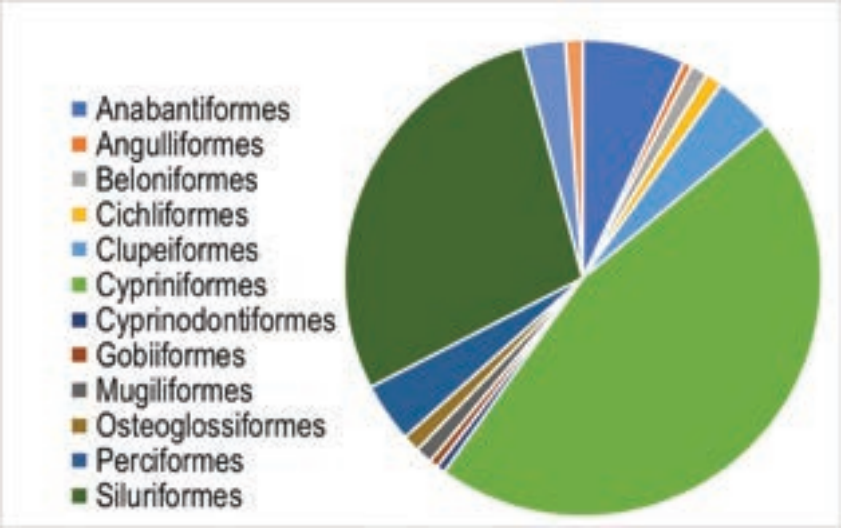


Fig. 139. Order-wise composition of fish species recorded from Uttar Pradesh

rivers. Among wetlands, fish species were recorded in Surha taal (>75 Species), followed by Bakhira wetland (>60 species) and Alwara wetland (>60 species). During primary field survey, a total of 40 fish species were reported from surveyed sites. The well-being of seven small indigenous fishes (n=400) in rivers of Uttar Pradesh was assessed using the length-weight relationship and condition factor analysis.

Climatic variables in Bundelkhand region

The temporal trend of climatic variables recorded for the Bundelkhand region was extracted from IMD for the last 50 years (1974-2023). A significant increasing trend was observed for the annual atmospheric mean temperature-minimum, while non-significant changes in annual rainfall and mean atmospheric temperature-maximum were evident.

Deep pools are perennial habitats in riverine systems that sustain rich fish diversity in water-scarce conditions by offering critical spawning and refuge habitats. The mapping of deep pools in the Yamuna, Ken, Betwa and Dhasan rivers of the Bundelkhand region are under progress.

High and low water temperature was recorded in Yamuna (34.6˚C) and Betwa (30.5˚C) rivers, respectively. Lowest DO was reported at 3.1 mg/l in Betwa river, revealing unsuitable conditions for the propagation of fish species (Fig. 140). Highest ammonia concentration (2.7 mg/l) was recorded in present study from Ken river at Bhuragarh.

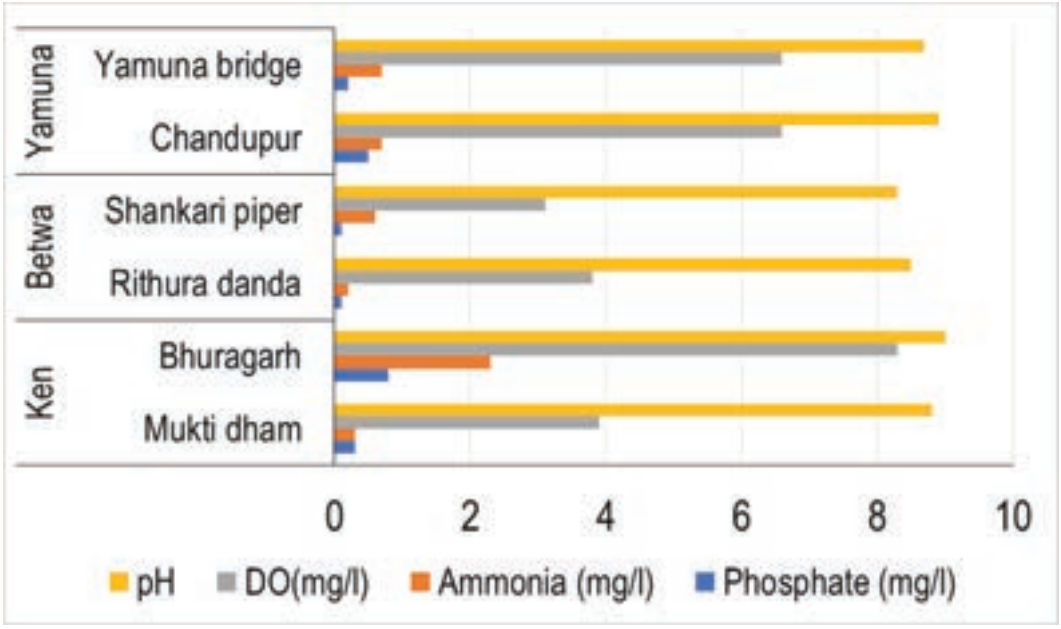


Fig. 140. Water quality and nutrient parameters recorded at various sites of the rivers

Evaluation of Fish Genetic Resources, Exotics and Health Management

Saprolegniosis in *Pangasianodon hypophthalmus*

Global movement of live fish has facilitated the transmission of exotic pathogens to new regions, leading to significant morbidity and mortality in both known hosts and newly susceptible native species. ICAR-NBFGR possesses strong expertise in this domain and actively tackles the issue through robust surveillance strategies and timely disease reporting. To mitigate outbreaks, the institute employs multidimensional approaches, including the development of rapid diagnostic tools, therapeutic and prophylactic measures against major aquatic diseases, understanding host-pathogen interaction, and developing measures for sero-surveillance. Furthermore, antimicrobial resistance (AMR) remains a pressing global health concern, and the institute is conducting programs to assess aquaculture's role in this phenomenon, as well as the potential risks posed by AMR in the context of climate change.

Project:

National surveillance programme for aquatic animal diseases (NSPAAD) - Phase II

Period: June, 2022 – March, 2026

Coordinator: J. K. Jena, Deputy Director General (Fisheries Science)

Co-coordinator: Uttam Kumar Sarkar

Personnel: Neeraj Sood (PI), Pravata Kumar Pradhan, Anutosh Paria, Chandra Bhushan Kumar, Arun Sudhagar S. and Gaurav Rathore

Funding Support: PMMSY, Government of India

The Phase II of National Surveillance Programme for Aquatic Animal Diseases (NSPAAD) funded under Pradhan Mantri Matsya Sampada Yojana (PMMSY) by Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Govt. of India, is being implemented pan-India and coordinated by ICAR-National Bureau of Fish Genetic Resources, Lucknow.

Popularization of 'ReportFishDisease' app

For strengthening of farmer-based reporting of diseases, the ICAR-NBFGR has developed an android-based app, named as 'ReportFishDisease'. Using the app, the farmers can report incidence of disease in finfish, shrimps and molluscs on their farms with the field-level officers and fish health experts and get scientific advice for quickly addressing the disease problems on their farms. During this period, efforts were made to popularize the app for reporting disease cases affecting finfish, shrimp, and molluscs by conducting awareness programmes in Barapani, Meghalaya; Srinagar, J&K; Suri, Bolpur, Darjeeling and Mirikh, West Bengal; Ranchi and Deoghar, Jharkhand; Gangtok, Sikkim; and Agartala, Tripura. Farmers are using the app to report disease cases and management measures are suggested based on the presumptive diagnosis, wherever possible. The iOS version as well as desktop version of the app for State Fisheries Departments/ NSPAAD Collaborating Centres and Coordinating Institute have been developed. In addition, a new website of the NSPAAD has been developed and hosted on ICAR-NBFGR website.

First report of new disease

During the reporting period, new diseases, namely Infection with *Macrobrachium rosenbergii* golda virus (*Mr*GV), Bacillary necrosis of pangasius (BNP) and Infection with koi herpesvirus (KHV), were reported for the first time in the country. *Mr*GV was detected by ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar, in two hatcheries of freshwater prawn larval samples exhibiting moralities from Puri district in Odisha, whereas BNP, caused by *Edwardsiella ictaluri*, was detected in pangasius from Varanasi, Uttar Pradesh by ICAR-NBFGR, Lucknow. Besides, KHV in koi carps was reported by College of Fisheries, Mangalore. All pathogens were confirmed through validation in two National laboratories and compiled reports were submitted to the Competent Authority, i.e. Department of Fisheries, Govt. of India.

Development of positive controls

Positive controls were developed for Lymphocystis virus, Wenzhou shrimp virus 8, *Macrobrachium rosenbergii* golda virus, Salmonid alphavirus (Fig. 141) and Candidatus *Hepatobacter penaei*. Besides, the positive controls were provided to NSPAAD Collaborating Centres, *viz*. ICAR-CIFE; ICAR-CIBA; FCRI, Thoothukoodi; ICAR-CIARI; CoF, Agartala.

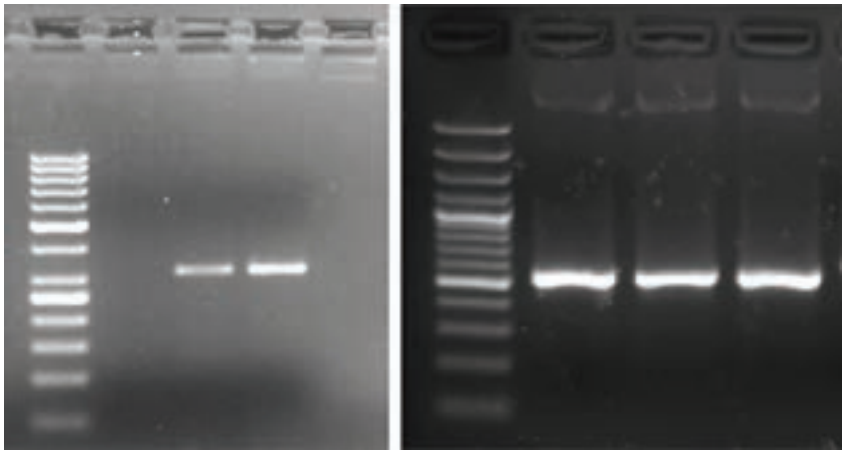


Fig. 141. Positive controls of *Macrobrachium rosenbergii* golda virus and Salmonid alphavirus

Submission of QAAD reports

The QAAD reports for the period Oct. - Dec. 2023, Jan. - Mar. 2024, Apr. - Jun. 2024 and July - Sept. 2024 were compiled based on the reports of the Collaborating Centres and submitted to the Department of Fisheries, Govt. of India.

Testing of samples for WOAH-listed pathogens

A total of 14 samples (Fig. 142) were received from Animal Quarantine & Certification Services (AQCS), Department of Animal Husbandry and Dairying, Govt. of India, for testing of different pathogens of finfish, shrimps and molluscs. The samples were tested and reports submitted to AQCS.

NABL accreditation

Aquatic Animal Health laboratory of the EAAH Division received NABL accreditation for 25 WOAH/NACA-listed and emerging pathogens affecting finfish and shellfish (Fig. 143).

e-Governance award

ICAR-NBFGR, Lucknow, received National Award for

National Accreditation Board for Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

AQUATIC ANIMAL HEALTH LABORATORY, ICAR-NATIONAL BUREAU OF FISH GENETIC RESOURCES

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

CANAL RING ROAD, P.O. DILKUSHA, LUCKNOW, UTTAR PRADESH, INDIA

in the field of

TESTING

Certificate Number: TC-15085

Issue Date: 11/12/2024 Valid Until: 10/12/2028

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.

(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Entity: ICAR-NATIONAL BUREAU OF FISH GENETIC RESOURCES

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

Fig. 143. NABL accreditation certificate

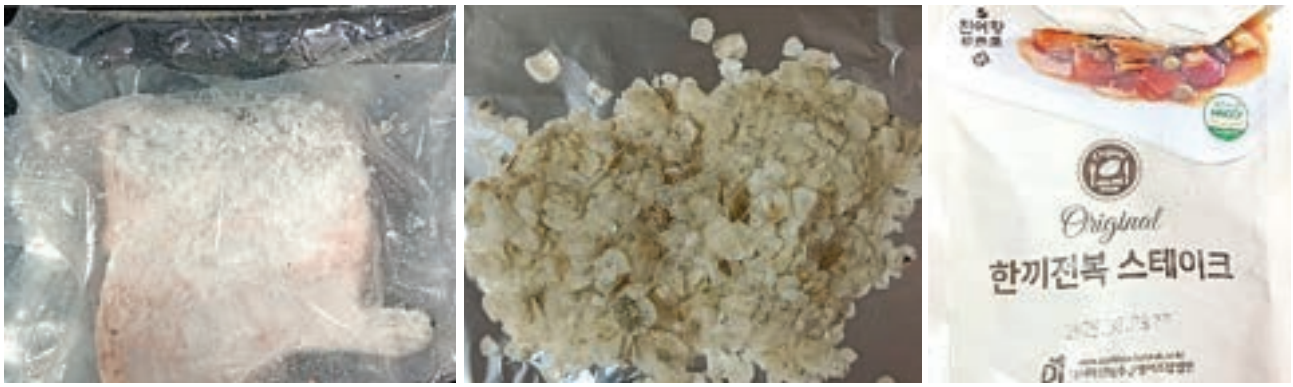


Fig. 142. Types of samples for testing WOAH-listed pathogens

Fig. 144. e-Governance award for NSPAAD

e-governance 2024 (Silver) for National Surveillance Programme for Aquatic Animal Diseases (NSPAAD) - Establishment of e-Governance in aquatic animal disease management system under category IV (Research on Citizen Centric Services by Academic/Research Institutions) by Department of Administrative Reforms and Public Grievances, Government of India (Fig. 144). The silver award carries a value of Rs. 5.0 lakhs and a certificate. The award was presented on September 3, 2024 during 27th National Conference on e-Governance held at Jio Convention Centre, Mumbai, Maharashtra. Hon'ble Chief Minister of Maharashtra, Sh. Eknath Shinde and Hon'ble Deputy Chief Minister of Maharashtra, Sh. Devendra Fadnavis, graced the occasion and presented the award.

Sub-Project

NSPAAD - Phase II: Surveillance of freshwater fish and shellfish diseases in Uttar Pradesh

Period: June, 2022 – March, 2026

Personnel: Pravata Kumar Pradhan (PI), Chandra Bhushan Kumar, Gaurav Rathore and Neeraj Sood

Funding Support: PMMSY, Government of India

Under passive disease surveillance, a total of 41 disease cases were reported in Indian Major Carps, pangasius and pacu from different districts of Uttar Pradesh, which included 10 disease cases from Lucknow, 6 each from Barabanki and Siddharthnagar, 4 from Azamgarh, 2 each from Varanasi and Chandauli, 1 each from Kanpur, Maharajganj, Balrampur, Pratapgarh, Kushinagar, Sonbhadra, Bareilly, Baghpat, Banda, Mahoba and Jaunpur.

Investigation of these disease cases indicated that 5 cases were of Saprolegniosis, 1 of Infection with *Aphanomyces invadans*, 5 of Lernaeosis sp., 4 of Argulosis sp., 2 of Dactylogyrosis, 1 of Motile aeromonas septicemia and 1 of Bacillary necrosis of pangasius due to *Edwardsiella ictaluri*, whereas 18 cases were suspected to be due to bacterial infection and 4 due to poor water quality. Furthermore, the active surveillance for *Saprolegnia parasitica* was carried out in 39 pangas farms in Azamgarh and 29 farms in Siddharthnagar districts respectively, in which 20 (51.28%) farms in Azamgarh and 8 (27.58%) farms in Siddharthnagar were found positive for *S. parasitica* (Fig. 145).

Fig. 145. Mortality of pangas and pacu due to *Saprolegnia parasitica* infection

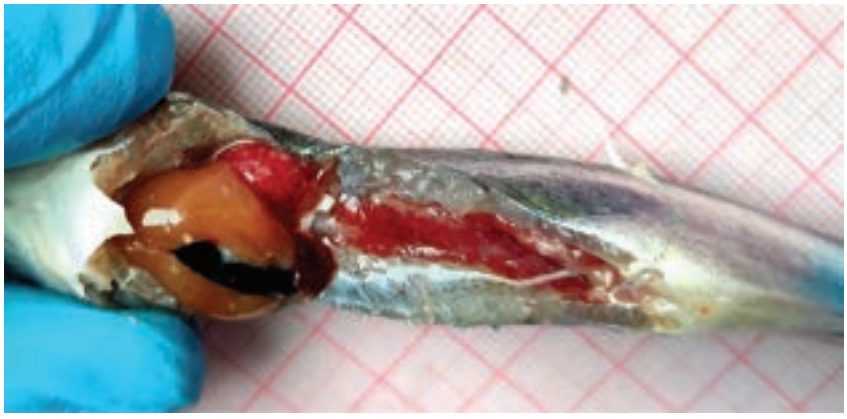


Fig. 146. Bacillary necrosis of pangasius

Importantly, one of the farmers from Chandauli district of Uttar Pradesh, India, reported large scale mortality of pangasius in his farm. As a follow-up, NSPAAD team of ICAR-NBFGR investigated the case and diagnosed the causative agent as *E. ictaluri*, based on isolation, histopathology, molecular identification and bioassay (Fig. 146). It was the first detection of *E. ictaluri* from India. Since, *E. ictaluri* was detected in pangasius farms of Chandauli districts; hence, active surveillance was carried out in nearby pangasius farms (n=10) of Varanasi and Chandauli. All the farms were found to be negative for *E. ictaluri*.

Three awareness programmes were organized for fish farmers in Azamgarh, Siddharthnagar and Barabanki districts of Uttar Pradesh, where 230 farmers participated (Fig. 147). The farmers were made aware on oomycete diseases, their management, and about the use of "ReportFishDisease" app for reporting diseases from their farms.

Fig. 147. Glimpses of the awareness programmes

Sub-Project:

NSPAAD - Phase II: Surveillance of freshwater fish diseases in Kerala

Period: April, 2022 - March, 2025

Personnel: V.S. Basheer (PI) and Arun Sudhagar S.

Funding Agency: PMMSY, Government of India

An extensive disease surveillance of food and ornamental fishes was conducted in Kerala. During the reporting period, 52 samples were collected using both active and passive methods. A total of 616 fish specimens, belonging to cyprinids, cichlids, characids, murrels, livebearers, etc., were sampled for disease diagnosis. The PCR-based diagnostics were used to detect emerging pathogens, such as Carp edema virus (CEV), Cyprinid herpes virus-2 (CyHV-2), Infectious spleen and kidney necrosis virus (ISKNV), Koi herpesvirus (KHV), Red seabream iridovirus (RSIV), Spring viremia of carp virus (SVCV), Tilapia lake virus (TiLV), Tilapia parvovirus (TiPV), Viral nervous necrosis (VNN), and *Mycobacterium* sp. Furthermore, routine bacteriological and parasitological examinations were also carried out.

A small number of ornamental fishes, including blue morphs, GloFish tetras and angelfish, were tested positive for ISKNV. Additionally, red snapper sampled from the Thrissur District of Kerala coast was tested positive for VNN (Fig. 148). However, no cases of SVCV, CyHV-2, CEV, KHV, or RSIV were detected. Parasites such as *Centrocestus*

Fig. 148. Red snapper infected with viral nervous necrosis (VNN), exhibiting severe skin ulcers and exophthalmia with opaque eyes

Fig. 149. Oscar fish brooder exhibiting clinical signs of hole-in-the-head disease

sp. (metacercariae), *Lernaea* sp., *Chilodonella* sp., *Piscinoodinium* sp., *Oodinium* sp., and *Tricodina* sp. were detected in sampled fishes. Notably, a severe case of hole-in-the-head disease was observed in brooders of oscar fish (Fig. 149). Some of the important bacterial species identified in the samples were *Mycobacterium* sp., *Elizebethkinga* sp., *Acinetobacter baumannii, Chryseobacterium* sp., *Microbacterium paraoxydans, Shewanella algae, Enterococcus faecalis, Aeromonas* spp., *Klebsiella* sp., *Lactococcus garvieae, Vibrio parahaemolyticus* and *Vibrio harveyi.* Antibiotic sensitivity testing (AST) was performed to gauge the susceptibility of these bacterial strains to antibiotics.

An outbreak of Lactococcosis, caused by *Lactococcus garvieae* in oscar fish farm in Ernakulam District, Kerala, was comprehensively studied. Affected fish exhibited clinical signs such as irregular swimming, lethargy, ocular lesions, and has a cumulative mortality rate of 80%. Gross pathological findings included clinical signs such as haemorrhages in the skin and fin, pale gills, and swollen kidney. The bacteria were isolated from the kidney and identified using 16S rDNA sequencing and biochemical tests. Virulence genes, including *haemolysin* (1, 2, 3), *NADH oxidase*, *adhesin pav*, *adhesin cluster 1*, and *capsule*, were detected, along with evidence of antimicrobial resistance. Among the 35 antibiotics tested, only gentamicin, ampicillin, and cefixime proved effective. A challenge study (LD50: 7.4×10^8 CFU/mL) confirmed Koch's postulates. This highlights the significant threat posed by *L. garvieae* to oscar fish farming, emphasizing its association with high mortality rates, virulence factors, antimicrobial resistance and host-pathogen interactions during the infection.

Additionally, a detailed investigation was conducted for the outbreak of *Chryseobacterium* sp. in clinically infected goldfish (*Carassius auratus*) from a fish farm in Calicut district, Kerala. The bacterial colonies were isolated from the kidneys of infected goldfish. A total of 28 antibiotics from different classes were tested to determine the antibiotic resistance pattern. Of these, 25 antibiotics showed resistance, while vancomycin, cotrimoxazole, and cefoxitin were highly susceptible. Amplification and sequence analysis of the 16S rDNA identified the microorganism as *Chryseobacterium* sp. The pathogenicity of this bacterial pathogen was experimentally confirmed in goldfish by a challenge experiment. Histopathological analysis of the infected fish revealed necrosis and degenerative changes in kidney and spleen. This underscores the virulence of *Chryseobacterium* sp. as a significant opportunistic pathogen in goldfish, thus, highlighting the need for vigilant monitoring and intervention strategies to prevent outbreaks.

Two awareness-cum-interaction meetings on 'ReportFishDisease' app were conducted in May, 2024, in Ernakulam and Kozhikode districts of Kerala, benefiting a total of 113 farmers and Sagar Mitras. Participants gained practical experience and proficiency in using the app, empowering them to actively contribute to disease surveillance efforts in aquaculture and fisheries sectors. Additionally, a training program on 'Fish Disease Management' was organized in January, 2024. The program was attended by 15 officials from Fisheries Department, Kerala, who were sensitized on key aspects of aquaculture, disease management, surveillance, and reporting of diseases using the app.

Project:

All India network project on antimicrobial resistance (AMR) in fisheries and livestock

Period: April, 2024 – March, 2026

Personnel: Gaurav Rathore (PI), Chandra Bhushan Kumar, Anutosh Paria and Vikash Sahu

Funding Support: Institutional, ICAR-NBFGR

Antimicrobial resistance (AMR) is a growing global public health concern, emerging when microorganisms, such as bacteria, fungi, viruses, or parasites, become resistant to drugs that once effectively targeted them. This resistance undermines treatment efforts, making infections harder to control. Thus, assessing the prevalence of AMR in fisheries and aquaculture is crucial for safeguarding both aquatic life and human health.

Collection of fish samples from fish farms

A total of 50 specimens from freshwater fish farms of Sitapur district of Uttar Pradesh were sampled during April – December, 2024 for isolation of *E. coli, Aeromonas* spp., and *Staphylococcus* spp. (Table 10).

Table 10. Details of freshwater fish farms where samples were collected

Fish species/ specimen	Number of farms/ samples	*E. coli*	*S. aureus*	CONS	*Aeromonas* spp.
Sitapur					
cca	3	3	0	3	3
ccr	0	0	0	0	0
cid	3	3	0	3	2
cmr	9	9	0	9	8
hmo	6	5	0	6	4
lro	2	2	0	1	2
phy	1	1	0	1	1
oni	1	1	0	1	1
cpw	23	22	0	21	20
ppw	1	1	0	1	1
tpw	1	1	0	1	1
Grand Total	50	40	0	47	43

cca: *Catla catla*; ccr: *C. carpio*; cid: *C. idella*; cmr: *C. mrigala*; hmo: *H. molitrix*; lro: *Labeo rohita*; oni: *Oreochromis niloticus*; phy: *P. hypophthalmus*; cpw: carp pond water; ppw: pangasius pond water; tpw: tilapia pond water

Collection of fish samples from fish cages

A total of 70 specimens from the freshwater fish cages of Hazaribagh district of Jharkhand were sampled during April – December, 2024 for isolation of *E. coli, Aeromonas* spp., and *Staphylococcus* spp. (Table 11).

Isolation, identification and antimicrobial susceptibility testing

A total of 346 isolates, comprising of 113 of *Aeromonas* spp., 116 *E. coli*, 90 Coagulase negative *Staphylococcus* (CONS) and 27 *S. aureus,* were recovered from the samples. The isolates were phenotypically identified and stored at -80^{o}C as a glycerol stock. Antimicrobial susceptibility testing (AST) was done by disc diffusion method following CLSI breakpoints and data was analysed by WHONET software.

Antimicrobial resistance profile of *E. coli*

A total of 110 isolates of *E. coli* were analysed for AMR against 15 listed antibiotics. Out of these, highest resistance of 16.4% was seen against ampicillin. Comparative AMR in *E. coli* isolated from freshwater fish (n=53) and pond water (n=57) against β lactam and non-β lactam class of antimicrobials is shown in Figs. 150a, b.

AMR profile of coagulase negative *Staphylococcus* (CONS)

A total of 90 isolates of coagulase negative *Staphylococcus* species

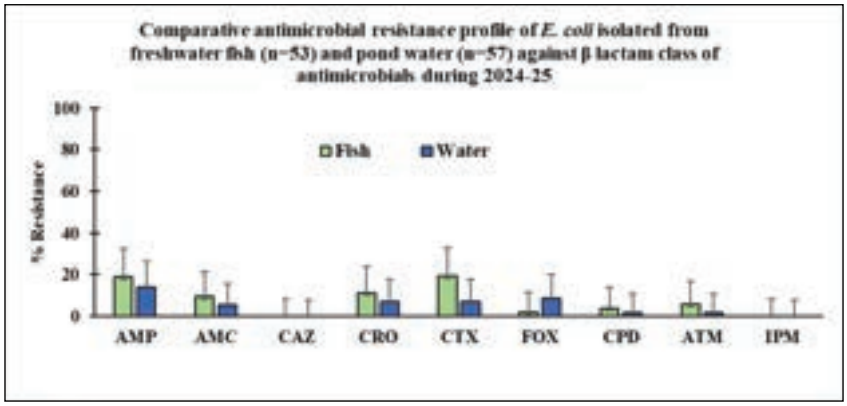


Fig. 150a. Comparative antimicrobial resistance in *E. coli* isolated from freshwater fish and pond water against β-lactam class antimicrobials

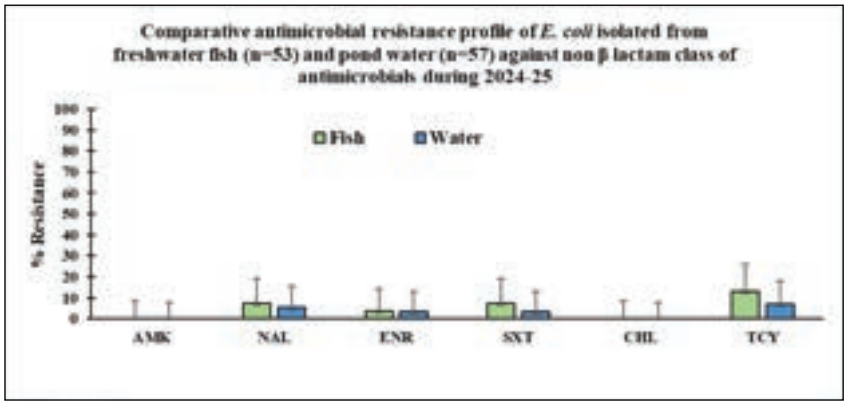


Fig. 150b. Comparative antimicrobial resistance in *E. coli* isolated from freshwater fish and pond water against non-β lactam class antimicrobials

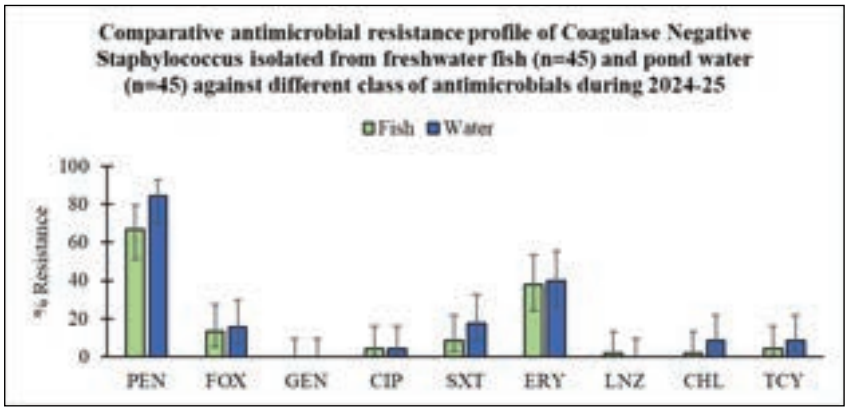


Fig. 151. Comparative antimicrobial resistance in coagulase negative *Staphylococcus* (CONS) (n=90) isolated from freshwater fish and pond water against different antimicrobials

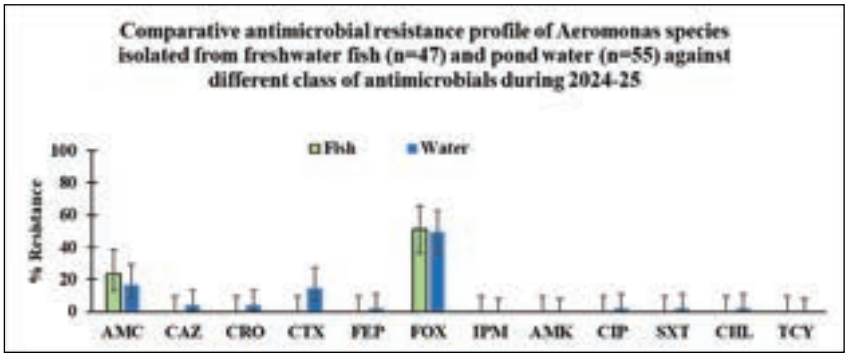


Fig. 152. Comparative antimicrobial resistance in *Aeromonas* spp. (n=102) isolated from freshwater fish and pond water against antimicrobials

Table 11. The details of freshwater cages from which samples were collected

Fish species/ specimen	Number of farms/ samples	*E. coli*	*S. aureus*	CONS	*Aeromonas* spp.
Hazaribagh					
cca	0	0	0	0	0
ccr	0	0	0	0	0
cid	0	0	0	0	0
cmr	0	0	0	0	0
hmo	0	0	0	0	0
lro	0	0	0	0	0
phy	16	16	5	11	16
oni	18	18	8	10	18
cpw	0	0	0	0	0
ppw	18	18	7	11	18
tpw	18	17	7	11	18
Grand Total	70	69	27	43	70

cca: *Catla catla*; ccr: *C. carpio*; cid: *C. idella*; cmr: *C. mrigala*; hmo: *H. molitrix*; lro: *Labeo rohita*; *oni*: *Oreochromis niloticus*; phy: *P. hypophthalmus*; cpw: carp pond water; ppw: pangasius pond water; tpw: tilapia pond water

were analysed for AMR against 9 listed antibiotics. Out of these, 75.6% isolates were resistant to penicillin, and 14.4% isolates were resistant to cefoxitin. Majority of the isolates were susceptible to tested antimicrobials. Comparative AMR in CONS isolated from freshwater fish (n=45) and pond water (n=45) against different antimicrobials is shown in Fig. 151.

AMR profile of *Aeromonas* species

A total of 102 isolates of *Aeromonas* spp. were analyzed for AMR against 12 listed antibiotics. Out of these, 50% isolates were resistant to cefoxitin. A total of 6.3% of isolates were intermediate resistant to tetracycline and 19% were resistant to amoxycillin-clavulanic acid. Comparative AMR in *Aeromonas* spp. isolated from freshwater fish (n=47) and pond water (n=55) against different antimicrobials is shown in Fig. 152.

Project:

All India network project on fish health

Period: July, 2017 - March, 2026

Personnel: Pravata Kumar Pradhan (PI), Anutosh Paria, Gaurav Rathore and Neeraj Sood

Funding Support: ICAR Scheme, New Delhi

Evaluation of therapeutic potential of drugs against *Saprolegnia parasitica*

The study assessed the antifungal efficacy of four therapeutic agents, *viz.* clotrimazole, econazole nitrate, griseofulvin and ketoconazole, against different life stages of

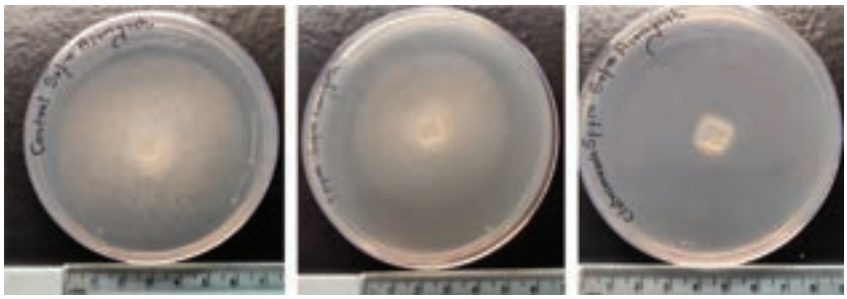


Fig. 153. Growth of hyphae in different concentrations of clotrimazole

S. parasitica, specifically zoospore production and hyphal growth under laboratory conditions. The compounds were tested at concentrations ranging from 0.1 to 100 ppm. The results indicated that clotrimazole was the most effective compound, completely inhibiting hyphal growth at 10 ppm and significantly reducing zoospore production at 1 ppm (Fig. 153). Econazole nitrate fully inhibited hyphal growth at 100 ppm and completely suppressed zoospore production at 10 ppm. Griseofulvin showed complete inhibition of both hyphal growth and zoospore production at highest tested concentration (100 ppm). Similarly, ketoconazole effectively inhibited hyphal growth at 100 ppm and suppressed zoospore production starting at 10 ppm. Among all the tested agents, clotrimazole stood out for its strong antifungal activity at lowest concentration, making it a promising candidate for controlling *Saprolegnia* infections.

Efficacy of Bezalkonium Chloride for the control of Saprolegniosis

The study investigated the efficacy of Benzalkonium Chloride (BKC) on hatching and survival of *Labeo rohita* eggs and larvae infected with *Saprolegnia* spores. Viable and non-viable eggs were divided into 7 treatment groups and exposed to different BKC concentrations and *Saprolegnia* spores. The treatments included a naïve control (C) with no BKC or spores, a positive control (PC) with spores only, and five BKC-treated groups: prolonged bath (P), short bath (S), dip bath (D), short and prolonged bath (SP), and dip and prolonged bath (DP). The highest hatching rate was observed in the naïve control, followed by P, D, SP, DP, PC, and S. Survival rates at 48 hours post-hatching were highest in the SP treatment, followed by P, S, DP, P and D. These findings indicate that BKC treatments, particularly the SP protocol effectively reduce *Saprolegnia*-induced mortality and improve survival rates in *L. rohita* larvae. This suggests that

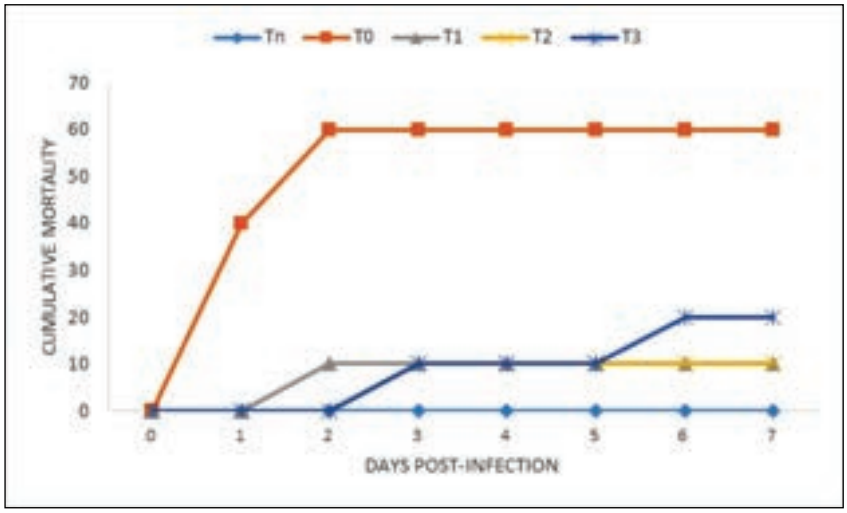


Fig. 154. Cumulative mortality in different treatments of BKC and control

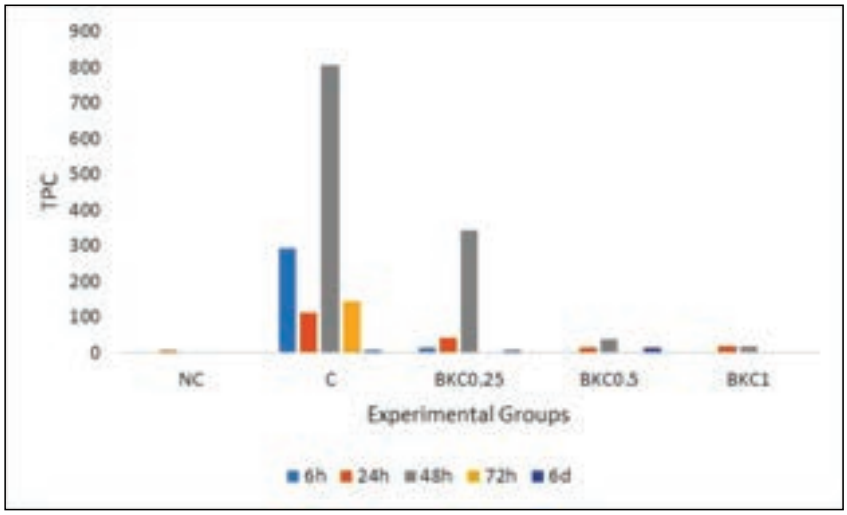


Fig. 155. Total plate count (TPC) in different treatments and control at different time-interval

BKC could be a valuable tool in protecting fish eggs and larvae from fungal infections during early development.

Efficacy of Benzalkonium chloride following infection with *Aeromonas veronii*

Effectiveness of BKC in treating *Aeromonas veronii* infections in *L. rohita* was also evaluated. The first experiment determined the median lethal dose (LD50-96h) of *A. veronii*, which was determined as 2×10^6 $CFUmL^{-1}$. Forty fish were divided into four groups: a control group (T0) exposed to the pathogen without treatment and 3 treatment groups (T1, T2, and T3) receiving BKC at concentrations of 0.25, 0.5, and 1 ppm, respectively. The highest cumulative mortality was observed in untreated control group (T0), while 10% mortalities occurred in the BKC-treated groups (T1, T2, and T3), indicating BKC's protective effect (Fig. 154).

In the second experiment, 100 *L. rohita* fingerlings were divided into 5 groups: an untreated infected group (T0), a naïve control group (Tn), and 3 treatment groups (T1, T2, T3) receiving BKC at concentrations of 0.25, 0.5, and 1 ppm, respectively. Bacterial colony counts were highest in T0 and progressively declined with increasing BKC concentrations. By six days post-infection, no bacterial colonies were detected in 1 ppm BKC group (T3), indicating complete pathogen eradication (Fig. 155). These findings highlight the strong therapeutic potential of BKC against *A. veronii* infections in *L. rohita*, with 0.5 or 1 ppm concentration, thus, proved most effective in eliminating the pathogen.

Project:

Global warming a potential driver of antimicrobial resistance in aquaculture: An in-vitro study in *Aeromonas hydrophila*

Period: January, 2022 - March, 2025

Personnel: Gaurav Rathore (PI) and Chandra Bhushan Kumar

Funding Support: National Initiative on Climate Resilient Agriculture (NICRA)

Climate change is anticipated to contribute to the rise of AMR in pathogens, while also facilitating the horizontal gene transfer of antibiotic-resistant genes (ARGs). This project examines the impact of prolonged exposure to elevated temperatures, combined with antibiotic selection pressure, on the AMR profile of *Aeromonas hydrophila* and the transfer of ARGs.

Long term exposure of *Aeromonas hydrophila* strain, RJTS to increasing concentrations of tetracycline

RJTS strain was originally a tetracycline susceptible strain with MIC of 0.027 µg/ml. RJTS strain was cultured with increasing concentrations of tetracycline to 100 passages at three temperatures *viz*. 28°C, 35°C and 40°C. At the end of the experiment, the passaged strains were designated as RJTS100P28, RJTS100P35 and RJTS100P40, respectively.

AST profile of wild RJTS and passaged strains

The AST profiles of wild and passaged strains of RJTS were different. The passaged strains were resistant to cefoxitin, enrofloxacin and tetracycline, whereas wild RJTS strain was

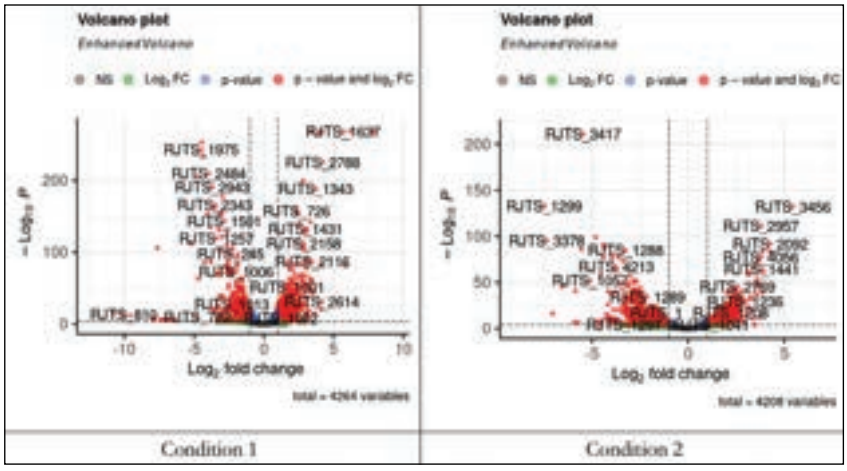


Fig. 156. Volcano plot of DEGs with top 20 genes for condition 1 & 2

The data analysis for interpreting the role of differentially expressed genes in attributing resistance to cefoxitin, tetracycline and enrofloxacin is in progress

susceptible to all the tested antibiotics. The AST profiles of the passaged strains at all the three temperatures were similar for all the antibiotics. The results indicate that the exposure of tetracycline induce resistance to cefoxitin, enrofloxacin and tetracycline in RJTS. Furthermore, no effect of temperature was observed on the AST profiles of passaged strains. MIC of tetracycline for RJTS100P28 and RJTS100P35 was 125 µg/mL and for RJTS100P40 was 31.2 µg/mL. MIC of tetracycline was ~four-fold lower for strain passaged at 40°C as compared to strains passaged at 28°C and 35°C.

Detection of ARGs in RJTS passaged strains

No ARGs were detected in RJTS wild and passaged strains. The resistance of the passaged strains to cefoxitin, tetracycline and enrofloxacin could not be attributed to any of the screened ARGs. There could be some other mechanism of resistance that needs to be explored.

Whole genome sequencing of *Aeromonas hydrophila*, strain RJTS

High quality genomic DNA was isolated from bacterial strain and whole genome was sequenced using Illumina NovaSeq 6000. Adapter sequences and low-quality reads were removed by FASTP to get high quality reads on the parameter of <Q20. SPAdes genome assembler v3.15.3 was used and total 11 scaffolds were obtained with a N50 value of 4,745,344 bp. Assembly quality was assessed using Quast software and BUSCO was used to assess completeness of genome assembly. Overall mapping was 99.2% to the reference genome. RJTS genome has 4490 protein coding sequences (887 hypothetical proteins and 3603 proteins with functional assignments), 99 tRNA genes, and 4 rRNA genes.

RNA sequencing

Bacterial RNA was isolated using RNeasy minispin column from overnight bacterial culture at 28°C and 40°C. The bacterial RNA samples in triplicate (3 wild type as controls and 6 tetracycline exposed grown either at 28°C (T28°C) or 40°C (T40°C) as treatments were sequenced using Illumina NovaSeq 6000. Bacterial rRNA depletion was done through ribozero treatment, followed by RNA-Seq library preparation. Sequence data QC and quality-based filtering and trimming was done by FASTP to generate at least 15 million high quality reads having Q30 scores of more than 90%. All high-quality reads were mapped with the reference genome RJTS using HISAT2 genome aligner tool. Overall alignment ranged between 98.3-99.59%. The assembled transcriptome expression was estimated using the DESeq2. Majority of the assembled transcripts had expression ≥1 FPKM. Genes whose expression displayed an average fold change >1 and was statistically significant (adjusted p value ≤0.05) were considered differentially expressed (DEGs). The differential gene expression was studied in two conditions- Condition 1: Control versus T28°C; and Condition 2: Control versus T40°C. The annotation of DEGs were performed using the BLAST2GO software on the basis of NR database, InterPro, and KEGG pathways (Fig. 156).

Project:

Novel approaches for disease free health certification in finfish and development of high health shrimp for sustainable aquaculture

Period: June, 2022 – May, 2025

Personnel: Gaurav Rathore (PI), Neeraj Sood and Chandra Bhushan Kumar

Funding Support: ICAR-NASF, New Delhi

Monoclonal antibodies (MAbs) against fish immunoglobulins play a crucial role in sero-surveillance and ensuring disease-free health certification in finfish. This project focuses on developing cross-reactive MAbs that target serum immunoglobulins (sIgs) in Indian Major Carps.

Production of cross-reacting monoclonal antibodies to serum Ig of Indian Major Carps

Detection of anti-rohu-Ig antibodies in immunized mice serum

Balb/c mice were immunized with purified rohu serum immunoglobulins. On the 45th day of immunization, the mice were test bled for monitoring specific immune response. The detection of anti-rohu-Ig antibodies in the serum of immunized mice was done by an indirect ELISA.

Fusion of rohu-Ig immunized mice

Spleen cells of rohu-Ig immunized mice were collected and fused with myeloma cells (SP-2/0) at a ratio of 10:1, respectively, using polyethylene glycol. Cells were seeded in 96 well microtiter tissue culture plates and the growth of hybridoma was observed regularly under a selection medium (HAT) containing aminopterin. Well-to-well screening of hybridoma clones, employing an indirect ELISA, was performed at an appropriate stage of growth. A total of four fusions were performed.

ELISA for screening of hybridomas positive for anti-rohu-Ig antibodies

After 7th day of the fusion, wells were screened by indirect ELISA for positive hybridomas. A total of 480 wells of 8 tissue culture plates were seeded with fused cells. Out of these, 470 wells showed growth of hybridomas. All 470 wells containing hybridomas were screened for detection of anti-rohu antibodies by ELISA. Out of these, 17 hybridomas showed more than 2.0 OD at 492 nm at 2nd screening, and in the 3rd screening only 8 hybridomas showed more than 2.0 OD. The hybridoma supernatant was collected from these eight clones at regular intervals and used for checking the cross reactivity in western blotting and ELISA. On confirmation, these 8 clones were termed as MAbs, expanded in 24 well plates and later in 25 cm^2 flasks before storage at -196°C in liquid nitrogen.

Three hybridoma clones namely P3F4 and P7D10 (heavy chain reactive) and P7C10 (light chain reactive) were selected for single cell cloning. All three hybridomas were serially diluted up to minimum 1 cell/well in a 96 well microtiter plate. After, the 14th day of limiting dilution, all the wells were screened by ELISA for the production of MAbs reacting to rohu-Ig. The clones from the single cells were expanded and stored at -196°C in liquid nitrogen.

Western blot analysis

In western blot, 7 clones showed binding to heavy chain of rohu-Ig at ~82 kDa, while one MAbs namely P7C10 showed binding to light chain of rohu-Ig at~26 kDa. Out of 7 MAbs specific to heavy chain, P7D10 showed more efficient binding to heavy chain of rohu-Ig at 1:30 dilution. The MAbs P7D10 showed cross reactivity with heavy chain of catla and mrigal.

Cross reactivity of MAbs P7D10 with serum Ig

The P7D10 MAbs showed cross reactivity in ELISA with serum Ig of all three IMC and other fish species like *Hypophthalmichthys molitrix* (silver carp), *Ctenopharyngodon idella* (grass carp), *Oreochromis niloticus* (Tilapia) and *Heteropneustes fossilis* (singhi). This MAb did not show cross reactivity with serum-Ig of fish species like *Cyprinus carpio* (common carp), *C. carpio koi* (koi carp), *Pangasianodon hypophthalmus* (pangas) and *Carassius auratus* (gold fish).

In dot blot also, the MAb showed binding with serum of *Labeo rohita*, *L. catla*, *Cirrhinus mrigala*, *H. molitrix*, *C. idella*, *O. niloticus* and *H. fossilis*. No cross reactivity was observed with *C. carpio*, *C. carpio koi*, *P. hypophthalmus* and *C. auratus*.

Development and detection of *Flavobacterium columnare* specific antibodies

L. rohita weighing 100-150 g were immunized with 10^8 CFU/mL of formalin-inactivated whole cells of *F. columnare* mixed in Freund's Complete/Incomplete adjuvant. The serum was collected from each fish and stored at -20°C for further use as positive control. The negative control for this assay were the un-immunized healthy fish, and their serum was collected and stored. The detection of *F. columnare* specific antibodies was done in the serum of fish immunized with *F. columnare*, fish exposed to live *F. columnare* and un-immunized fish/field serum samples by an indirect ELISA. MAb P7D10 was used for detection of *F. columnare* specific antibodies in the serum. The average OD of immunized fishes was 1.70 ± 0.15, while fishes exposed to live *F. columnare* in sub-lethal concentration showed an average OD of 0.75 ± 0.08. The average OD of the field collected samples was 0.16 ± 0.03. This study indicates that P7D10 MAbs can successfully detect *F. columnare*-specific antibodies in the serum of *L. rohita*.

Project:

CRP on vaccines and diagnostics: Development of point-of-care diagnostic kit and vaccine against Tilapia Lake Virus

Period: January, 2023 – March, 2025

Personnel: Anutosh Paria (PI), Neeraj Sood and Pravata Kumar Pradhan

Funding Support: ICAR Scheme, New Delhi

The emergence of Tilapia lake virus (TiLV) has led to significant mortalities, posing a major threat to tilapia farming worldwide, including India. Given that tilapia is often cultivated by lower-income farmers, there is a need for affordable, reliable diagnostic methods that do not require extensive laboratory infrastructure. Additionally, vaccination is regarded as an effective strategy for mitigating losses, particularly those caused by viral diseases. Therefore, in the project, a field-based diagnostic kit and an inactivated vaccine against TiLV aims to be developed to enhance disease management and safeguard tilapia farming.

Propagation of TiLV in OnH and OnIL cell line

Initially, based on the TiLV copy number and $TCID_{50}$ obtained in the cell lines, OnIL cell line has been selected for further mass propagation of TiLV. However, TiLV propagated in OnH cell line was more virulent as observed in the *in-vivo* trial. Hence, the TiLV propagated in OnH cell line was used for purification and immunization.

Inactivation of TiLV for immunization of tilapia

The cell-free supernatant from OnH cell line infected with TiLV was inactivated by exposing to a specific temperature or certain concentration of formalin for a specific period. For heat-inactivation, the supernatant was exposed to two different temperatures i.e. 50°C and 60°C. At both the temperatures, the supernatant containing TiLV was kept for 2.5h. In case of formalin inactivation, the cell-free supernatant of TiLV-infected OnH cell line was treated with either 0.01 or 0.05% formalin and kept at 4°C for 24h. Following incubation, for checking the inactivation, an aliquot of the heat-inactivated or formalin-inactivated supernatant was re-inoculated in OnH cell line. The cells were observed till 12 days post-inoculation for checking the CPE. The process continued for two more passages in OnH cell line, for ensuring the complete inactivation. Based on the observations, the TiLV-infected with 50°C temperature and 0.05% formalin was selected for immunization.

Development of anti-tilapia IgM MAb

For developing MAb against Nile tilapia IgM, initially hyperimmune sera in Nile tilapia was generated in apparently-healthy fish by injecting with BSA suspended in PBS. Each fish was injected with 100 µL of PBS containing 1 mg of BSA in conjunction with Freund's Complete Adjuvant (FCA). After the first injection, the fish were injected two more times with same dose regime of BSA emulsified with Freund's Incomplete Adjuvant (FIA) at 3 weeks interval. Pre- and post-immunization blood samples were collected from the BSA-injected fish regularly and serum was stored at -80°C. The Nile tilapia serum immunoglobulins were purified using CL-Agarose column coupled with BSA (Fig. 157). The BALB/c mice was immunized with the 100 µg of serum IgM of Nile tilapia along with FCA. Two booster doses with same dose of IgM with FIA at 2 weeks interval were given.

The splenocytes from immunized BALB/c mice was fused with SP 2.0 myeloma cells for generating

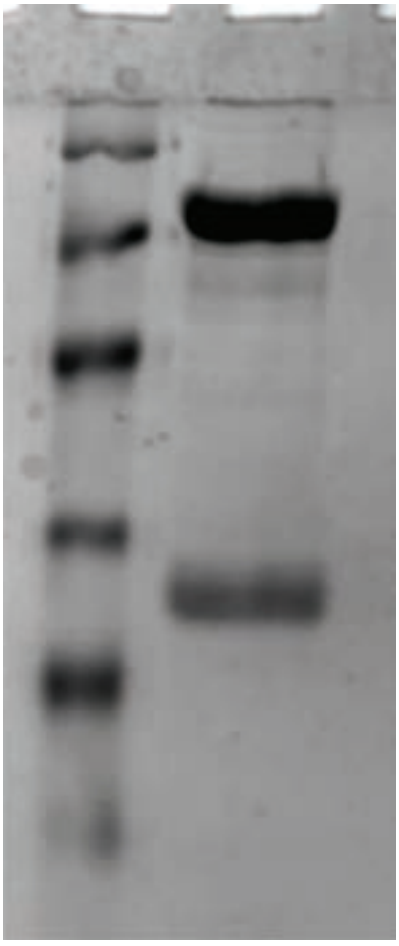


Fig. 157. SDS-PAGE of the purified immunoglobulins

the hybridomas. Following the fusion, a total of 89 hybridomas were obtained. Supernatant from the hybridomas were screened by indirect ELISA for the reactivity. Out of the hybridomas, only 6 hybridomas showed reactivity with heavy chain of purified Ig of Nile tilapia, however in Wester blotting, two hybridoma showed reactivity with heavy chain and one with light chain (Fig. 158).

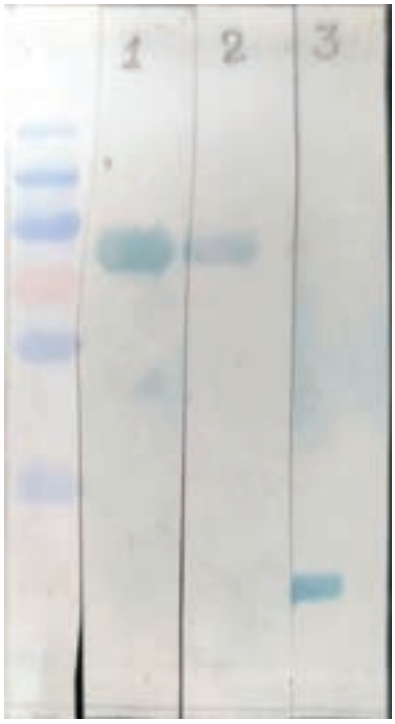


Fig. 158. Reactivity of the hybridomas against purified Ig of Nile tilapia in Western blot

Project:

Assessment of exotic fishes' prevalence and their impacts on indigenous fish diversity

Period: April, 2023 – March, 2026
Coordinator: Uttam Kumar Sarkar
Personnel: Tarachand Kumawat (PI), V. S. Basheer, Sharad K. Singh, Achal Singh, Ajey K. Pathak, P. R. Divya, Aditya Kumar, Anutosh Paria, Ranjana Sinha, Ravi Kumar and Vikash Sahu

Funding Support: Institutional, ICAR-NBFGR

Exotic fish *Pterygoplichthys* sp.

Pterygoplichthys sp. (suckermouth sailfin catfish), native to South America, are now invading freshwater ecosystems worldwide. A survey was conducted along the Sarayu river stretch to assess the occurrence of exotic species. The study described the first occurrence of an invasive *Pterygoplichthys* sp. in the sacred Sarayu river, Ayodhya, expanding the known distribution of these catfishes in the Ganga river basin. The collected sample (Fig. 159) was examined for morphometrics, sucker-mouth morphology, meristic parameters and biological parameters (gut content and reproductive organs).

The sample was caught by local fishers using a gill net (20 mm mesh) in the Sarayu river. The specimen (total length 236 mm and weight 123.9 g) showed the characteristic dorsoventral flattened body and armoured plates of *Pterygoplichthys*. Its dorsal fin was sail-like and the abdomen exhibited dark vermiculate markings, consistent with the vermiculated sailfin catfish *P. disjunctivus*. DNA barcode analysis of the COI gene yielded a >99% match to *P. disjunctivus* sequences, confirming the genus and invasive lineage. Otolith examination showed two opaque growth zones (indicative of ~2 years age), and radiograph (Fig. 160) shows a typical Loricariid skeletal structure with a complex armoured body.

Fig. 159. Sucker-mouth morphology, gut contents, and reproductive organs of *Pterygoplichthys* sp.

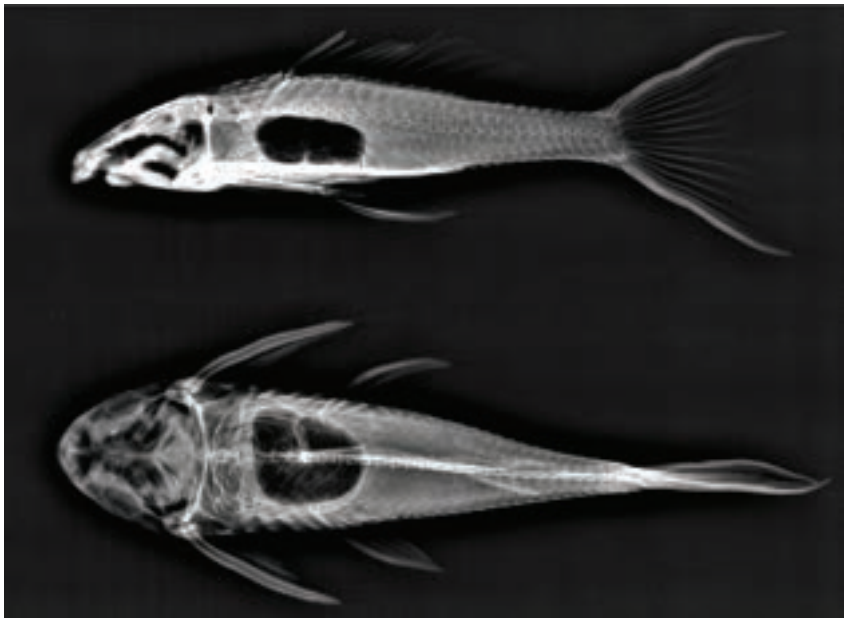


Fig. 160. Radiograph imaging of *Pterygoplichthys* sp. showing a typical Loricariid skeleton with a complex armoured body

Gut content analysis revealed predominantly detritus and mud with traces of plant matter, indicating a detritivorous diet. The fish was a mature female containing yolked eggs, suggesting an ability to reproduce in the wild. Multi-season water profiles of the Sarayu river showed temperature ranging from 16.79 to 28.9°C, dissolved oxygen 4.93 to 10.3 mg/l, and pH 7.36 to 8.48, conditions favourable for *Pterygoplichthys* sp. This study in the Sarayu river highlights a westward range expansion of sailfin catfish. Given this species' hardy physiology and invasive traits, its establishment poses ecological risks to native riverine fauna and fisheries. The study suggested potential impacts such as competition with native fishes and habitat alteration due to burrowing behaviour and predation on fish eggs and larvae, disrupting recruitment cycles of indigenous fishes. The study emphasised the need for monitoring and management to prevent further spread.

Exotic mussel *Mytella strigata* in Kerala backwaters

A study was conducted across three major backwater sites in Kerala (Ashtamudi, Kadinamkulam, and Paravur) to document the invasion of *M. strigata*, commonly known as the American brackish water mussel/Charu mussel. This species, originally from Central and South America, has established a significant presence in these regions. The key findings show a highly dense mat (Fig. 161, Table 12) of invasive mussels spread widely in the water bodies.

Table 12. Distribution and density of *Mytella strigata*

Backwater	Pre-monsoon density (no./m^2)	Monsoon density (no./m^2)
Ashtamudi	1388	1900
Kadinamkulam	400	415
Paravur	523	638

The study documented environmental and socioeconomic impacts due to emerging *M. strigata*. *M. strigata* outcompetes native mussel species such as the Asiatic green mussel (*Perna viridis*) and short-neck clam (*Paphia malabarica*), leading to habitat modification. It forms dense byssal mats that restrict the natural settlement of native bivalves. It alters sediment composition by creating a slimy substrate, unsuitable for native clams such as *Villorita cyprinoides*. Due to its market price of ₹120 per kg, fishers are increasingly harvesting *M. strigata*, which makes up 39% of

Fig. 161. Dense mat of *Mytella strigata*

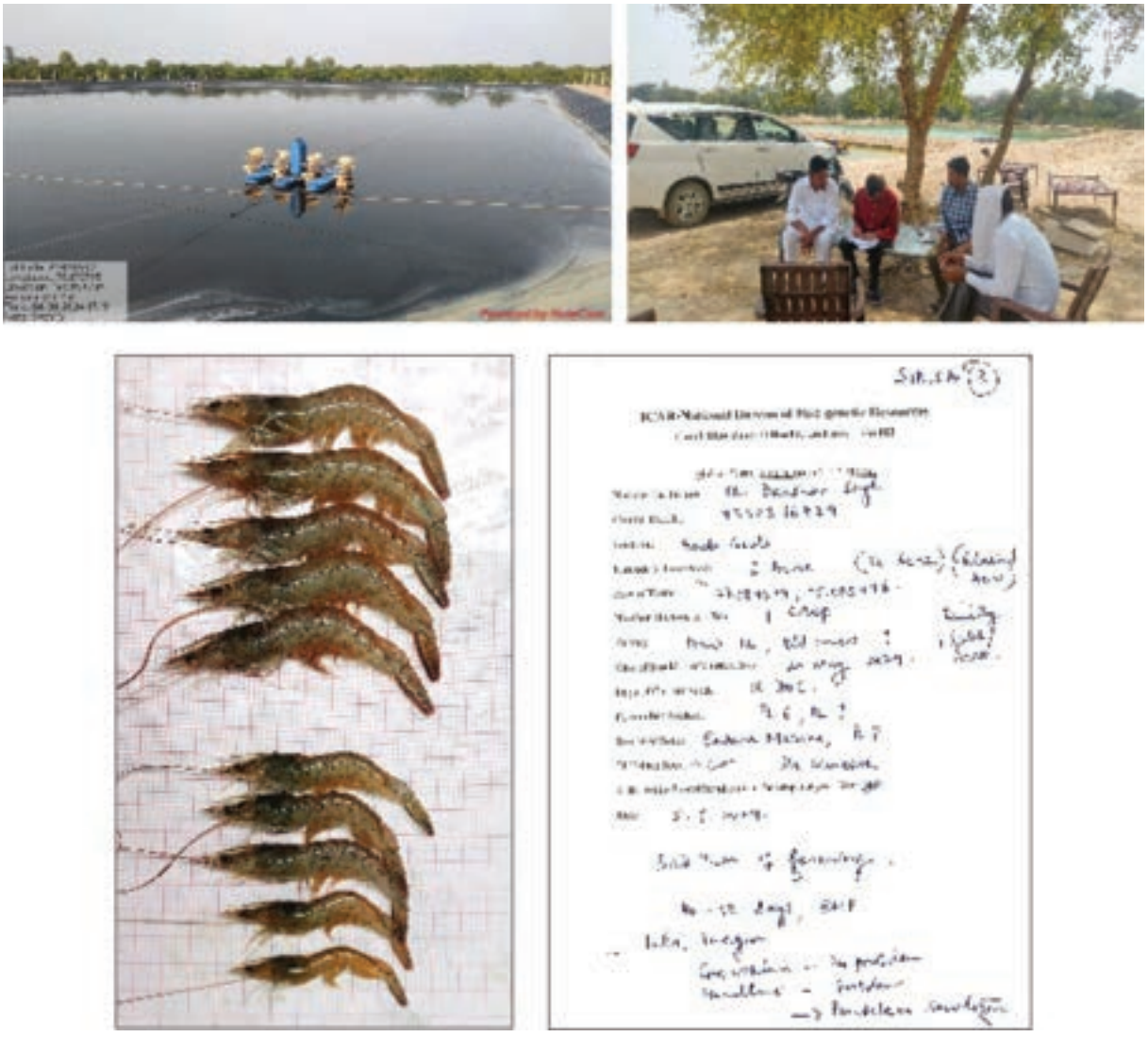


Fig. 162. Sampling and collection of baseline information

the mussel fishery. The decline in *P. viridis* populations has driven-up prices for native mussels, affecting local livelihoods. The fishers have started using *M. strigata* for food and exports, due to the gradual stabilisation of its population. The study recommends preventive and control measures, including targeted removal of invasive species from critical habitats. Exploring commercial utilization of *M. strigata* to mitigate its ecological impact while supporting local fisheries is recommended.

Project:

Understanding the association of gut microbiome with *Enterocytozoon hepatopenaei* (EHP) infection in inland saline shrimp culture system

Period: February, 2024 – March, 2026

Personnel: Anutosh Paria (PI), Neeraj Sood and Pravata Kumar Pradhan

Funding support: ICAR-NBFGR Corpus Fund

Collection of *Penaeus vannamei* samples

For understanding the differences between microbiome profiles during EHP infection in *P. vannamei* cultured in inland saline shrimp farms, samples were collected from three different districts of Haryana

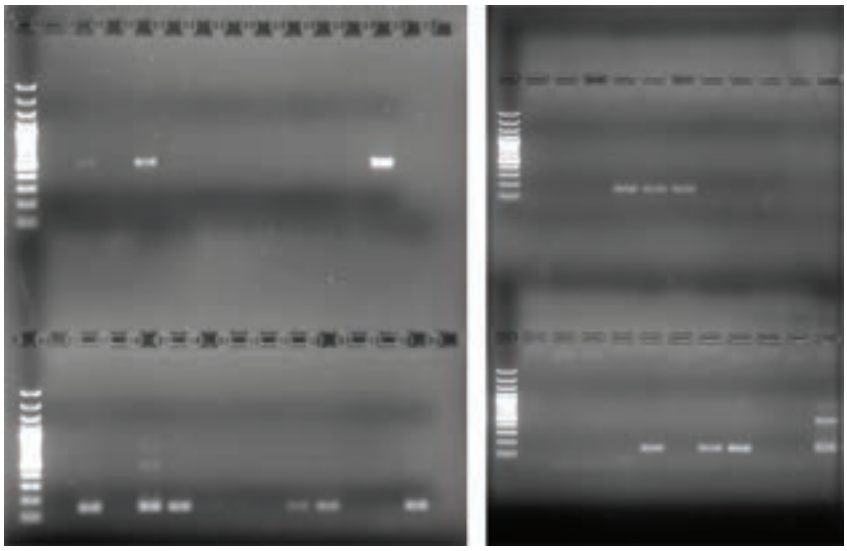


Fig. 163. Two-step PCR for detection of EHP in hepatopancreas of *Penaeus vannamei* cultured in inland saline waters

namely Rohtak, Sirsa and Jhajhar (Fig. 162). A total of two sampling trips were conducted and samples were collected from a total of 30 farms. From each farm, 10 shrimp samples of different sizes were collected. During the sampling, basic information about the farms and culture practices were also noted. Following collection, shrimps were dissected and tissues from hepatopancreas and intestine were preserved in RNAlater for further processing. It is noteworthy to mention that in the two sampling surveys conducted, visible EHP-associated white faecal disease could be observed only in a single farm, however shrimps with growth variation were observed in many farms.

Confirmation of EHP infection

From the collected samples, DNA was isolated from hepatopancreas of all the shrimp samples. The isolated DNA samples were subjected to the EHP-specific PCR targeting spore wall protein

Fig. 164. Acclimatization of fish in wet laboratory

Fig. 165. Sample collection for gene expression study

of EHP. Out of the 21 farms from which samples collected during first sampling trip (June, 2024), 4 farms tested positive for EHP in second step PCR, whereas during second sampling trip conducted during September, 2024, out of the 9 farms, 5 tested positive for EHP (First step positive: 1; Second step positive: 4) (Fig. 163).

Metagenome sequencing and comparison of gut microbiome profiles

Out of the samples collected and tested for EHP, a total of 9 EHP positive shrimp samples from each sampling survey were identified. Precisely, 3 shrimp sample each from 3 EHP-positive farms were selected from a sampling trip. So, a total of 18 EHP positive shrimp samples has been identified for gut microbiome analysis using metagenome sequencing. Likewise, a total of 10 EHP-positive samples consisting of 5 with growth retardation and 5 with normal growth were identified for analysis of microbiome associated with growth retardation during EHP infection. Altogether, a total of 37 samples including EHP positive and control samples are being processed for metagenome sequencing.

Project:

Elucidating the role of temperature on immune response and susceptibility of *Pangasianodon hypophthalmus* against infection with *Saprolegnia parasitica*

Period: February, 2024 - March, 2026

Personnel: Chandra Bhushan Kumar (PI), Pravata Kumar Pradhan and Neeraj Sood

Funding support: ICAR-NBFGR Corpus Fund

Saprolegniosis is one of the most destructive oomycete diseases of fish. The disease severely affects the pangas culture during the winter leading to huge mortalities and significant economic losses to farmers. The present study aims to elucidate the effect of temperature on modulation of immune genes and susceptibility of *P. hypophthalmus* against *Saprolegnia parasitica*.

Collection of fish and experimental design

The fingerlings of pangas were procured and acclimatised in the wet laboratory of Exotics and Aquatic Animal Health Laboratory of ICAR-NBFGR for two weeks (Fig. 164). Thereafter, fish were allocated in plastic tubs and steadily decreased the water temperature to the desired experimental temperatures 28°C, 22°C and 16°C. Water parameters such as ammonia, pH, dissolve oxygen and the stability of the fish were continuously monitored.

Optimization of primers for qPCR

Previously reported primers of innate immune (CRP, C3, MHC-II, IL-1β, transferrin), housekeeping and heat shock protein (HSP 90) genes were synthesised, and a new primer set for HSP 70 gene of *P. hypophthalmus* was designed. Standardised the optimal condition for qPCR of all these primers. After exposure of fish at three designated temperatures, sampling was done at different time points (6h, 7 & 14 days). Fish from each temperature were collected, euthanised with MS-222 (250 mg/L) and dissected to collect tissues in RNAlater solution (Fig. 165). Total RNA extraction from the kidney tissue and cDNA synthesis was carried out. The qPCR was done to assess the expression of genes. The data analysis is in progress.

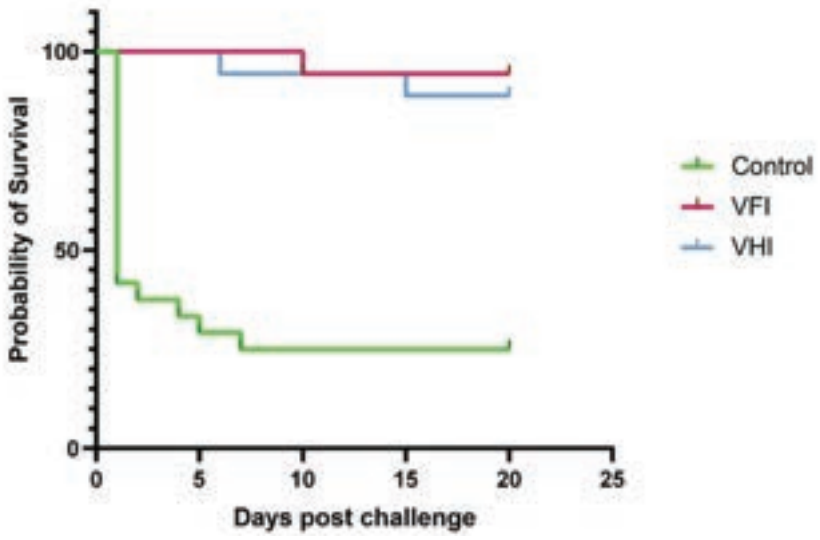


Fig. 166. Kaplan–Meier survival curve of *Astronotus ocellatus* after challenge with *A. jandaei* and *E. tarda*

Project:

Development and evaluation of autogenous inactivated vaccine against *Aeromonas* sp. and *Edwardsiella tarda* in Oscar fish (*Astronotus ocellatus*)

Period: February, 2024 - March, 2026

Personnel: Arun Sudhagar S. (PI), Anutosh Paria and Rekha M. U.

Funding support: ICAR-NBFGR Corpus Fund

Two Gram-negative bacterial strains were isolated from diseased Oscar fish (*Astronotus ocellatus*) collected from a hatchery in Perumbavoor, Kerala. Based on biochemical characteristics and whole genome sequence (WGS) analysis, the isolates were identified as *Aeromonas jandaei* and *Edwardsiella tarda*. The genome sizes of *A. jandaei* and *E. tarda* were 4.42 MB and 8.55 MB, respectively. Lethal dose 50% (LD_{50}) values for *A. jandaei* and *E. tarda* in Oscar fish were determined to be 5.31×10^8 CFU/mL and 7.49×10^8 CFU/mL, respectively. A co-infection study was carried out wherein Oscar fish were divided into four groups, each comprising triplicates of 10 fish: one group infected with *A. jandaei*, another with *E. tarda*, third group co-infected with both pathogens, and an uninfected control group. Mortalities and clinical signs were closely monitored, and samples were collected for molecular analysis. Mortality rates were 65% in the *A. jandaei*-infected group, 50% in the *E. tarda*-infected group, and a significantly higher 90% in the co-infected group.

Inactivated vaccines were developed using both formalin and heat inactivation methods. Various concentrations of formalin (0.1, 0.3, 0.5, 0.7 and 1%) were tested over a 24h period, while heat inactivation was evaluated at 40°C, 50°C, 60°C, 70°C, and 80°C for 1h. Optimal inactivation conditions were established as 0.3% formalin treatment and heating at 70°C. Bivalent vaccines were then formulated by combining inactivated *A. jandaei* and *E. tarda* in equal proportions to achieve a final concentration of 1×10^{10} CFU/mL. The primary vaccine dose was emulsified in Freund's Complete Adjuvant, while booster doses were emulsified in Freund's Incomplete Adjuvant at a 50:50 ratio.

A total of 90 Oscar fish, with an average weight of 14g, were randomly assigned to 3 groups: one receiving the bivalent formalin-inactivated vaccine (VFI), another the bivalent heat-inactivated vaccine (VHI), and a control group injected with sterile PBS. Each group comprised 30 fish, arranged as 3 replicates of 10 fish each. All fish were administered 4 intraperitoneal injections (100 µL/ fish), consisting of one primary dose followed by 3 booster doses at 14-days interval. Post-vaccination, both immunological and molecular responses were monitored. To assess vaccine efficacy, a challenge trial was conducted 42 days after the final booster. A mixed bacterial suspension was prepared by combining equal volumes of *A. jandaei* and *E. tarda*, based on their respective LD_{50} values. A total of 18 fish each from VHI and VFI groups, and 24 from control group (all in triplicates) were intraperitoneally injected with 100 µL of the challenge suspension. Mortality patterns and survival rates were observed for a period of 20 days and samples were collected for immunological and molecular analyses. Relative percentage survival (RPS) was 92.6 for the VFI group and 82.5 for the VHI group (Fig. 166).

Workshop/Conference/Seminar/ Symposia/Training/Meeting Organized

View of participants of International Symposium

Participants of fish disease management program

Training program on Fish Disease Management

A 3-days hands-on training program on 'Fish Disease Management' was organised during January 3-5, 2024 by the PAGR Centre, ICAR-NBFGR, Kochi. The training was funded by Department of Fisheries, Government of Kerala, and was organized as a part of National Surveillance Programme on Aquatic Animal Diseases with the aim to sensitize the officials of State fisheries department about disease management in aquaculture. About 15 officials representing all the districts of Kerala attended the training program.

National Workshop on Fish Systematics

ICAR-NBFGR, Lucknow, and Zoological Survey of India (ZSI), jointly hosted the 'National Workshop on Advances in Fish Systematics: Morphological and Molecular Approaches' during January 18-19, 2024, at Hyderabad. Over 20 speakers shared their expertise on various aspects of fish systematics, both morphological and molecular. The workshop was participated by over 50 delegates, involving researchers, academicians and students. A significant feature of the workshop was the release of a booklet titled 'State Fishes of India' and a bound galley of the first edition of 'Barcode Atlas of India Fishes'.

Snapshots of Fish Systematics Workshop

Release of ICAR-NBFGR publication in satellite symposium

National Workshop on Fish Systematics and Conservation

ICAR-NBFGR, Lucknow organised a Satellite Symposium on Fish Genetic Resource and Conservation jointly with ICAR-CIFRI, Barrackpore at Kolkata on February 24, 2024, under 13th Indian Fisheries and Aquaculture Forum, to spotlight the critical role of aquatic genetic resources in sustainable development, conservation efforts, and the innovative approaches required to address contemporary challenges. The event was chaired by Dr. A. G. Ponniah, Former Director, ICAR-CIBA & NBFGR and Dr. Dhriti Banerjee, Director, ZSI, Kolkata. A total of 6 lead, 10 oral and 16 poster presentations on various aspects of aquatic genetic resource management was held.

Awareness cum Interaction Meeting on 'ReportFishDisease' App

Two awareness-cum-interaction meetings on 'ReportFishDisease' App was organized on May 15 and 29, 2024 at Kodungallur, Ernakulam and at Kozhikode, Kerala, respectively, under NSPAAD Phase II in collaboration with the Department of Fisheries, Government of Kerala. Around 55 fish farmers participated in each program.

Glimpses of awareness-cum-interaction meeting

Launch Workshop of AINP-AMRFL

Launch workshop of All India Network Project on Antimicrobial Resistance in Fisheries and Livestock (AINP-AMRFL) was held on May 22, 2024 at NASC Complex, New Delhi. The workshop was inaugurated by Dr. Himanshu Pathak, Secretary, DARE & Director General, ICAR, New Delhi in presence of Dr. J. K. Jena, DDG (Fisheries Science), and National Coordinator (AINP-AMR), Dr. Ashok Kumar, ADG (Animal Health), ICAR, New Delhi, Director, ICAR-NBFGR, and Co-coordinator AINP-AMR. Officers from Animal Science and Fisheries Division of ICAR, FAO, India, Principal investigators and Co-Principal investigators of the network project attended the workshop. The project is being implemented by 31 partners from Fisheries and Animal science institutes of ICAR and Central Agricultural Universities/ State Agricultural Universities across India. The objective of the workshop was to review the progress of work done, expansion as well as operational framework of network and future roadmap for surveillance of AMR in farmed animals and fish.


Glimpse of AINP-AMRFL launch workshop

International Symposium on Changing Status of Ecosystem Health

The Aquatic Ecosystem Health & Management Society, South & Southeast Asia Chapter in collaboration with ICAR-NBFGR; Central University of South Bihar; University of Delhi; the Aquatic Biodiversity Conservation Society (ABCS), Lucknow and Vijnana Bharati (Vibha Bihar State) organised International Symposium on 'Changing Status of Ecosystem Health of the River Ganga: An Update and Review' hosted in hybrid mode during June 10-11, 2024. This symposium aimed to bring together experts, researchers, and practitioners from around the world to review and update the understanding of the current state of Ganga's ecosystem health and to discuss strategies for its conservation and management.

View of participants of International Symposium

Over 40 presentations, including 9 keynote lectures, were delivered during the symposium, and over 100 participants were present.

Livelihood development initiative for fisherwomen

Inauguration of the Marine Ornamental Fish Rearing RAS (MORR) Facility at DIFST (St. Devasahayam Institute of Fisheries Science & Technology), Kanyakumari district, Tamil Nadu, funded by the SCSP scheme of

the institute, was held on June 15, 2024, in the college premises after inauguration of the facility, in which Fr. T. John Rufus, Vicar General, Kottar diocese, Nagercoil and Dr. S. Felix, Dean, DIFST were Guests.

Interaction meeting with Prof. S. P. Singh Baghel, Hon'ble Minister

Prof. S. P. Singh Baghel, Hon'ble Minister of State for Fisheries, Animal Husbandry & Dairying, and Ministry of Panchayati Raj, Government of India, visited the Institute on June 19, 2024. The Director, ICAR-NBFGR, presented a comprehensive overview of ICAR-NBFGR's progress, including transformative activities, efforts and achievements for the conservation, development, and management of aquatic genetic resources of the country. During the event, the Hon'ble Minister released the ReportFishDisease App in 12 different regional languages for the benefit of the country's fish farmers and stakeholders. The Hon'ble Minister appreciated the institute's efforts toward unwavering commitment to the growth and development of the fisheries sector and the conservation of valuable

Interaction with Hon'ble Minister

aquatic genetic resources, including its focused approach to achieving the targets. He emphasized putting collective efforts towards achieving the goals of Viksit Bharat.

Training on breeding and larval rearing of *Clarias dussumieri* (Nadan mushi)

As part of the Agrobiodiversity project, the PAGR Centre organized a 3-day hands-on training programme on the breeding and larval rearing of *Clarias dussumieri* (Nadan mushi) from July 10-12, 2024. Seventeen participants, including farmers, hatchery managers, researchers and officials, received practical training in broodstock management, hormone induction, artificial fertilization, larval care, live feed culture and disease management. The programme also featured expert lectures, lab sessions and field visits. Participants received certificates and Nadan mushi seeds for farm-level rearing, reinforcing ICAR-NBFGR's commitment to skill development and sustainable aquaculture.

Review Meeting of collaborative Research program of North East

A Review meeting of 'Participatory Programme on Exploration and Characterization of Fish Germplasm Resources and Indigenous Knowledge in North-Eastern Region of India' was conducted on July 30, 2024, at ICAR-Research Complex for North Eastern Hilly Region, Umiam, Meghalaya. The Director, ICAR-NBFGR welcomed the Chief Guest Dr. V.K. Mishra, Director, ICAR Research Complex for NEH Region and other dignitaries including

Snapshots of participants of training on breeding and larval rearing

Sh. David Kharwanlang, Deputy Director of Fisheries, Department of Fisheries, Meghalaya; Dr. Dimos Khynriam, Scientist-D, ZSI-NERC, Shillong; and Dr. Deepjyoti Baruah, Principal Scientist, ICAR- IARI, Dirpai, Gogamukh. Progress made under 11 projects operated under ICAR-NEH component of ICAR-NBFGR was presented by the respective project investigator.

Review Meeting of CRP on Genomics

The 8th Annual Review Meeting of ICAR- Consortium Research Platform (CRP) on Genomics was held at ICAR-National Agricultural Science Complex (NASC), New Delhi on September 18, 2024, under the Chairmanship of Dr. J.K. Jena, Co-ordinator and DDG (Fisheries Science), ICAR, New Delhi. Dr. Shubhadeep Ghosh, ADG (Marine Fisheries), Dr. Devika Pillai, ADG (Inland Fisheries) and project personnel (PIs and Co-PIs) of nodal and collaborating institutes were present during the meeting.

National Scientific Hindi Seminar-cum-Workshop

A National Scientific Hindi Seminar-cum-Workshop on 'New Directions in Fisheries Conservation Science' was organized on September 25, 2024. The event was inaugurated by Dr. Anand Kumar Singh, Vice Chancellor, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. On this occasion, Director, ICAR-NBFGR emphasized the need to organize such workshop in Official Language Hindi for effective dissemination of technologies to stakeholders. In his address, Chief Guest Dr. Singh said that the fisheries resources of the country play an important role in overcoming the problem of malnutrition prevalent in the society, generating employment opportunities and increasing

Dignitaries and collaborative partners of the review meeting of North East

Dignitaries and participants of CRP on Genomics review meeting

Dignitaries of Hindi seminar-cum-workshop

livelihood options for local communities, hence there is an urgent need to conserve fisheries resources and disseminating the related knowledge to the stakeholders in common language is itself a very important effort. The aim of this symposium was to highlight new dimensions of conservation and management of fishery resources as well as to encourage scientific dialogue in Hindi language, which is a laudable effort. More than 170 participants from 26 research and academic institutions participated in this workshop in hybrid mode and 122 research abstracts were presented during the program.

Training on AMR and WHONET software

Training on 'Antimicrobial Susceptibility Testing and WHONET software for data management of Antimicrobial Resistance (AMR)' was organised under All India Network Project on AMR (AINP-AMR) in Fisheries and Livestock at ICAR-NBFGR, Lucknow, from October 15-17, 2024. A total of 17 persons comprising of PIs/Co-PIs of new centres from Animal Science, Fisheries Science and Regional Disease Diagnostic Labs (RDDLs) participated in the training. The training was organised with the financial support from UN FAO, ECTAD India.

National workshop on 'Conservation of indigenous fishes in changing climate scenario'

A 2-days National Workshop on 'Conservation of indigenous fishes of Jammu & Kashmir in changing climate scenario' was organized during November 18-19, 2024, at Srinagar in collaboration with Sher-e-Kashmir University of Agricultural Sciences and Technology (SKUAST), Kashmir. On this occasion, a MoU was signed between ICAR-NBFGR and the Faculty of Fisheries, SKUAST, Kashmir, to promote research and academic collaboration for the growth of hill stream fisheries. The program was attended by over 200 researchers with 12 lead, 56 oral and 20 poster presentations on various aspects of climate change, indigenous germplasm, sustainable fisheries management & biodiversity conservation.

Brainstorming Session on 'Climate adaptive conservation of aquatic genetic resources'

A brainstorming session on 'Climate adaptive conservation of aquatic

Glimpses of AMR and WHONET training


Glimpses of National workshop

genetic resources' was organised at NAAS complex, New Delhi on December 20, 2024, by National Academy of Agricultural Sciences, New Delhi, and ICAR-NBFGR, Lucknow. Dr. K M Bujarbaruah, Vice President, NAAS chaired the event and Dr. W.S. Lakra, Secretary, NAAS, invited for fruitful interactions for the way forward in policy and research aspects related to climate change in fisheries and aquaculture. Director, ICAR-NBFGR, and Convener of the event, emphasised on the changing climatic conditions and research as well as policy needs for preserving the valuable fish genetic resources of the country. The session included lectures on climate change covering freshwater, marine and brackish water systems, genomic approaches and AMR in microbes and policy guidelines to mitigate these changes. A total of 50 participants participated in the hybrid mode event.

Important Institutional Meetings

Research Advisory Committee (RAC) Meeting

The 28th RAC meeting of the Institute was held during March 13-14, 2024, under the Chairmanship of Dr. W.S. Lakra, Former Vice Chancellor, ICAR-CIFE, Mumbai and Former Director, ICAR-NBFGR, Lucknow. RAC members, Dr. M.H. Balkhi, Former Dean, Faculty of Fisheries, SKUAS&T, Srinagar (J&K); Dr. A.D. Diwan, Former ADG (Marine Fisheries), ICAR, New Delhi; Dr. G. Gopikrishna, Former Head, Nutrition, Genetics & Biotechnology, ICAR-CIBA, Chennai and Dr. Shubhadeep Ghosh, ADG (Marine Fisheries), ICAR, New Delhi, attended the meeting. The Director, ICAR-NBFGR, Lucknow, welcomed the RAC members and other staff. Dr. Neeraj Sood, Member Secretary, RAC presented the action taken report on the recommendations of previous RAC meeting. The division-wise presentations were made by the respective HoD/SIC.


Glimpses of brainstorming session

Institute Research Committee (IRC) Meeting

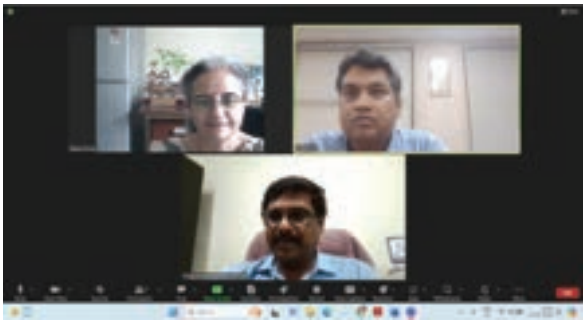
The 37th Annual IRC Meeting was held during 29-30 April, 2024 at ICAR-NBFGR, Lucknow. Dr. Mahender Singh, Member-Secretary, IRC briefed the house about ongoing projects. In the opening remarks, the Chairman welcomed the participants and outlined the progress made during the preceding year.

He also briefed the house about the various important events, and international and national seminars


Glimpses of IRC meeting

RAC meeting in progress

planned during the year. This was followed by discussion on major RAC recommendations, presented by Dr. Neeraj Sood, Member Secretary, RAC. This was followed by division wise presentations starting with GEEC Division, PAGR centre, EAAH division and GCR Division. In closing remarks, Chairman, IRC appreciated the progress presented by PIs and Co-PIs in all ongoing projects.



IBSC meetings in progress

Institute Management Committee (IMC) Meeting

The 38th IMC meeting was held on July 8, 2024. During the meeting, proceedings and action taken report for the 37th meeting of the IMC was approved. Besides, the progress report of ICAR-NBFGR, Lucknow, were presented and works (civil & electrical), procurement of equipment during 2024-25 was prioritized. Statement of expenditure for the year 2024-25 was also presented in the meeting.

Institutional Biosafety Committee (IBSC) Meeting

ICAR-NBFGR conducted 4th and 5th Institutional Biosafety Committee (IBSC) on July 12, 2024 and December 13, 2024, respectively. The meeting was intended to


IMC meeting in progress


IAEC meetings in progress

review the research projects of the ICAR-NBFGR regarding the implementation of the biosafety regulatory framework. The meeting was held in hybrid mode. The meeting was attended Dr. Ravindra Kumar, Principal Scientist & Chairman IBSC, Dr. Bhupendra Narain Singh, DBT Nominee and Chief Scientist, CSIR-CDRI, Lucknow; Dr. Chandra Bhushan Kumar, Scientist and Member Secretary, ICAR-NBFGR; Dr. Anjali Gupta, Independent Medical Officer and Biosafety Officer; Outside experts, Dr. T. Raja Swaminathan, Principal Scientist & Head, Microbiology, Fermentation & Biotechnology Division, ICAR-CIFT, Kochi, Kerala; and Dr. Reena Arora, Principal Scientist, ICAR-NBAGR, Karnal; Internal members: Dr. Rajeev Kumar Singh, Principal Scientist & Head, GEEC Division and Dr. Anutosh Paria, Scientist, ICAR-NBFGR, Lucknow.

Institutional Animal Ethics Committee (IAEC) Meeting

Two meetings of Institutional Animal Ethics Committee of ICAR-NBFGR, Lucknow, were held on January 23, 2024 and November 5, 2024 to discuss proposals received from the Principal Investigators for experiments on animals. Dr. Neeraj Sood, Veterinarian and Chairman, IAEC; Dr. Neelam Bala, CPCSEA- Main Nominee; Dr. Atul Kumar Baranwal, Link Nominee; Dr. Irfan Aziz, Scientist from outside the institute; Dr. Pradeep Kumar, Socially-aware nominee; Dr. Tarachand Kumawat, Biological Scientist and Member-Secretary; Dr. Monika Gupta and Ms. Tanwy Dasmandal, Scientists from different biological discipline; Dr. Santosh Kumar, Scientist In-charge of Animal House Facility attended the meetings. In the meetings, the proposals received for IAEC approval were discussed. All the proposals were approved by the committee subject to inclusion of suggested corrections by the IAEC. The Annual Animal House Inspection of ICAR-NBFGR for 2024 was conducted by Dr. Neelam Bala, Main Nominee CPCSEA as per the CPCSEA norms on December 19, 2024.

Important Days and Celebrations

Celebration of National Fish Farmers' Day

Glimpses of Republic Day celebration

Republic Day

Institute celebrated Republic Day on January 26, 2024, with great enthusiasm. Director hoisted the National Flag in the presence of staff members of the institute. In his remarks, he highlighted the achievements of the institute and appreciated the efforts of all staff members. On this occasion, sports and games were organized among the staff and their family members.

World Wetlands Day

The World Wetlands Day-2024 was celebrated by the institutes on February 2, 2024, as an event at the Coastal and Marine Biodiversity Centre in Airoli, Thane District, Maharashtra, in collaboration with the Mangrove Cell and Mangrove Foundation of the Forest Department, Maharashtra. The event featured the participation of 50 students from Navi Mumbai Municipal Corporation School, Airoli and the Department of Biotechnology at AMITY University, Mumbai, who took part in a quiz on

Celebration of World Wetlands Day

'Wetlands and Human Wellbeing'. The event concluded with a tour for the students to the NBFGR's clownfish hatchery facility and the

Interpretation Centre on Mangrove Biodiversity, providing a hands-on learning experience about marine ecosystems.

International Women's Day

ICAR-NBFGR celebrated International Women's Day 2024 on March 8 and 11, 2024, in allegiance to the campaign theme on *'Inspire Inclusion'*. Prof. Monisha Banerjee, Director, IAMGID, University of Lucknow, was the Guest of Honour. Director, ICAR-NBFGR threw light on the activities initiated to promote women in fisheries and entrepreneurship across the country. Dr. Vindhya Mohindra, Chairperson of Women's Cell, spoke on the necessity and importance of Women's Day and stressed the importance of inspiring and empowering women in every field. A stunning collage using photos of staff and students of ICAR-NBFGR striking the #InspireInclusion pose was also released reiterating the institute's commitment to the international theme. Prof. Monisha delivered a talk on 'Genetic studies: A personalized medicine approach in women's health'. The institute also honored 3 fisherwomen and 2 women entrepreneurs to appreciate their contribution towards societal upliftment. An elocution competition on 'Gender balance is also an economic issue' for staff and 'Inspire Inclusion: A gender equal world' for students was also organized on March 8, 2024. The winners of the competition were felicitated on March 11, 2024.

Collage of staff and students of ICAR-NBFGR striking #InspireInclusion pose


Address by Chief Guest, Prof. Monisha Banerjee

International 'Girls in ICT' Day

On April 25, 2024, the Institute celebrated International 'Girls in ICT' Day 2024 on the theme 'Digital Skills for Life and Leadership' in the presence of Mrs. Sharmila Singh, Principal, Pioneer Montessori Inter College. On this occasion, 20 female students from Class IX to XI actively participated in the program. Director, ICAR-NBFGR, encouraged young minds to embrace ICT-based services, particularly in agriculture and fisheries, as prospective career paths. Dr. Vindhya Mohindra, HoD and Chairperson of Women's Cell, shed light on the pivotal role of ICT in agricultural and allied sciences. Ms. Tanwy Dasmandal, Scientist, delivered a concise presentation elucidating various technologies prevailing in today's world, emphasizing the importance of digital skills for personal and professional growth. The event

Glimpses of International 'Girls in ICT' Day

concluded with the distribution of participation certificates to the students.

World Environment Day

The institute commemorated 'World Environment Day' on June 5, 2024, at ICAR NBFGR, Lucknow and its DST facility for marine ornamentals, CAS in Marine Biology, Faculty of Fisheries, Annamalai University, Parangipettai, Tamil Nadu, under the theme of 'Land restoration, desertification and drought resilience', and the slogan was 'Our Land Our Future'. The program was initiated with the welcome address by Dr. Monika Gupta. Dr. Rejani Chandran, a scientist, provided a comprehensive overview of World Environment Day, including the significance of the theme for the year. Dr. Sanjay Arora, Principal Scientist at ICAR-CSSRI, RC, Lucknow, delivered a talk on 'Restoring Sodic Lands for Environmental Sustainability' focusing the need to develop a strategic plan for the sustainable management of lands for future generations. All the scientific staff and research scholars participated in the discussion. Essay competitions were also conducted for the Institute's research scholars on the topic

Celebration of World Environment Day

of 'E-Waste Management for the Local Environment'. Around 50 B.F.Sc. students participated in the program at Annamalai University. Over 150 participants, including staff members and research scholars of the ICAR-NBFGR Headquarters, PMFGR Centre Kochi, and ARTU Unit Chinhat, also participated.

International Yoga Day

The institute observed 10th International Yoga Day 2024 on June 21, 2024 as per the guideline of Ministry of AYUSH, Gov. of India with theme of 'Yoga for Self and Society'. Dr. Basdeo Kushwaha, Nodal Officer Yoga, welcomed the participants and Yoga Teacher and explained the purpose of International Yoga Day celebration and its impact on human health. The Yoga teacher explained the benefits of practicing Yoga in daily life in order to maintain overall body fitness. The staff, students and contractual staff enthusiastically participated and learned various Yogasans and Pranayams.

Fish Farmers' Day

The institute organized 24th National Fish Farmers Day on July 10, 2024. Dr. Bijendra Singh, Chief Guest and Honorable Vice

Glimpses of Independence Day celebration

Glimpses of International Yoga Day celebration

Celebration of Fish Farmers' Day

Chancellor, ANDUAT, Kumarganj, Ayodhya, addressed fish farmers, and emphasized increasing fish production for increasing population of the country. Director emphasized on making full efforts for a developed India by making the fish farmers aware about the recent technological developments in the fisheries and aquaculture sector. Various aquaculture inputs were also distributed to farmers.

Independence Day

Institute celebrated 78th Independence Day with full enthusiasm and joy. Director hoisted the National Flag in the presence of staff and congratulated the staff for the achievements of the institute in enhancing the income of farming community. He stressed to undertake more research work on innovations in climate resilient technology for fish biodiversity conservation and sustainable utilization. The programme concluded with a cultural programme by children of staff members of the Institute.

Uprooting parthenium plant

Parthenium Awareness Week

As per the directives of ICAR for making ICAR Institutes' campuses parthenium free, as a component of Swachh Bharat Abhiyan, ICAR-NBFGR, organised 19th Parthenium Awareness week during August 16-22, 2024. The staff of the Institute carefully removed Parthenium from the Institute campus and its surroundings.

Vigilance Awareness Week

Vigilance Awareness Week-2024 was observed at the institute during October 28 to November 03, 2024 with the theme specified by the CVC 'Culture of Integrity for Nation's Prosperity'. The week commenced with the introductory remarks of Dr. Basdeo Kushwaha Vigilance Officer, in a specially convened programme on October 28, 2024 and the Pledge was administered by the Director to all staff to maintain integrity and transparency in the office. Several competitions, including invited

Staff taking vigilance awareness pledge

Formation of human chain and walkathon during Vigilance Awareness Week 2024

AMR awareness week celebration

lecture and human chain as well as walkathon, were also organized.

World AMR Awareness Week (WAAW)

ICAR-NBFGR celebrated World AMR Awareness Week (WAAW) during November 18-24, 2024, on 'Educate. Advocate. Act now' theme by organising several awareness programmes for different stakeholders. School and college students (~400 nos.) were sensitised about antimicrobial resistance. On World Fisheries Day, i.e. November 21, 2024, 40 fish farmers were made aware about the concern of AMR and emphasized on the responsible use of antibiotics in aquaculture.

World Fisheries Day

The Institute celebrated World Fisheries Day on November 21, 2024, which was inaugurated by Dr. A. K Singh, Former Director, ICAR-DCFR, Bhimtal. Director, ICAR-NBFGR, emphasized the conservation and culture of Small Indigenous Fish (SIF). The chief guest sensitized the farmers about the culture of minor carps and small fish for their livelihood and income generation. On the occasion, *Germplasm Resource Centre for Small Indigenous Fish* was inaugurated, and the fish seeds of important species such as *Labeo bata, L. gonius, Ompok bimaculatus* and *Mystus tengra* were released. This program was attended by about 50 fish farmers from different districts from UP and the fish seeds of SIF were distributed to the farmers.

World Fisheries Day Celebration

Foundation Day Celebration

The Bureau has celebrated its 41st Foundation Day on a momentous occasion coinciding with *Matsya Dwadashi*, a day of profound cultural and spiritual significance. The confluence of these two events underscores the institute's mission to conserve and sustainably manage India's invaluable aquatic genetic resources. The day commenced with a warm welcome extended to the distinguished Chief Guest, Dr. A. K. Singh, Vice-Chancellor, Rani Lakshmi Bai Central Agricultural University, Jhansi; Special Guest, Dr. W. S. Lakra, Secretary of NAAS and Former Director of ICAR-NBFGR and ICAR-CIFE; Guest of Honours, Dr. S. D. Singh, Former ADG (Inland Fisheries), Dr. A. N. Mukhopadhyay, Former VC, Assam Agriculture University, Jorhat, Dr. A. G. Ponniah, Former Director, ICAR-NBFGR & ICAR-CIBA, Dr. A. K. Singh, Former Director, ICAR-DCFR; Prof. I. J. Singh, Former Dean, College of Fisheries, GBPUAT & Distinguished Directors from other institutes, Prof. Rina Chakrabarti, Department of Zoology, Delhi University. Awardees, esteemed farmers, and other

distinguished contributors were honoured for their contributions to the institute and to the sector. The day concluded with a collective sense of pride, inspiration, and renewed dedication. An Open House was arranged in Ganga Aquarium and National Fish Museum and Repository for over 500 students, creating awareness of fish conservation.

List of ICAR-NBFGR 2024 Institutional Award winners

Category of Award	Name
Best Scientist Award	Dr. Rejani Chandran
Best Research Student Award	Dr. Arathi Dharmaratnam
Best Technical Staff Award	Shri Amit Singh Bisht
Best Technical Staff Award	Shri Ravi Kumar
Best Administrative Staff Award	Shri Sanjay Kumar
Best Administrative Staff Award	Shri Vinay Kumar Srivastava
Best Skilled Support Staff Award	Shri Vicky Kumar Prajapati
Student Merit Award for 10th Std.	Aman Husain
Student Merit Award for 10th Std.	Anwesha Pradhan
Best Performer Award	Dr. Anutosh Paria
Best Performer Award	Dr. Monika Gupta
Best Performer Award	Dr. Arun Sudhagar
Best Performer Award	Dr. Kantharajan G.
Best Performer Award	Shri Sandeep
Best Performer Award	Shri Harivilas
Best Performer Award	Dr. Murali S.
Appreciation Award	Dr. Chandra Bhushan Kumar
Appreciation Award	Dr. Tarachand Kumawat
Appreciation Award	Shri Subhash Chandra
Appreciation Award	Shri Ram Sakal Chaurasia
Appreciation Award	Shri Krishna K. Singh
Appreciation Award	Dr. Vikash Sahu
Appreciation Award	Shri Anshul Kumar Verma
Best Fisheries Entrepreneur Award	Shri Indra Mani Raja
Best Fisheries Entrepreneur Award	Shri G. Mustafa
Best Fisheries Entrepreneur Award	Dr. Sanjay Srivastava
Best Fish Farmer Award	Shri Sunil Kumar
Best Fish Farmer Award	Shri Masood Ahmad
Best Fish Farmer Award	Shri Sonnel Nerhona
Best Farmer Award	Shri Shailendra Kumar Raghuvanshi

Glimpses of 41st Institute Foundation Day Celebration

Kisan Diwas celebration

Kisan Diwas

The institute organised awareness programs for farmers on the occasion of Kisan Diwas to mark the birth anniversary of Former Prime Minister of India, Shri Chaudhary Charan Singh ji on December 23, 2024 at ARTU, Chinhat. About 35 participants, including Scheduled Caste (SC) farmers and staff, attended the programme. Farmers were briefed on different aquaculture systems like RAS, integrated aquaculture, organic farming, aquatic health management and other latest technologies. Importance of fish culture in relation to best management practices was discussed for the enhancing fish productivity. Dr. V.K. Tiwari, Former Principal Scientist, ICAR-CIFE, Mumbai addressed the gathering and distributed appreciation letter to the 3 SC aquafarmers.

Extension and Community Outreach

Hon'ble Minister for Fisheries, Animal Husbandry & Dairying and Panchayati Raj visiting ICAR-NBFGR stall at a conference

Input distribution to farmers of West Bengal

Capacity building and input distribution at Chotanagpur Plateau regions of West Bengal

Institute in collaboration with Dhaanyaganga Krishi Vigyan Kendra, Sargachi, Murshidabad; Rathindra Krishi Vigyan Kendra, Sriniketan, Birbhum and Hemnagar Sundarban Dream, West Bengal organised 3 sensitization and capacity development program for fish farmers of SC and ST communities at different locations namely Sargachi, Murshidabad; Abinashpur, Suri, Birbhum and Sriniketan, West Bengal under the STC and SCSP schemes during January 12-14, 2024. The main aim of the programmes was to empower and to build self-confidence among the farmers through fisheries enterprise and to motivate them in adapting fishery-based livelihood opportunities in Chotanagpur Plateau region of West Bengal. Over 250 fish farmers from SC & ST community belonging to Murshidabad and Birbhum districts of West Bengal participated in the programmes. Important aquaculture inputs such as quality fish seed of IMC and other high value food fishes, fish feed, aquarium, FRP tanks etc. were distributed.

Field demonstration on drone application

Institute organized a field demonstration of drone in large water body (25 Acre) at Mehura-Fatepurva village, Laullai, Chinhat, Lucknow on January 12, 2024. The programme fostered awareness and disseminated knowledge about drone technologies among the fish farming communities and unemployed youth. About 50 beneficiaries from diverse stakeholder groups actively participated. Drone for fish feed broadcasting and spraying medicine etc. in large aqua farm for enhancing fish productivity and opportunity for custom hiring support to fish farmers.

Input distribution program at Assam

Institute, in collaboration with the Department of Zoology, Gauhati University, Guwahati organised an awareness-cum-input distribution

View of drone demonstration



Awareness cum input distribution at Baksa district, Assam

program at Tamulpur village, Baksa district, Assam, an aspirational district, under NEH component on February 11, 2024. A total of 54 fish farmers participated and were provided with quality seed and feed to augment the aquaculture practices in the region. Lectures on various aspects of aquaculture, supplementary feed formulation, catfish hatchery management, importance of germplasm management for sustainable fisheries management were delivered.

Awareness cum input distribution program at West Tripura

ICAR-NBFGR organized one day awareness cum input distribution program under NEH & STC schemes to demonstrate conservation aquaculture and polyculture methods on February, 12 2024 at Uttar Majlishpur Gram Panchayat, West Tripura District in collaboration with ICAR-RC for NEH Region, Tripura Centre, Lembucherra. A total of 100 fish farmers participated in the program. Different inputs like good quality IMC fingerlings, quick lime, floating pelleted fish feed, handy, cast net, dragnet, and ice box were distributed. Technical sessions focused on various fish culture methods like fish conservation practices, fish-cum horticulture, fish cum agroforestry system etc.

Awareness-cum-input distribution program at Masouda, Uttar Pradesh

Awareness-cum-capacity building and input distribution program on 'Sustainable utilization of fisheries resource and ornamental fish culture for income generation' was conducted under SCSP scheme on February 16, 2024 in KVK, Masouda, Uttar Pradesh. A total of 50 farmers were involved and inputs like fabricated glass aquarium with accessories, feed, medicine, ornamental fish, ice-boxes etc were provided.

Augmenting livelihood of fish farmers through establishing trout hatchery and input distribution

Institute in collaboration with Hemnagar Sundarban Dream, West Bengal established a small-scale trout hatchery and rearing unit, and organised a sensitization and capacity development program for fish farmers of scheduled tribe and scheduled caste communities at Takdah, Darjeeling, West Bengal under the STC and SCSP schemes on February 19, 2024. A total of 305 fish farmers from ST & SC communities belonging to Darjeeling district of West Bengal participated. A small-scale trout hatchery and rearing unit was established, and other important aquaculture inputs such as quality fish seed of high value food fishes, fish feed, FRP tanks for ornamental aquaculture, pond lining material etc. were distributed. In the technical session, different important aspects like scientific fish farming, species diversification,


Input distribution to farmers of West Tripura



Input distribution and interaction with farmers

disease management and feed management were discussed.

Capacity building and livelihood support programs for fish farmers of hilly regions

Institute in collaboration with Department of Fisheries, Government of Sikkim and Hemnagar Sundarban Dream, West Bengal organised 2 capacity development and aquaculture input distribution programs for fish farmers of hilly region at Mirik, West Bengal and Gangtok, Sikkim under the STC, SCSP and NEH Schemes during February 20-21, 2024. A total of 120 fish farmers of Mirik and Gangtok participated in the programme. Scientific fish farming, species diversification, feed management, disease management and reporting of fish diseases through ReportFisDisease app were discussed. Important aquaculture inputs such as quality fish seed of high value food fishes, fish feed, FRP tanks for ornamental aquaculture etc. were distributed.

Aquarium Pathshala for fostering women entrepreneurship under SCSP

ICAR-NBFGR, Lucknow, organized a 3-day Ornamental Fish Aquarium Pathshala in Barabanki, Uttar Pradesh during February 21-23, 2024, under the Mission Navshakti initiative of the SCSP on aquarium fabrication, assembly, and maintenance, equipping them with entrepreneurial skills for sustainable livelihoods in the ornamental fish industry. Participants also visited Machli Ghar at Nawab Wajid Ali Shah Zoological Garden, Lucknow, as well as Ganga Aquarium and Museum at ICAR-NBFGR, Lucknow. The initiative promotes backyard fish rearing, particularly benefiting small landholding women, fostering economic independence and self-sufficiency.

Input distribution to farmers of Takdah, Darjeeling

Input distribution to farmers of West Bengal and Sikkim

Awareness cum sensitization program on integrated fish farming

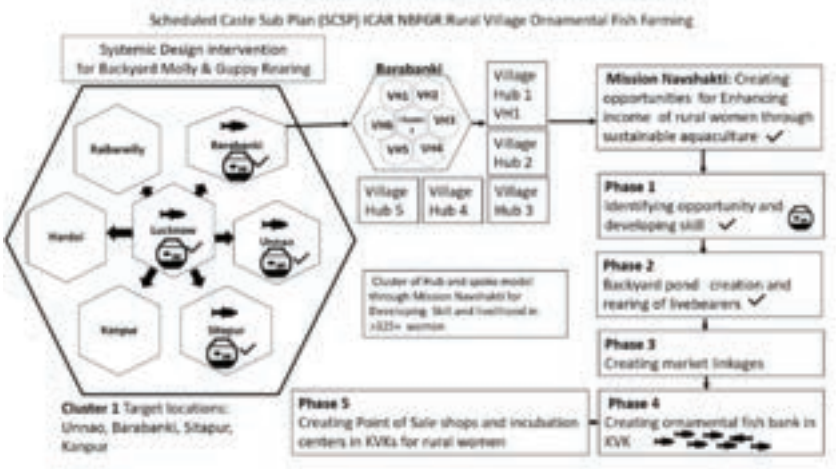
Institute organized an awareness cum sensitization program at ARTU, Chinhat, Lucknow for 50 beneficiaries of Gorakhpur, U.P. under ATMA programme of Department of Agriculture, U.P. on February 23, 2024.

Capacity development programme and input distribution for fish farmers at Gangasagar

Institute, in association with Hemnagar Sundarban Dream, West Bengal organised a stakeholder meet-cum-awareness programme under SCSP scheme at Gangasagar, South 24 Parganas district, West Bengal on February 26, 2024. Several fishery inputs including quality fish seeds of high-value food fishes, cast nets, etc. were distributed to 50 beneficiaries. Topics such as pond preparation, species diversification, fish culture and feed management, and disease reporting, were discussed during the technical session.

Har Ghar, Machli Ghar Initiative

ICAR-NBFGR, Lucknow, organized an Ornamental Fish Pathshala in Dhankutti, Barabanki, under the SCSP Mission NavShakti on March 1, 2024, as part of the 'Har Ghar, Machli Ghar' initiative. Women were trained to rear molly and guppy livebearers in backyard ponds, cement tanks, and repurposed cattle troughs, promoting household-based fish farming. With 50 ponds being established by Self-Help Groups (SHGs), the initiative fosters sustainable



Workplan of SCSP Aquarium Pathshala

livelihoods through a public-private partnership, enabling women to sell fish via distributors or online platforms.

Stake holder consultation and input distribution program at Puducherry

A stake holder consultation and input distribution program was jointly organized by the Bureau, Fish for all Research and Training centre, M.S. Swaminathan Research Foundation, Poompuhar, Kanchi Mamunivar Government Institute for Post Graduate Studies & Research (KMGIPSR), Puducherry at Puducherry on March 7, 2024.

Input distribution at Puducherry

Awareness cum input distribution at Gangasagar

A total of 100 fish farmers from 26 villages participated. Necessary inputs for fish farming such as nets for harvesting, hapa, feed etc., were distributed to the beneficiaries.

Captive breeding of indigenous fish at Peechi, Kerala

The institute has successfully demonstrated and disseminated technology during June 11-12, 2024 for the captive breeding and rearing of indigenous fish species, *viz*, *Clarias dussumieri*, *Heteropneustes fossilis*, *Horabagrus brachysoma*, and *Labeo dussumieri* in collaboration and MoU with Agency for Development of Aquaculture and Department of Fisheries, Peechi, Thrissur, Kerala. Technical consultation is continuously provided for the seed production of *H. brachysoma* and *L. dussumieri.*

Livelihood support of fish farmers of Gangasagar

Institute in association with Hemnagar Sundarban Dream, West Bengal, organised a Stakeholder-meet-cum awareness programme at Gangasagar, West Bengal, on June 27, 2024. A total of 100 fish farmers, including 20 women from 7 villages of the island, participated in the programme.

Empowering urban SHG women in ornamental fish micro enterprises

An interactive outreach workshop and ornamental fish distribution programme was held at Azad Nagar, Alambagh, Lucknow, under Mission NavShakti by ICAR-NBFGR,

Activities under Har Ghar, Machli Ghar initiative

Brooder selection of *Clarias dussumieri* and *Heteropneustes fossilis*

in collaboration with the District Urban Development Authority and AquaWorld on July 1, 2024. The event supported 25 Self-Help Group (SHG) women and two cobblers, providing training in aquarium fabrication and ornamental fish rearing, along with essential inputs like umbrellas and solar lights to promote economic stability.

Empowering women through ornamental fisheries

ICAR-NBFGR, under the SCSP, launched a skill development programme at Valmiki Sabhagrah, Valmiki Puri, Lucknow, in collaboration with AquaWorld, HiTech Fisheries, and Safai Karamchari Andolan on July 1, 2024. Dependents of safai karamcharis were trained in aquarium fabrication, ornamental fish rearing, and business management, creating sustainable livelihood opportunities. Participants received hands-on training, startup kits, and WhatsApp-based mentorship for ongoing support. They also learned 'Kabad Se Jugaad' techniques, using scrap materials to build low-cost aquariums. The women plan to scale up under the brand "VOFA: Valmiki Ornamental Fish Aquarium", aiming for financial independence and social dignity.

Fisheries Summer Meet 2024

To foster consultation with States/UTs, exhibit the contributions made by fish farmers, entrepreneurs and fishermen for the development of the fisheries and aquaculture sector and raise awareness about various DoF initiatives, 'Fisheries Summer Meet 2024' was organised by DoF, Government of India at Madurai, Tamil Nadu on July 12, 2024.

Hon'ble Minister for Fisheries, Animal Husbandry & Dairying and Panchayati Raj at ICAR-NBFGR stall

Awareness program on fish farming and fish health testing

Institute organized an 'Awareness program on fish farming, fish health testing, and reducing antimicrobial resistance in aquaculture' on July 27, 2024, under TSP in Kataundhi village, Sonbhadra district, Uttar Pradesh. A total of 50 tribal fish farmers participated in the program.

Awareness cum input distribution at Gangasagar

Activities to empower SC women through ornamental fisheries

Awareness program on fish farming and health management

Input distribution to farmers of Shillong, Meghalaya

Livelihood enhancement of fisher folks at ICAR-RC for NEH, Shillong

An Awareness-cum-input distribution programme for livelihood enhancement of fisherfolk was organised by the institute at ICAR Research Complex for NEH Region, Umiam, Shillong, Meghalaya on July 31, 2024. A total of 30 fish farmers were made aware of 'ReportFishDisease' app for timely reporting of diseases. A technical compendium published by NBFGR entitled, 'Advanced fisheries techniques for conservation and income generation: A guide' was released. Thirty beneficiaries were given aquaculture related inputs such as ice box, fish feed and fish seed.

Community empowerment of fish farmers at Sargachhi

Institute, in collaboration with Dhaanyaganga KVK, Sargachhi, organised skill development training cum demonstration program on 'Breeding techniques of fishes for conservation and livelihood development' and input distribution program during August 1-2, 2024 under SCSP scheme. A total of 70 fish farmers of SC community and twelve school students benefited by the program. On this occasion, live fish seed of diversified indigenous fish species *viz.* catla, rohu, mrigal, singhi, kawai and pabda, were distributed to farmers.

Dissemination of captive breeding technology

On-field demonstration of captive breeding of yellow catfish, *Horabagrus brachysoma,* developed by ICAR-NBFGR, was successfully carried out at AQURA fish farm during August 1-20, 2024. This achievement demonstrates the potential of farmer-driven aquaculture initiatives to enhance conservation efforts and ensure the sustainable propagation of endangered indigenous fish species. Similarly, the institute also successfully developed breeding

Input distribution at Sargachhi

Demonstration of technology transfer of *Horabagrus brahcysoma* to AQURA fish farm

protocol for another endemic and endangered catfish, *Horabagrus nigricollaris,* from Chalakudy river, which was adopted by Bio Organic World, a private hatchery in Chalakudy in November 2024.

Mission NavShakti 2.0 for livelihood opportunities

ICAR-NBFGR, Lucknow, in collaboration with ICAR-KVK Katia, Sitapur, conducted skill development training on ornamental fish rearing and aquarium fabrication under Mission NavShakti 2.0 of the SCSP on August 23-24, 2024. Women from Chhi, Katia, and Pratappur villages were trained in fish keeping, maintenance, and marketing, while Scheduled Caste farmers received startup kits including a 50-litre icebox, solar light with a USB charger, and a weighing machine.

Hands-on training on aquarium fabrication

Awareness cum input distribution to farmers of Ranchi

Awareness-cum-input distribution programme at Ranchi

An awareness-cum-input distribution programme was organised by the institute in collaboration with ICAR-IIAB, Ranchi under STC scheme for community empowerment through sensitization, technology demonstration and capacity development of fish farmers at Ranchi, Jharkhand on August 30, 2024. More than 100 tribal fish farmers participated in the programme and fish culture inputs including fish feed, ice box and high-quality indigenous

fish seed were provided to fish farmers. Additionally, stakeholders were also made aware of the 'ReportFishDisease' app for timely reporting of diseases and best management practices for aquaculture.

Ranching of threatened catfish in Periyar river

Institute, in collaboration with the Kerala Forest Department, conducted a conservation ranching programme in the Periyar river at Malayattoor on September 5, 2024. A total of 4,000 fingerlings (2,000 each) of 2 threatened catfish species, Near Threatened *Clarias dussumieri* (Malabar catfish) and Vulnerable *Horabagrus brachysoma* (Yellow catfish) were released to enhance wild populations.

Awareness programme cum input distribution

Institute, organized 'Fish culture awareness cum aquaculture input & gears distribution programme for 50 SC farmers at ARTU, Chinhat, Lucknow on September 18, 2024. Aquaculture input and gears, such as lime, bleaching powder, potassium permanganate, hand sanitizer, hand wash, fishing net and electric weighing.

Ranching of threatened catfish species

Livelihood development of fisher-folk of Arunachal Pradesh

Institute organized an awareness-cum-input distribution programme in collaboration with ICAR-NRC on Yak, Dirang, Arunachal Pradesh on September 25, 2024 under STC scheme, aimed to promote aquaculture in the hill region of the North-East. More than 59 fish farmers participated, and received critical inputs such as amur carp and Indian major carp fingerlings, lime, fish feed, and solar lanterns. Experts provided detailed

Awareness cum input distribution at Chinhat

Awareness cum input distribution to farmers of Dirang, Arunachal Pradesh

Awareness cum input distribution at West Kameng district

Awareness cum input distribution to farmers of Chotanagpur plateau

explanations on fish farming techniques, contributing to the goal of enhancing fish production and farmer income through scientific and sustainable practices.

Sensitization-cum-input distribution programme for livelihood development

Institute, in collaboration with Krishi Vigyan Kendra, West Kameng district, Arunachal Pradesh, conducted a farmers' sensitization-cum-input distribution programme for livelihood development of the fisher folks under NEH Component of CRP-Agrobiodiversity on September 26, 2024. Around 50 fisherman beneficiaries, including 7 women, participated. The beneficiaries received essential fishery inputs like quality carp fish seed, fish feed, probiotics and fishing net. The event featured deliberation on different aspects of fish farming in this area of West Kameng district including sustainable fish culture methods. Institutes' flagship programme on fish disease surveillance through a farmer friendly app called ReportFishDisease app was popularized.

Livelihood promotion of tribal fish farmers and fishers of Chotanagpur plateau

Institute in collaboration with Hemnagar Sundarban Dreams organized 2 programmes under STC scheme at Deoghar, Jharkhand and Abinashpur, Suri, West Bengal for promoting livelihood through technology demonstration, capacity building of fish farmers on important aspects such as species diversification with incorporating high-value food fishes, scientific aquaculture practices for enhancing per unit production, culture of ornamental fishes, best management practices and disease reporting during September 26-27, 2024. More than 200 tribal fish farmers, mainly women, participated and fish culture inputs, including high-value indigenous fish seed, cast net, fish carrier (handi), were distributed to 120 fish farmers.

Awareness programme cum input distribution programme at Chinhat

Fish culture cum aquaculture input distribution programme was organized at ARTU, Chinhat, Lucknow for 53 SC farmers on October 28, 2024. Aquaculture inputs like lime was provided.

Input distribution at Chinhat

Capacity development programme for tribal fish farmers at Farakka, West Bengal

Institute, in collaboration with Hemnagar Sundarban Dream, West Bengal, organized a sensitization and capacity development programme for tribal fish farmers under STC scheme on November 02, 2024, at Farakka West Bengal. The programme was attended by 50 tribal fish farmers and other local eminent personalities. Aquaculture inputs such as fish carrier (handi), cast net, fish feed and live fish (singhi) were distributed.

Ranching of critically endangered fish endemic to Cauvery river

As a conservation initiative, the institute conducted ranching of young ones of *Hemibagrus pucntatus*, a critically endangered and endemic fish locally known as *Kettalu meenu,* was conducted in Shivanasamudra Fish Sanctuary, Cauvery river, on November 04,

Ranching and input distribution at Cauvery river

Awareness cum input distribution at Farakka

2024 in collaboration with Wildlife Association of South India (WASI), Bangalore, and Department of Fisheries, Karnataka, under the guidance of Padmasree Dr. S. Ayyappan, Former Secretary, DARE & DG, ICAR. During the occasion, coracle was provided as input to the local fishers as part of livelihood development through SCSP component.

Mission NavShakti 2.0 empowering rural women through ornamental fish farming

ICAR-NBFGR, Lucknow, launched an initiative under Mission NavShakti 2.0 to empower Scheduled Caste women in Dhankutti, Barabanki, through ornamental fish farming on November 5, 2024. SHGs from Gurwagouri, Basant Nagar, Rehramau, and Dhankutti have successfully transformed small spaces into fish ponds, cultivating molly and guppy species. Women were trained to rear ornamental fish, progressing from home aquariums to small ponds. Encouraged by their success, they are now forming a Farmer Producer Organization (FPO) with NABARD's support, ensuring market access, better pricing, and government resources. To enhance operational efficiency, ICAR-NBFGR is establishing a women-led resource hub, centralizing fish collection and sales. The hub, equipped with shared assets, reinforces the project's commitment to dignity and economic empowerment.

Awareness-cum-capacity building program for farmers in Sikkim

An awareness and capacity-building program aimed at enhancing the livelihoods of fisherfolk was organised by the institute, in collaboration with Fisheries Department, Sikkim at Gangtok, under NEH component on November 6, 2024. A total of 60 fish farmers participated. Shri Puran Kumar Gurung, Hon'ble Minister of Fisheries, Agriculture, Animal Husbandry & Veterinary Services, and Horticulture, was the chief guest. Hon'ble minister emphasised on strengthening regional fisheries

Mission NavShakti 2.0 empowering rural women through ornamental fish farming

Awareness cum input distribution at Gangtok

resources by fostering local expertise and encouraging the adoption of modern techniques. Important aquaculture-related inputs, including quality seed, feed, FRP tanks, ice box, and solar lanterns, were distributed to aquafarmers to support their livelihood.

Awareness-cum-capacity building program for fisheries stakeholders in North Sikkim

Institute, in collaboration with the Fisheries Department, Sikkim, organized an awareness and capacity-building program at KVK, Mangan, North Sikkim on November 7, 2024 under NEH component. A total of 60 fish farmers participated. The chief guest of the program, Shri. Kado Lepcha, Hon'ble Zilla Adhyaksha, Mangan emphasised on the adoption of advanced technologies for livelihood and regional development. Important aquaculture-related inputs, including quality seed, feed, FRP tanks, ice boxes, and solar lanterns, were distributed to stakeholders to support their livelihood.

Ranching of indigenous food fishes

On the occasion of World Fisheries day, November 21, 2024, a ranching program was carried out at Gomti river, Lucknow, where around 15,000 minor carps, *Labeo gonius* and *L. bata* fingerlings were ranched under CRP-Agrobiodiversity.

From backyards to business

ICAR-NBFGR launched Mission

Awareness cum input distribution at Mangan

Ranching of minor carps fingerlings in Gomti river

Boosting women's income through ornamental fish farming

Training and input distribution to farmers

NavShakti 2.0 under SCSP on November 21, 2024 to empower rural women through ornamental fish farming in Dhankutti, Barabanki. The project also established a centralized Fish Bank at KVK Katia, Sitapur, ensuring a steady supply of molly and guppy fish, reducing transportation costs, and boosting local production. Participants received startup kits, including iceboxes and solar lights, enhancing efficiency and market readiness.

Sustainable livelihood generation using indigenous ornamental fishes

A training cum input distribution program was organized by the institute on 'Conservation of ornamental fish genetic resources and their sustainable utilization for livelihood' at ICAR-NBFGR, Lucknow under SCSP scheme from November 26-28, 2024. A

total of 31 participants, including 12 women attended the program. Participants were introduced to the basics of ornamental fish farming, including species selection, tank setup, water quality management, feed management and disease management. Inputs such as aquarium, ornamental fishes, and feed were distributed.

Capacity development and input distribution programme for livelihood improvement at Sikkim

Institute, in collaboration with Hemnagar Sundarban Dream, West Bengal, organized a one-day 'Capacity development-cum-fishery inputs distribution programme' in Sirwani, East Sikkim under NEH component of CRP-Agrobiodiversity on December 4, 2024. The programme benefitted 50 fish farmers, including 25 women, who received vital inputs like singhi fingerlings, tarpaulin sheets, fish carriers, and fish feed. The institute highlighted the role of aquaculture and biofloc fish farming in enhancing livelihoods, while experts delivered sessions on advanced aquaculture practices, species diversification, and sustainable fish production with the aim to promote sustainable fisheries, empowering farmers, and advancing the Government's vision of 'Doubling farmers' income.

Field day on diversified aquaculture for livelihood improvement

A field day on 'Awareness cum demonstration of diversified aquaculture for livelihood improvement' was organised at Durganagar village, West

Awareness cum input distribution at Sirwani, East Sikkim

Field Day at Durganagar village, West Tripura

Awareness cum input distribution at Tripura

Tripura under NEH component on December, 20, 2024 in collaboration with ICAR-RC for NEH Region, Tripura Center, Lembucherra. Around 85 fish farmers, including 14 women, participated. The farmers received essential fishery inputs like quality Indian major carp fingerlings, fish feed, quick lime and cast net. The event featured expert deliberation on the scientific aspects of fish farming and the importance of species diversification for sustainable fish production.

Livelihood improvement of fisher-folk at Tripura

Institute, in collaboration with ICAR-RC for NEH Region, Tripura Center conducted an awareness-cum-input distribution program for livelihood improvement of fisher-folk under STC scheme on December 21, 2024 at Kobrakhamar village, West Tripura. Around 50 fish farmers, including 20 women, participated. The farmers received essential fishery inputs like quality Indian major carp fingerlings, singhi fingerlings, lime and cast net. The event focused on expert discussions regarding the scientific aspects of fish farming and the critical role of species diversification in promoting sustainable fish production.

Live Fish Germplasm Resource Centre

Broodstock selection at ICAR-NBFGR farm

Personnel involved

Farm In-charge: Aditya Kumar (June 29, 2024 onwards), Santosh Kumar (till June 28, 2024)

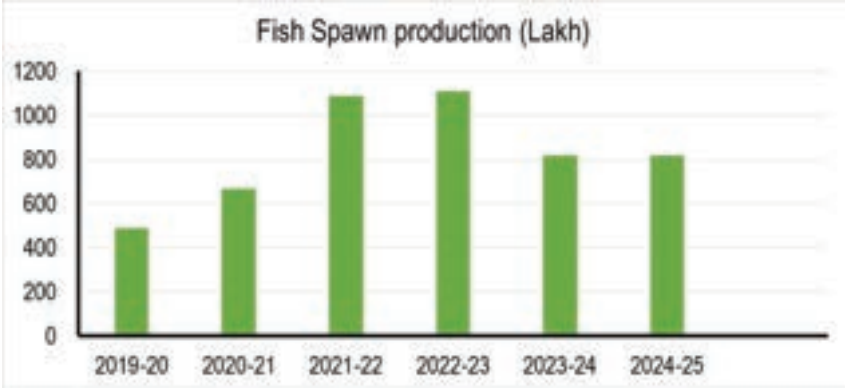
Team members: Rajeev K. Singh, Raghvendra Singh, Monika Gupta, Ajay Kumar Singh (till October 31, 2024), Deva Narayan, Ranjan Singh, Sushil Kumar and Dukhi Shyam Deo

Collection

Live specimens of *Rita rita* (n=164), *Ompok bimaculatus* (n=43), *Mystus bleekeri* (n=210), and *Mystus tengra* (n=64), *Chitala chitala* (150), *Notopterus notopterus* (98), *Mastacembalus armatus* (8), *Wallago attu* (27) were collected from Gomti river, Lucknow. Mixed riverine seed (1.5 Lakh) from Ganga river, Patna was also collected for broodstock development.

Seed production

Quality fish seed production is one of the important activities of the institute. Institute produced



815 lakh spawn of 14 species, *i.e. Labeo rohita*, *L. calbasu*, *L. bata*, *L. gonius*, *Catla catla*, *Cirrhinus mrigala*, *Cyprinus carpio*, *C. rubrofuscus*, *C. carpio* koi, *Carassius auratus*, *Ctenopharyngodon idella*, *Heteropneustes fossilis, Clarias magur* and *Channa striata,* and a revenue of Rs. 7,48,000 was generated.

Live germplasm resource centres at other places

The Institute has developed live germplasm resource centres at the following 6 places for the conservation and livelihood promotion of the local community:

1. Agatti, Lakshadweep
2. Airoli, Maharashtra
3. Gauhati University, Assam
4. Kerala University of Fisheries and Ocean Studies, Kochi, Kerala
5. Nagarjuna Sagar, Telangana
6. Pichavaram, Cuddalore, Tamil Nadu

Rita rita

Ompok bimaculatus

Award and Recognition

Team NSPAAD receiving e-Governance award

National Accreditation Board for Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

AQUATIC ANIMAL HEALTH LABORATORY, ICAR-NATIONAL BUREAU OF FISH GENETIC RESOURCES

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

CANAL RING ROAD, P.O. DILKUSHA, LUCKNOW, UTTAR PRADESH, INDIA

in the field of

TESTING

Certificate Number: TC-15085

Issue Date: 11/12/2024 Valid Until: 10/12/2028

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of thislaboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Entity: ICAR-NATIONAL BUREAU OF FISH GENETIC RESOURCES

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

Certificate of NABL accreditation

NABL accreditation

- ICAR-NBFGR's Aquatic Animal Health Laboratory was assessed and accredited in accordance with the standard ISO/IEC 17025:2017 for 25 pathogens of finfish, shellfish and molluscs on December 11, 2024.

Team NSPAAD, ICAR-NBFGR

- National Award for e-Governance 2024 (Silver) along with prize money of Rs. 5.0 lakhs for National Surveillance Programme for Aquatic Animal Diseases (NSPAAD) – Establishment of e-Governance in aquatic animal disease management system under category IV (Research on Citizen Centric Services by Academic/Research Institutions) organized by Department of Administrative Reforms and Public Grievances and Ministry of Electronics and Information Technology, Government of India; and Government of Maharashtra in 27th National Conference on e- Governance at Jio Convention Centre, Mumbai during September 3-4, 2024.

Dr. T. T. Ajith Kumar

- Distinguished Alumnus Award - 2024 by Annamalai University, Chidambaram.
- 'Padma Shri Prof. N. Balakrishnan Nair Award for Environmental Excellence' in the International Conference on Ecosystem conservation and Sustainable development, Bangalore, Karnataka on August 8, 2024.
- 'Aquaculture Contribution Award 2024' by Hawassa University, Ethiopia.

Dr. P.K. Pradhan

- Member, Institute Management Committee of ICAR-CIBA, Chennai.
- Member, Institute Management Committee of ICAR-CIFT, Kochi.

Dr. Ravindra Kumar

- Member, Institute Management Committee of ICAR-DCFR, Bhimtal.
- Member, Institute Management Committee of ICAR-IISR, Lucknow.

Dr. Neeraj Sood

- Dr. Punyabrata Das Research Award – 2024 by Aquatic Biodiversity Conservation Society (ABCS), Lucknow.
- Member of Regional Technical Working Group (RTWG) which has been entrusted with

responsibility for managing the implementation of Regional Aquatic Organism Health Strategy being implemented by Food and Agriculture Organisation of the United Nations, Rome, Italy and Network of Aquaculture Centres in Asia-Pacific, Bangkok.

Dr. V.S. Basheer

- Member, Institute Management Committee of ICAR-CMFRI, Kochi.

Dr. Achal Singh

- Certificate of Merit for oral presentation in 2nd International Conference organized by Department of Science, Maharishi School of Science and Humanities, Maharishi University of Information Technology, Lucknow on 'Innovation in Science and Technology for Sustainable Development 2.0' during November, 19-21, 2024.

Dr. Divya P.R.

- Prof. NJ Shetty Gold Medal for research presentation at 8th International Conference on Ecosystem Conservation and Sustainable Development organized by AET College and Society for Advancement of Biological Sciences, Bangaluru during August 8-9, 2024.

Dr. Divya P.R. receiving Prof. NJ Shetty Gold Medal

Dr. A. Kathirvelpandian

- Dr. Punyabrata Das Research Award – 2024 by Aquatic Biodiversity Conservation Society (ABCS), Lucknow.
- External Member of Research Council of Tamil Nadu Dr. J.

Dr. Charan R., receiving Young Scientist Award 2024

Dr. Kantharajan G., receiving Best Oral Presentation Award in 13th IFAF

Jayalalithaa Fisheries University (TNJFU), Nagappattinam.

- Chaired a session at International Conference on Integration and Transformation with SDGs (ICITS-2024) organised by Hindustan Institute of Technology and Science, Chennai, during April 15-16, 2024.

Dr. Charan R.

- Young Scientist Award - 2024 by Aquatic Biodiversity Conservation Society (ABCS), Lucknow.

Dr. Murali S.

- Best poster presentation award in 13th IFAF-Fostering Indian Fisheries and Aquaculture held at Kolkata during February 23-25, 2024.
- Best oral presentation award in National Workshop on Conservation of Indigenous Fishes of Jammu & Kashmir in changing climate scenario held at Faculty of Fisheries, SKUAST, Rangil, Ganderbal, J&K during November 18-19, 2024.

Dr. Arun Sudhagar S.

- Member of Technical Committee of Rajiv Gandhi Centre for Aquaculture (RGCA), overseeing the technical activities of Shrimp Evaluation Study Unit (SEU) at Rajakkamangalam, Tamil Nadu held on September 25, 2024.

Dr. Kantharajan G.

- Best oral presentation in Satellite Symposium on Fish Genetic Resources and Conservation conducted under 13th Indian Fisheries and Aquaculture Forum organised by ICAR-CIFRI at Kolkata during February 23-25, 2024.

Dr. Jaspareet Singh

- Young Scientist award in ICAR sponsored International Conference on Current Innovations and Technological Advances in Agriculture and Allied Sciences held at GKU, Bhatinda during August 29-31, 2024.

Research Projects

Institutional projects

Genomics and Computational Resources Division

S. No	Project title	Personnel	Period
1.	Development of fish cell lines from prioritized endemic fish species for conservation and *in vitro* applications	Basdeo Kushwaha (PI), Ravindra Kumar, Murali S., Vijay Kumar Singh	April 2023 - March 2026
2.	Development of molecular system for identification of fishes	Mahender Singh (PI), Santosh Kumar, Tanwy Dasmandal, Deva Narayan	April 2023 - March 2026
3.	Part A: Developing adaptive markers in freshwater fishes for temperature stress Part B: Proteome profiling of cultivable freshwater fishes and bioprospecting for bioactive peptides and regulatory factors through integrative approach	Part A: Satish K. Srivastava (PI), Poonam Jayant Singh, Akhilesh Mishra Part B: Poonam Jayant Singh (PI), Satish K. Srivastava	April 2022 - March 2025
4.	Nanofibre and biocomposite development from fish waste resource for circular economy	U.K. Sarkar (Coordinator), Poonam Jayant Singh (PI), G.T.V. Prabhu (PI), ICAR-CIRCOT, A.K. Pathak, A. Kathirvelpandian, Mahender Singh, S.K. Srivastava, Ravi Kumar, Senthil Kumar, ICAR-CIRCOT	April 2023 – March 2026
5.	Exploring potential of traditional knowledge associated with aquatic genetic resources for access and benefit sharing under Nagoya protocol and BBNJ for food and agriculture for sustainable empowerment and conservation	U.K. Sarkar (Coordinator) Poonam Jayant Singh (PI), Ajey Kumar Pathak, A. Kathirvelpandian, Ravi Kumar	April 2023 – March 2025
6.	Mining and characterization of bioactive compounds for insights into sea anemone ecological adaptation	Murali S. (PI), Ravindra Kumar, Basdeo Kushwaha, A. Kathirvelpandian	April 2022 – March 2025

Germplasm Exploration, Evaluation and Conservation Division

S. No	Project title	Personnel	Period
1.	Development of novel microsatellite markers for genetic and adaptive divergence in natural populations of selected fish species	Rajeev K. Singh (PI), Vindhya Mohindra, L. Mog Chowdhury	April 2023 – August 2025
2.	Impact assessment of the technological interventions of ICAR-NBFGR in livelihood development and achieving the SDG goals	U.K. Sarkar (Coordinator) L. K. Tyagi (PI), A. Kathirvelpandian, Poonam Jayant Singh, Anutosh Paria, Aditya Kumar, L. Mog Chowdhury, Raghvendra Singh, Monika Gupta, Tarachand Kumawat, Vijay Kumar Singh, K. K. Singh	April 2023-March 2025
3.	Information system of selected commercially important shellfish resources from prioritized Indian aquatic ecosystem	Ajey Kumar Pathak (PI), A. Kathirvelpandian, Teena Jayakumar T.K, Ravi Kumar, Vikas Kumar	July 2020- April 2024
4.	Investigation of fish diversity of fish communities along the river Banas flowing through Rajasthan, India	Ajey Kumar Pathak (PI), Kantharajan G., Raghvendra Singh, Ravi Kumar	April 2021- March 2024
5.	Quantifying meta-structure matrices of biodiversity & ecosystem services for the assessment of fish genetic resources. Subproject 2: Ganga River Basin	U. K. Sarkar (Coordinator), Achal Singh (PI), Rejani Chandran, Raghvendra Singh, Tarachand Kumawat, Vikash Kumar	April 2023-March 2026
6.	Quantifying meta-structure matrices of biodiversity & ecosystem services for the assessment of fish genetic resources Sub Project 3: NEH Region	U. K. Sarkar (Coordinator) Rejani Chandran (PI), L. K. Tyagi, Achal Singh, A. K. Pathak, L. Mog Chowdhury, Kantharajan G., Amit Singh Bisht	April 2023- March 2025

7.	Fish milt cryopreservation for broodstock development and quality seed production	U.K. Sarkar (Coordinator) Santosh Kumar (HQ) (PI), Charan R. (PAGR) (PI) Aditya Kumar, Raghvendra Singh, L.K. Tyagi, Monika Gupta, Ajay K. Singh, R.S. Sah, V.S. Basheer, A. Kathirvelpandian	April 2023-March 2025
8.	Establishment of standardized genomic markers for cataloguing diversity below species level	L. Mog Chowdhury (PI) Vindhya Mohindra, Rajeev K. Singh, Divya P. R.	April 2020- March 2024
9.	Fish diversity assessment of Ramsar wetlands of Uttar Pradesh by integrating ecological approaches and stakeholder perception under climate change scenario	Rejani Chandran (PI), Rajeev Kumar Singh, L. K. Tyagi, Achal Singh, A. K. Pathak, Kantharajan G., Amit Singh Bisht, Deva Narayan	April 2023- March 2026

Exotics & Aquatic Animal Health Division

S. No	Project title	Personnel	Period
1.	Livelihood improvement through freshwater aquaculture human resource development for the Scheduled Caste of the Government of India prioritized selected district of Uttar Pradesh	S. K. Singh (PI), L. K. Tyagi, Achal Singh, Aditya Kumar, Raghvendra Singh, Amit Singh Bisht, Sanjay Kumar Singh	April 2020- March 2024
2.	Assessment of exotic fishes' prevalence and their impacts on indigenous fish diversity	Tarachand Kumawat (PI), V. S. Basheer, Sharad K Singh, Achal Singh, Ajey K. Pathak, Divya P. R., Aditya Kumar, Anutosh Paria, Ranjana Sinha, Ravi Kumar, Vikash Sahu	April 2023-March 2026

Peninsular Aquatic Genetic Resources Centre

S. No	Project title	Personnel	Period
1.	Network Project on Ornamental fish breeding and Culture (NPOFBC)	V. S. Basheer (PI), Charan Ravi, Monika Gupta	April 2018- March 2025
2.	Exploration of the tributaries of Cauvery river for fish species diversity and detailed studies on mahseer	V. S. Basheer (PI), Charan Ravi, Divya P.R., Kantharajan G.	April 2023- March 2026
3.	Genetic approach and evaluation to aid conservation and sustainable propagation of near threatened catfish *Clarias dussumieri* in natural waters	Divya P.R. (PI), V.S. Basheer	August 2020- March 2024
4.	Identification of conotoxins from the selected Cone snails from Indian waters using transcriptome sequencing	A. Kathirvelpandian (PI), Murali S., Arun Sudhagar S.	April 2022 – March 2024
5.	Assessment of coastal fish diversity, vulnerability indicators, and ecosystem services in the Pichavaram mangrove region	A. Kathirvelpandian (PI), T.T. Ajith Kumar, Ajey Kumar Pathak, Poonam Jayant Singh, Kantharajan G.	April 2023- March 2025
6.	Taxonomic studies of the deep-sea fish resources along southern coasts of India	Teena Jayakumar T. K. (PI), Arun Sudhagar S.	April 2022 – March 2024
7.	Development and characterization of anti-immunoglobulin antibodies (Anti-Ig Abs) against an indigenous aquaculture species	Arun Sudhagar S. (PI) Neeraj Sood	April 2021 – March 2024

8.	Community aquaculture for livelihood and conservation: Economic upliftment to the local population at Lakshadweep, utilizing indigenous fish genetic resources	Rekha M. U. (PI), T.T. Ajith Kumar	July 2021- March 2024
9.	Quantifying meta-structure matrices of biodiversity & ecosystem services for the assessment of fish genetic resources Subproject 1: Western Ghats	Uttam Kumar Sarkar (Co-ordinator), V. S. Basheer (PI), Divya P.R., Charan Ravi	April 2023 – March, 2026

Institutional corpus funded projects

S. No	Project title	Personnel	Period
1.	Evaluation of new candidate species Pabda, *Ompok bimaculatus* under Biofloc Aquaculture System	Aditya Kumar (PI), Rajeev Kumar Singh, Chandra Bhushan Kumar, Raghvendra Singh	February 2024 - March 2025
2	Elucidating the role of temperature on immune response and susceptibility of *Pangasianodon hypophthalmus* against infection with *Saprolegnia parasitica*	Chandra Bhushan Kumar (PI), P.K. Pradhan, Neeraj Sood	February 2024 - March 2025
3	Understanding the association of gut microbiome with *Enterocytozoon hepatopenaei* (EHP) infection in inland saline shrimp culture system	Anutosh Paria (PI), Neeraj Sood, P.K. Pradhan	February 2024 - March 2025
4	Study of reproductive phenology variation of *Notopterus notopterus* in wild and captive environment	Monika Gupta (PI), Kantharajan G., Raghvendra Singh	February 2024 - March 2025
5	Ecosystem dynamics and conservation strategies for the Sarayu river, Ayodhya: Assessment of physicochemical attributes, fish biodiversity, and human impacts	Tarachand Kumawat (PI), Mahender Singh, Rejani Chandran, Kantharajan G., Jaspreet Singh, Vikash Sahu	February 2024 - March 2025
6	Development and evaluation of a small-scale prototype of species-specific Recirculatory Aquaculture System	Raghvendra Singh (PI), Aditya Kumar, Monika Gupta	February 2024 - March 2025
7	Physiological insights into the reproductive mechanism of *Clarias dussumieri*, a near-threatened endemic catfish of the Western Ghat	Charan Ravi (PI), Rekha M.U., Aditya Kumar	February 2024 - March 2025
8	Development and evaluation of autogenous inactivated vaccine against *Aeromonas hydrophila* and *Edwardsiella tarda* in Oscar fish (*Astronotus ocellatus*)	Arun Sudhagar S. (PI), Anutosh Paria, Rekha M. U.	February 2024 - March 2025
9	Unravelling the genetic diversity and population structure of *Chromis viridis* in Indian waters	Rekha M.U. (PI), Teena Jayakumar T. K., Rejani Chandran	February 2024 - March 2025

ICAR Plan fund Projects

S. No	Project title	Scheme	Personnel	Period
1.	Participatory programme on exploration and characterization of fish germplasm resources and indigenous knowledge in the North-Eastern region of India	ICAR-NEH	U.K. Sarkar (Coordinator), Rejani Chandran (Nodal Officer), Lalit Kumar Tyagi, Mahender Singh, Ajey Kumar Pathak, Aditya Kumar, L. Mog Chowdhury, Raghvendra Singh, Tarachand Kumawat, Kantharajan G., Amit Singh Bisht, Akhilesh Kumar Mishra	April 2020- March 2025

2.	Network project on Agricultural bioinformatics and computational biology Sub Project: Understanding genomic factors responsible for growth performance in *Clarias magur*	ICAR-CABin	Ravindra Kumar (PI), Basdeo Kushwaha, Murali S., Santosh Kumar, Tanwy Dasmandal	July 2020- March 2026
3.	CRP on Genomics: Structural and functional characterization of *Clarias dussumieri*, *Chitala chitala* and *Catla catla* genomes and transcriptomes	ICAR Plan	Vindhya Mohindra (PI), Basedeo Kushwaha, Rajeev K. Singh, L. Mog Chowdhury	April 2023 – March 2026
4.	CRP on Agrobiodiversity: Evaluation of fish germplasm from Indo-Gangetic rivers for their captive breeding, domestication, and conservation aquaculture (NBFGR HQ component)	ICAR Plan	U.K. Sarkar (Coordinator), Aditya Kumar (PI), Santosh Kumar, Raghvendra Singh, Monika Gupta, Ajay Kumar Singh	April 2021- March 2026
5.	CRP on Agrobiodiversity: Conservation aquaculture of endemic fish species from peninsular rivers through captive propagation and culture evaluation	ICAR Plan	Charan Ravi (PI), V.S. Basheer, T.T. Ajith Kumar, Rekha M.U.	April 2021- March 2026
6.	All India network project on fish health	ICAR Plan	P. K. Pradhan (PI), Anutosh Paria, Gaurav Rathore, Neeraj Sood	April 2022 – March 2026
7.	CRP on vaccines and diagnostics: Development of point- of-care diagnostic kit and vaccine against Tilapia Lake Virus	ICAR Plan	Anutosh Paria (PI), Neeraj Sood, P.K. Pradhan	January 2023-March 2026
8.	All India network project on antimicrobial resistance (AINP-AMR) in fisheries and livestock	ICAR Plan	Gaurav Rathore (PI), Chandra Bhushan Kumar, Anutosh Paria, Vikash Sahu	April 2024- March 2026
9.	Scheduled Caste community empowerment through sensitization, capacity development, and input distribution	SCSP Component	U.K. Sarkar (Coordinator), Poonam J. Singh (Nodal Officer), A. Kathirvelpandian (Nodal Officer, PAGR), Raghvendra Singh, Monika Gupta, Tarachand Kumawat, Vikas Kumar, K. K. Singh	April 2023- March 2024
10.	Scheduled Tribe community empowerment through sensitization, capacity development, and input distribution	STC Component	U.K. Sarkar (Coordinator), Anutosh Paria (Nodal Officer), A. Kathirvelpandian (Nodal Officer, PAGR), Santosh Kumar, Aditya Kumar, L. Mog Chowdhury, Vijay Kumar Singh, Akhilesh Kumar Mishra	April 2023- March 2024
11.	Genome editing of *Labeo rohita* and *Trichogaster chuna* for enhancement of economic traits	ICAR-NEH	U.K. Sarkar (Coordinator) L. Mog Chowdhury (PI), Vindhya Mohindra, Mahender Singh, Aditya Kumar, Murali S., Dandadhar Sarma (Gauhati Agricultural University)	April 2023- March 2026

Externally funded projects

S. No	Project tile	Funding	Personnel	Period
1.	National Surveillance Programme for Aquatic Animal Diseases (Phase-II)	Department of Fisheries, Government of India, PMMSY	Coordinator: J.K. Jena, DDG (Fy.Sc.), ICAR Co-coordinator: Uttam Kumar Sarkar, Consortium Principal Investigator: Neeraj Sood P.K. Pradhan, Anutosh Paria, Chandra Bhushan Kumar, Arun Sudhagar, Kantharajan G., V.S. Basheer, Gaurav Rathore	July 2022- March 2025

2.	National Surveillance Programme for Aquatic Animal Diseases - Phase II Sub-project Number 01: Surveillance of freshwater fish and shellfish diseases in Uttar Pradesh	Department of Fisheries, Government of India, PMMSY	P.K. Pradhan (PI), Chandra Bhushan Kumar, Gaurav Rathore, Neeraj Sood	July 2022- March 2025
3.	National Surveillance Programme for Aquatic Animal Diseases - Phase II Sub-project Number 09: Surveillance of freshwater fish diseases in Kerala	Department of Fisheries, Government of India, PMMSY	V. S. Basheer (PI), Arun Sudhagar S.	July 2022- March 2025
4.	Intellectual property management and transfer/ commercialization of agricultural technology scheme (Up-scaling existing components i.e. Intellectual Property Right)	NAIF, ICAR	Poonam Jayant Singh (PI), Mahender Singh, Arun Sudhagar S.	January 2022 – March 2026
5.	Quantifying agrobiodiversity and ecosystem services in Godavari river basin landscape	Bioversity - International	Rajeev K. Singh (PI), L.K. Tyagi, Achal Singh, Rejani Chandran, Kantharajan G.	September 2021 - November 2025
6.	Global warming a potential driver of antimicrobial resistance in aquaculture: An in-vitro study in *Aeromonas hydrophila*	NICRA	Gaurav Rathore (PI), Chandra Bhushan Kumar	January 2022 – March 2025
7.	Novel approaches for disease free health certification in finfish and development of high health shrimp for sustainable aquaculture	NASF	Gaurav Rathore (PI), Neeraj Sood, Chandra Bhushan Kumar	June 2022 - May 2025
8.	Assessment of climate change impact in the waterbodies of Uttar Pradesh and developing climate resilient strategies for sustainable fisheries management	UPCST	U. K. Sarkar (Coordinator), Kantharajan G. (PI) L. K. Tyagi, Ajey Kumar Pathak, Santosh Kumar, Rejani Chandran, Tarachand Kumawat	January 2024 - January 2027
9.	Setting up of marine ornamental fish village at Maharashtra: Way forward to promote livelihood to mangrove dwellers and biodiversity conservation (Phase II)	Mangrove Foundation & Mangrove Cell, Government of Maharashtra	U.K. Sarkar (Coordinator) T. T. Ajith Kumar (PI), Raghvendra Singh	October 2021- January 2025
10.	Mainstreaming marine ornamental shrimp diversity for actions to enhance livelihood and gender empowerment opportunities among native Lakshadweep communities	CMLRE	T. T. Ajith Kumar (PI), Rejani Chandran	May 2022- April 2025
11.	Establishment of marine ornamental species hub in Pitchavaram region, Tamil Nadu for sustainable livelihood development of local SC fisher folks	DST	T. T. Ajith Kumar (PI), A. Kathirvelpandian	June 2022- May 2025
12.	Establishment of brood bank of Pearlspot through selective breeding at brackish water fish farm, Ayiramthengu in Kollam District	ADAK	U. K. Sarkar (Coordinator), Divya P.R. (PI), Rekha M.U., Santosh Kumar	November 2021- March 2025
13.	Diving Down the Deep: Exploring the deep-Sea ichthyo-faunal resources of Indian waters for sustainable utilization - A multidisciplinary approach	MoES	T.T. Ajith Kumar (Co-coordinator), A. Kathirvelpandian (PI), T.T. Ajith Kumar, Arun Sudhagar S., Ravindra Kumar, Mahender Singh, Murali S., Kantharajan G.	April 2024 – March 2026
14.	NNP (Agri-Genomic Repository and Intelligent Analytical System) of ICAR-Indian Agricultural Statistics Research Institute, New Delhi	DBT	Murali S. (PI), Basdeo Kushwaha	September 2024 - September 2029

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Agarwal, D., S.A. Shanmugam, A. Kathirvelpandian, S. Eswaran, M.A. Rather and G. Rakkannan, 2024. Unraveling the Impact of Climate Change on Fish Physiology: A Focus on Temperature and Salinity Dynamics. *Journal of Applied Ichthyology*, 2024(1): 5782274.

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Participation in Seminar/ Symposia/ Workshop/ Training/ Meeting

Dr. Uttam Kumar Sarkar

- 2nd Acharya Prafulla Chandra Roy Smarak Vigyan Mela & Pradarshani on 'Sustainable Food Security in Changed Climatic Scenario' as Guest of Honour at WBUA&FS, Kolkata, on January 07, 2024.
- Special Guest of 'Krishi Samridhhi Mela-cum-National Seminar on Integrated Farming System towards Food Security and Sustainable Agriculture' at RMA, Sargachhi, Murshidabad during January 12-16, 2024.
- Meeting of ICAR Fisheries Research Institutes on Research Programmes: Mutual Learnings and Collaborations at ICAR-CIFE, Mumbai on February 1, 2024.
- Chaired Session themed 'Climate research in fisheries and Aquaculture' in 13th Indian Fisheries and Aquaculture Forum at Kolkata during February 23-25, 2024.
- Vice Chancellors and Directors' Conference of ICAR held at NASC, New Delhi on February 26-27, 2024.
- NACA meeting at NAAS New Delhi on March 5, 2024.
- Chief Guest for a Training on 'Boosting Productivity of Sodic Soils' at ICAR-Central Soil Salinity Research Institute, Regional Research Station, Lucknow on March 18, 2024.
- QRT Meeting at ICAR-CSSRI, Regional Research Station, Lucknow on April 05, 2024.
- Meeting on the Role and Importance of Secondary Agriculture, a spin-off meeting (virtual) to discuss secondary agriculture, during the review meeting of ICAR-NISA on April 08, 2024.
- Meeting with all ICAR institutes on Five Action Points under Pradhan Mantri Matsya Sampada Yojana (PMMSY) on May 14, 2024.
- 4th Meeting of Matsya Manthan on the latest technology applications for Fisheries and Aquaculture on May 16, 2024.
- 31st Annual General Body Meeting of the National Academy of Agricultural Sciences at NASC, New Delhi during June 4-5, 2024.
- 147th Authority Meeting (virtual) hosted by MPEDA on June 21, 2024.
- 109th Foundation Day Celebration of ZSI & Inauguration of Animal Taxonomy Summit at Kolkata on June 30, 2024.
- 201st and 203rd Meetings of Board of Management of ANDUAT, Kumarganj, Ayodhya on July 5, 2024 and October 14, 2024.
- Interactive Meeting for Innovative Projects with ICAR Fisheries Institutes held at NFDB on August 13, 2024.
- XXVII Regional Committee-II Meeting (virtual) at ICAR-NRRI, Cuttack on August 23, 2024.
- Chief Guest in the National seminar on 'Augmenting production and disease mitigation strategies in food-animal under changing climatic scenario' in Kolkata organized by IJAH on September 14, 2024.
- Convened a Brainstorming session on Climate adaptive conservation of Aquatic Genetic Resources at NAAS, NASC New Delhi on December 20, 2024.

Dr. T.T. Ajith Kumar

- 28th meeting of the ICAR - Regional Committee for Zone VIII organised by ICAR-CIBA and held at NIOT, Chennai on February 16, 2024
- 146th Authority Meeting of the Marine Products Export Development Authority (virtual) on March 01, 2024
- Research Advisory and Monitoring Committee meetings of Zoological Survey of India during April 11-12 at Madhya Pradesh and at Kodaikanal on November 4-5, 2024
- Fisheries Summer Meet on National Fish Farmers Day, organised by the Ministry of Fisheries, Animal Husbandry and Dairying, Govt. of India, held at Madurai, Tamil Nadu on July 10, 2024
- Research Advisory Committee (RAC) meeting of CMLRE, Kochi on July 19, 2024

- National Stakeholders Consultation on Sustainable Development of Ornamental Fisheries in India held at ICAR-CIFA, Bhubaneswar during August 1-2, 2024
- One-day meet on Livelihood promotion activities for islanders, organised by the Department of Fisheries, Andaman & Nicobar Islands on August 21, 2024
- Expert Committee meeting to prepare the Detailed Technical Report for the Establishment of a Marine Finfish Propagation Facility in CMLRE, Kochi on November 11, 2024

Dr. Vindhya Mohindra

- Advisory committee meeting of NASF-funded project entitled 'Genome-wide association studies in giant freshwater prawn, M. rosenbergii: Linkage mapping and QTL identification' at ICAR-CIFA, Bhubaneswar on March 18, 2024
- Expert Committee meeting (Virtual) of NASF Strategic area 'Biotechnology, genomics and allele mining in plants, animals and fisheries' for presentation of project report on April 23-24, 2024
- National Workshop on climatic risks and adaptations in fisheries at ICAR-CIBA, Chennai on May 3, 2024
- ISO/TC 331: Biodiversity as a member of Indian delegation in virtual mode held at Brazil during May 20-24, 2024
- Workshop on 'Decoding the Genome with PacBio's Long and Short Read Sequencing Solutions' at Chennai on August 30, 2024
- National Conference on Managing Agro-Biodiversity in North Eastern India (NCMBN-2024) held at ICAR-Research Complex for North Eastern Hill Region, Umiam, Meghalaya from October 23-25, 2024

Dr. P.K. Pradhan

- World Organization of Animal Health (WOAH) meetings (virtually) as an expert member of WOAH ad hoc Group on susceptibility of fish species to infection with WOAH listed diseases (Epizootic Ulcerative Syndrome) on April 11 and April 16, 2024
- 40th meeting of the National Committee on the Introduction of Exotic Aquatic Species, focusing on the evaluation and regulation of exotic species introductions in Indian waters on April 30, 2024.
- Meeting convened by the Department of Fisheries, Government of India, under the chairmanship of the Joint Secretary (Inland Fisheries) to review progress under the NSPAAD Phase-II within the central sector component of the Pradhan Mantri Matsya Sampada Yojana on May 10, 2024
- 41st meeting of the Committee, co-chaired by the Joint Secretaries of Inland and Marine Fisheries, to discuss regulatory concerns and proposals on exotic species introductions on June 18, 2024
- Served as a member of the Technical Committee for the Shrimp Evaluation Study Unit at RGCA, and participated in an on-site inspection at the Rajakkamangalam facility, Kanyakumari District, Tamil Nadu, during September 11-12, 2024
- 73rd IMC meeting of ICAR-CIFT, Cochin, held on November 6, 2024
- 56th IMC meeting of ICAR-CIBA, Chennai, held on December 18, 2024

Dr. Rajeev Kumar Singh

- Review meeting of NEH collaborators at ICAR Research Complex for NEH region, Barapani, Meghalaya on July 30, 2024
- Mid-term review meeting of the project from The Alliance of Bioversity International, CIAT at NASC, New Delhi on December 17, 2024

Dr. Ravindra Kumar

- 11th Steering Committee meeting of Network Project on 'Agricultural Bioinformatics and Computational Biology' organized Division of Agricultural Bioinformatics, ICAR- IASRI, New Delhi (virtual) on May 21, 2024
- Online meeting for presentation of research project submitted under the National Priority category of Corpus Fund in Fisheries Science Division on 07 August, 2024

Dr. Neeraj Sood

- Meetings of the 'Regional Technical Working Group for implementation of Progressive Management Pathway for Aquaculture Biosecurity' by FAO/NACA, held on April 4, 2024, April 22, 2024 and May 10, 2024
- 32nd meeting of the Local Advisory Committee of the Regional Science City, Lucknow a Unit of National Council of Science Museums on September 12, 2024

Dr. Gaurav Rathore

- Training on 'Genomic surveillance on AMR' organized by Gujarat Biotechnology Research Centre (GBRC) in collaboration with FAO, India at Gandhinagar, Gujarat during May 27-31, 2024.

Dr. Sharad Kumar Singh

- State Level Approval and Management Committee meeting organized by U.P. Fisheries at Bapu Bhawan, Lucknow on August 8, 2024
- State fisheries workshop and presented/deliver a lecture on Scope of Fish Production Enhancement in Reservoirs of Uttar Pradesh at Matsya Nideshalya, Lucknow on October 26, 2024

Dr. Achal Singh

- Statistical software training, 'Webinar on Factor analysis' organised by SPSS on May 24, 2024
- Webinar for data officer & filling-up of online portal-Evaluation of Innovation Excellence Indicators for public funded Organisations organised by CII, CTIER & PSA O/o PMO, on April 14, 2024
- Webinar 1.0-Round 2.0: Final Webinar for Data Officers for Round 2: Evaluation of Innovation Excellence Indicators for public funded Organisations organised by CII, CTIER & PSA O/o PMO, on April 26 and May 24, 2024
- International workshop on Digital Agriculture: ITU/FAO Workshop on 'The Future of Digital Agriculture: Role of Artificial Intelligence' organised by International Telecommunication Union in collaboration with FAO, AgriBITs, VNU Europe at Netherlands (virtual) on June 17, 2024
- 4th International Web Conference-Natural Resource management for Global Food Security and Environmental Stewardship organized by Academy of Natural Resource Conservation and Management, Lucknow, KSN University of Agricultural and Horticultural Science, Shivamoga, University of Agricultural Sciences, Bengaluru (virtual) during October 15-16, 2024
- 2nd International Conference on Innovation in Science and Technology for Sustainable Development 2.0, organized by Department of Science, Maharishi School of Science and Humanities, Maharishi University of Information Technology, Lucknow (virtual) during November 19-21, 2024

Dr. Poonam Jayant Singh

- Symposium on 'Emerging Technologies and Materials in Medicine' organized by Centre of Excellence for Materials in Medicine at Gangwal School of Medical Sciences and Technology at IIT Kanpur during May 3-4, 2024.
- Annual Review Meeting of ICAR-ZTMCs/ITMUs under the Fisheries Science Division on July 30, 2024

Dr. Rejani Chandran

- International Conference on Conservation of Aquatic Biodiversity and Ecosystem Services of Ganga Basin (virtual) organised by Government P. G. College New Tehri, Uttarakhand, in association with ZSI Gaya Bihar and Indian Academy of Environmental Sciences, Haridwar during October 21-23, 2024

Dr. Aditya Kumar

- 35th All India Congress of Zoology and International Conference on Impact of Climate Change with Special Reference to Challenges and Approaches in Applied Zoology Biodiversity Conservation Food and Health Security organized by Department of Zoology School of Studies of Life Science, Guru Ghasidas Vishwavidyalaya (Central University) Bilaspur, Chhattisgarh during June 05-07, 2024
- Mid-Term Review Workshop of Animal and Fish Genetic Resources, of the project 'CRP on Agrobiodiversity' held at ICAR-CIBA, Chennai on September 17, 2024 and at ICAR-NBPGR, New Delhi on October 18, 2024

Dr. Anutosh Paria

- Review meeting of CRP on Vaccines & Diagnostics organized by ICAR-IVRI, Bengaluru and presented the progress of ICAR-NBFGR component of CRP Vaccines & Diagnostics during March 4-5, 2024
- Stakeholders Meet-Cum-Awareness Programme organized by ICAR-NBFGR in collaboration with Kalyani University, ABCS and NSPAAD during July 03-04, 2024

Dr. Arun Sudhagar S.

- 'SRIJAN 2.0: AgrIP 2024 - Short Course on Patents in Agriculture' during January

15 - February 15, 2024 and Orientation program on 'SRIJAN: Empowering ZTMUs/ ITMUs of ICAR institutes' organised by IPTM, ICAR, New Delhi during February 13-15, 2024.

- AquaBiz Summit 2024 organised by ZTM-ABI Centre, ICAR-CIFT, Kochi on March 20, 2024.
- Introductory Training Program on 'ECHO (Extension for Community Healthcare Outcomes) India Project' organised by MANAGE, Hyderabad, during May 23-24, 2024.
- Tri Sea Fisheries summit (TSFS24) organised by St. Devasahayam Fisheries Institute & Technology (DIFST), Kanyakumari on June 14, 2024.

Mrs. Rekha M. U.

- International Fisheries Congress & Expo, 'Charting Sustainable Horizons: Fisheries, Blue Economy and the Global Goals' 2024, organised by KUFOS, Kochi during January 12-14, 2024

Dr. Tarachand Kumawat

- 22nd Annual Fishbase Symposium 'Fishes in Changing Ecosystems' (online) during September 2-3, 2024.

Dr. Kantharajan G.

- National Seminar on 'Augmenting production and disease mitigation strategies in food-animals under changing climatic scenario' organised by the Indian Journal of Animal Health held at Kolkata on September 14, 2024.

Mrs. Teena Jayakumar T. K.

- FAO/BOBP-IGO - Expert meeting (virtual) on 'New tools and Methods for FAO Fishing fleet Techno-Economic Performance Reviews' on December 04, 2024

Mr. Jaspreet Singh

- National Seminar on 'Advances in Environment Management for Sustainable Fisheries and Livestock Production (AEMS-2024)' organized by College of Fisheries, Kishanganj, BASU during November 18-19, 2024

Ms. Tanwy Dasmandal

- Generative AI Tools for Agriculture organized by ICAR-NAARM, Hyderabad from June 26-28, 2024.
- IP Awareness/Training programme organized under National Intellectual property awareness mission, by Intellectual Property Office, India on August 9, 2024

Dr. Vikash Sahu

- North Zone Regional Agricultural Fair at Rani Laxmi Bai Central Agriculture University, Jhansi during February 08-10, 2024
- 96th Foundation & Technology Day of ICAR Society with Concurrent Industry-Institute Interaction Meet and Agri-Technology & Product Exhibition at NASC Complex during July 15-16, 2024.
- 3 days FAO supported training program on Antimicrobial Susceptibility Testing and WHONET software for data management of Antimicrobial Resistance (AMR) organized at ICAR-NBFGR, Lucknow during October 15-17, 2024.
- 28th Sundarban Kristi Mela O Loko Sanskriti Utsab, An Educational and Traditional cum Rural Heritage fair with Theme: Highlighting the Rich Cultural Heritage of Developing India by Kultali Milon Tirtha Society at Kultali, Basanti, Sundarban, West Bengal during December, 2024

Drs. P.K. Pradhan and Neeraj Sood

- Meeting on marine products as a follow up of 4th India-Korea SPS JWG meeting held at Korea on April 12, 2024
- 'Cost-Benefit Analysis of Aquatic Biosecurity Systems: Data Analysis Workshop' organised by Food and Agriculture Organization of the United Nations in Rome, Italy during March 18-22, 2024.
- Virtual meeting to discuss about Standard Operating Procedure (SOP) for the import of SPF crustacean broodstock with emphasis on mitigating risks from Acute Hepatopancreatic Necrosis Disease (AHPND) under the chairmanship of the Joint Secretary (Marine Fisheries) held on May 7, 2024
- Virtual introductory meeting on the WOAH Performance of Veterinary Services (PVS) – Aquatic programme, organized by the Department of Fisheries, Government of India, on July 2, 2024
- Technical cooperation webinar on biosecurity and aquatic animal health management by Australian Government, organized by Department of Fisheries, Government of India on July 26, 2024
- Served as a reviewer during the International Conclave on

NextGen Technologies in the Seafood Sector, organized by MPEDA and evaluated research proposals virtually on August 8, 2024

- 27th National Conference on e-Governance on the theme 'Viksit Bharat: Secure and Sustainable E-Service Delivery' held at Jio Convention Centre, Mumbai, Maharashtra by Department of Administrative Reforms and Public Grievances and Ministry of Electronics and Information Technology, Government of India; and Government of Maharashtra during September 3-4, 2024

Drs. Gaurav Rathore and Chandra Bhushan Kumar

- Application training on Sensititre System and Reagents by ThermoFisher Scientific at ICAR-NBFGR, Lucknow on October 22, 2024

Drs. Chandra Bhushan Kumar and Vikash Sahu

- National Conference on 'Expanding the Horizons of Microbial Research in Agriculture' and to display the exhibits of Institute amongst the stalwarts and researchers from different parts of India at ICAR-NBAIM, Mau during June 10-11, 2024.

Drs. Gaurav Rathore, Chandra Bhushan Kumar and Vikash Sahu

- Launch Workshop of "All India Network project on Antimicrobial Resistance (AINP-AMR) in Fisheries and Livestock" held at NASC Complex New Delhi on May 22, 2024

Drs. Aditya Kumar and Vikash Sahu

- International Conference on Nature Science and Modern Lifestyle: Issues and perspectives (ICNSMIP-2024) & Green Scientist Award (2024) Organized by Sarvhit Kalyan Seva Samiti at Pioneer Montessori Inter College, Lucknow during December 28-29, 2024

Drs. Rejani Chandran and Tarachand Kumawat

- National Workshop on Advances in Fish Systematics: Morphological and Molecular Approaches organised by ZSI and ICAR-NBFGR at Hyderabad during January 18-19, 2024.
- Webinar on Knowledge Exchange Series on Aquatic Resources Management in the session, titled, 'Benefits of small indigenous fish: Food, income & environment' organised by GIZ's NERAQ (Protection and sustainable management of Aquatic resources in North-eastern Himalayan region) project on June 28, 2024

Drs. Anutosh Paria, Kantharajan G., Amit Singh Bisht and Vikash Sahu

- 27th National Agriculture Exhibition on theme, 'India Developed Nation by 2047' and 2nd International Conference on "Sustainable Fisheries & Aquatic Resource Management (SFARM 2024): Life below Water at Science City, Kolkata organized by Central Calcutta Science and Cultural Organization for Youth, Kolkata during September 11-14, 2024.

Drs. A. Kathirvelpandian, Rejani Chandran, Teena Jayakumar T. K.

- Animal Taxonomy Summit 2024 organized by ZSI at Kolkata during June 30-July 3, 2024

Drs. Achal Singh, A. Kathirvelpandian, Chandra Bhushan Kumar, Kantharajan G.

- National Workshop (virtual) on 'Conservation of Indigenous Fishes of Jammu & Kashmir in the Changing Climate Scenario' organised by ICAR NBFGR in collaboration with SKUAST-K at Faculty of Fisheries, Rangil, SKUAST-K during November 18-19, 2024

Drs. Rajeev Kumar Singh, Gaurav Rathore, A. Kathirvelpandian, Kantharajan G.

- NAAS Brainstorming Session on 'Climate Adaptive Conservation of Aquatic Genetic Resources' organised by National Academy of Agricultural Sciences (NAAS), in collaboration with ICAR-NBFGR, held at NAAS Complex, New Delhi, on December 20, 2024

Drs. T. T. Ajith Kumar, Vindhya Mohindra, Basdeo Kushwaha, V. S. Basheer, A. Kathirvelpandian, Rejani Chandran, Murali S., Anutosh Paria, Aditya Kumar, Kantharajan G., Raghvendra Singh, Monika Gupta and Tarachand Kumawat

- 13th Indian Fisheries & Aquaculture Forum, Satellite symposium on Riverine Fisheries Management organised by ICAR-CIFRI held at Kolkata during February 23-25, 2024

Drs. Uttam Kumar Sarkar, P. K. Pradhan, Rajeev Kumar Singh, Basdeo Kushwaha, Neeraj Sood, V. S. Basheer, A. K. Pathak, Charan R., Rejani Chandran and Murali S.,

- National Workshop on 'Conservation of Indigenous Fishes of Jammu & Kashmir in changing climate scenario' held at Faculty of Fisheries, SKUAST, Rangil, Ganderbal, J&K during November 18-19, 2024

All staff participated in the following events

- Online meeting by Honorable DG, ICAR regarding Guidelines for foreign visit management on April, 3, 2024
- Online meeting by Honorable DG, ICAR regarding Ecoregional Working Group Program on April 12, 2024
- Online meeting by Honorable DG, ICAR regarding World Intellectual Property Day on April 24, 2024
- Seminar on IPR, Inclusivity, creativity and innovation organised by ITMU of ICAR-NBFGR on the occasion of World IP Day on April 25, 2024
- Online meeting by ICAR-DARE regarding Viksit Bharat on April 16, 2024 and May 30, 2024
- World Environment Day celebration at ICAR-NBFGR on June 05, 2024
- International Hybrid Symposium on 'Changing Status of Ecosystem Health of the River Ganga: An Update and Review', organised by Aquatic Ecosystem Health & Management Society, South & Southeast Asia Chapter, in collaboration with ICAR-NBFGR, Central University of South Bihar, University of Delhi, ABCS, Lucknow and Vijnana Bharati during June 10-11, 2024
- Interactive meeting of Prof. S. P. Singh Baghel, Honorable minister of State, Ministry of Fisheries, Animal Husbandry and Dairying & Ministry of Panchayati Raj, GOI at ICAR-NBFGR on June 19, 2024.
- 10th International Day of Yoga program organized on June 21, 2024
- Hindi workshop on 'राजभाषा कार्यान्वयन' organized by Hindi Cell, ICAR-NBFGR, Lucknow on June 24, 2024
- 'एक पेड़ माँ के नाम' celebrated at ICAR-NBFGR on July 10, 2024
- National Fish Farmer Day celebration at ICAR-NBFGR on July 10, 2024
- 96th ICAR Foundation and Technology Day programme in virtual mode on July 16, 2024.
- Foundation stone laying for Vadhvan port and various fisheries projects by the honorable PM on August 30, 2024
- Stakeholders' consultation on the theme "Transforming Agriculture Research- Enhancing role of Private sector" organized by Ministry of Agriculture and Farmers Welfare on September 03, 2024
- National scientific Hindi Seminar cum Workshop on 'New directions in fish conservation science' organised by ICAR-NBFGR on September 25, 2024
- 'Vigilance Awareness Week' with the theme "Culture of integrity for nation's prosperity" observed at ICAR-NBFGR, Lucknow during October 28 - 04 November, 2024.
- Lecture by DG ICAR and Secretary DARE on "Best Practices for Project Formulation" on December 16, 2024
- Various programmes conducted under Swachhta campaigns during September 15 to October 2, 2024 and Swachhta Pakhwada by ICAR- NBFGR during December 16-31, 2024

Invited Lecture/ Presentation

Dr. Uttam Kumar Sarkar

- Keynote address at International seminar on 'Green Management of the Environment using Eco-friendly Technology-2024 (Green MEET-2024)' in the Department of Ecological Studies, University of Kalyani, West Bengal on February 20, 2024.
- Lead lecture for the Satellite Symposium in 13th Indian Fisheries and Aquaculture Forum at Kolkata during February 23-25, 2024.
- Keynote Speaker in 'National Seminar on Recent Advances in Sustainable in Aquaculture and Fish Health Management' organised by The Neotia University, Kolkata on May 13, 2024.
- Guest lecture on 'Climate Change Adaptation and Climate Resilient Technologies for Fisheries' (virtual), as part of the Training Programme on Climate Resilient Interventions in Agri and Allied Sectors organized by Extension Education Institute (Southern Region), Directorate of Extension, Dept. of Agriculture & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Govt. of India on September 18, 2024

Dr. T.T. Ajith Kumar

- Invited talk on 'Bridging conservation and community: Ensuring the future of coastal habitats' at the International Fisheries Congress and Expo 2024 organized by KUFOS, Kochi, during January 12-14, 2024
- Invited lecture on 'Revolutionizing livelihoods: Role of taxonomy and reef-associated fauna' at the Workshop 'Advances in fish systematics: Morphological and molecular approaches' organized by the ZSI in association with ICAR-NBFGR at Hyderabad during January 18-19, 2024
- Invited talk on 'Clownfish aquaculture and entrepreneurship development' in a residential training programme "AquaBiz 2024" on Aquabusiness opportunities, organized by ICAR-CIBA during January 22-27, 2024.
- Invited talk on 'Fish genetic resources and conservation' in 13th Indian Fisheries & Aquaculture Forum held at Kolkata during February 23-25, 2024
- Invited talk on 'Hatchery technologies for adoption at Kanyakumari district- Scope and viability' in the conference on Tri Sea Fisheries Science & Technology (TSFS-24), organized by St. Devasahayam Institute of Fisheries Science & Technology, Midalam, Kanyakumari at Nagercoil on June 14, 2024
- Invited talk on 'Marine ornamental aquaculture' in the training programme on ornamental fish culture, organized by Kerala Aquaventure International Ltd. (KAVIL), Dept. of Fisheries, Govt. of Kerala, at Kodungallor, Aluva on June 28, 2024
- Invited talk on 'Opportunities in marine ornamental aquaculture' organized by Department of Fisheries, Andaman & Nicobar Islands on August 21, 2024

Dr. Vindhya Mohindra

- Lead lecture in Technical Session on 'Open water fisheries resource management' on the theme 'Conservation genetics and genomics for sustainable open water fisheries' at 13th Indian Fisheries & Aquaculture Forum organized by ICAR-CIFRI at Kolkata during February 23-25, 2024
- Invited lecture on 'Genomics and aquatic genetic resources in India' during Technical session on 'Innovations and modern tools for ex situ conservation and utilization (Animal and Fish Genetics Resources)' at 'National Conference on Managing Agro-Biodiversity in North Eastern India (NCMBN-2024)' at ICAR-Research Complex for NEH Region, Umiam, Meghalaya during October 23-25, 2024

Dr. P.K. Pradhan

- Lead lecture on 'Aquatic animal disease surveillance in India: Opportunities and Challenges for Research in Aquatic Animal Health' at the International Workshop on 'Perspectives, opportunities and challenges in fisheries sciences in a changing climate: A workshop for emerging scientists' during November 19-23, 2024

Dr. Rajeev Kumar Singh

- Lead lecture on "Role of germplasm resource centres in AqGR management' in National Workshop on 'Conservation of Indigenous Fishes of Jammu & Kashmir in the Changing Climate Scenario' organized by ICAR-NBFGR in collaboration with SKUAST-K at Faculty of Fisheries, Rangil during November 18–19, 2024

Dr. Basdeo Kushwaha

- Invited lecture on 'Cytogenetic diversity of hill stream fishes of Jammu and Kashmir' in National Workshop on 'Conservation of Indigenous Fishes of Jammu & Kashmir in the Changing Climate Scenario' organized by ICAR-NBFGR in collaboration with SKUAST-K at Faculty of Fisheries, Rangil during November 18–19, 2024

Dr. Neeraj Sood

- Presentation on 'Regional Workshops for Strengthening and Harmonization of Surveillance, Monitoring and Reporting of Aquatic Animal Diseases' in 'Round Table Meeting: Progressive Management Pathway for Aquaculture Biosecurity (PMP/AB): updates and roll out' organized by Food Safety, Nutrition and Health Team of the Food and Agriculture Organization of the United Nations and the Chinese Academy of Fisheries Sciences in Qingdao, China during May 13-15, 2024
- Presentation on 'National Surveillance Programme for Aquatic Animal Diseases: Establishment of e-governance in Aquatic Animal Disease Management System' during 27th National Conference on e-Governance at Jio Convention Centre, Mumbai during September 3-4, 2024
- Presentation on 'National Surveillance Program on Aquatic Animal Health Management' in National Workshop on 'Conservation of Indigenous Fishes of Jammu & Kashmir in the Changing Climate Scenario' organized by ICAR-NBFGR in collaboration with SKUAST-K at Faculty of Fisheries, Rangil during November 18–19, 2024

Dr. V.S. Basheer

- Oral presentations on 'Ornamental fish diversity in India: An overview' and 'Milt cryopreservation: A tool for conservation of fishes' in National Workshop on 'Conservation of Indigenous Fishes of Jammu & Kashmir in the Changing Climate Scenario' organized by ICAR-NBFGR in collaboration with SKUAST-K at Faculty of Fisheries, Rangil during November 18–19, 2024

Dr. Gaurav Rathore

- Invited lecture on 'Antimicrobial resistance in fisheries and livestock sector: Status & challenges' in Research Conclave on Antimicrobial resistance, One Health & Pandemic Preparedness organized by GSBTM, GoG at IIT, Gandhinagar during July 8-9, 2024
- Invited lecture (virtual) on 'Automated systems for antimicrobial resistance detection' in training programme on 'Antimicrobial resistance testing: A hands-on training' organized by the Division of Bacteriology & Mycology, ICAR-IVRI, Izatnagar during November 6-12, 2024
- Invited lecture on 'Indian Network for Fisheries and Animal Antibiotic Resistance (INFAAR)' in FAO reference centre Hands-on-Workshop on 'Utilisation of microbiome and genomic resources for understanding and mitigation of antimicrobial resistance in one health context' at Nitte University, Mangalore during November 18-22, 2024

Dr. Sharad Kumar Singh

- Oral presentation on 'Possible way for restoring sustainable carp biodiversities of Sai river (Adi Ganga) through solar based FRP carp hatchery as innovative conservation strategies' in International Hybrid Symposium on 'Changing Status of Ecosystem Health of the River Ganga: An Update and Review', organized by Aquatic Ecosystem Health & Management Society, South & Southeast Asia Chapter, in collaboration with ICAR-NBFGR, Central University of South Bihar, University of Delhi, ABCS, Lucknow and Vijnana Bharati during June 10-11, 2024

Dr. Achal Singh

- Lecture on 'Evaluating environmental parameters for landscape profiling in the Ganga river basin employing receiver operating characteristics diagnosis' in International Hybrid Symposium on 'Changing Status of Ecosystem Health of the River Ganga: An Update and Review', organized by Aquatic Ecosystem Health & Management Society, South & Southeast Asia Chapter, in

collaboration with ICAR-NBFGR, Central University of South Bihar, University of Delhi, ABCS, Lucknow and Vijnana Bharati during June 10-11, 2024

- Oral Presentation on 'आर्टिफिसिएल इंटेलिजेंस मॉडल तथा लीनियर रिग्रेसन मॉडल द्वारा गंगा नदी बेसिन में मत्स्य प्रजातियों के वितरण की माडलिंग' in National Scientific Hindi Seminar-cum-Workshop on 'New Directions in Fish Conservation Science' organized by ICAR-NBFGR on September 25, 2024
- Lecture on 'Measuring the sustainability and accuracy of the role of correlated environmental parameters in the meta-structure of the Ganga river basin' in 4th International Web Conference on Natural Resource management for Global Food Security and Environmental Stewardship (GLOFES) organized by Academy of Natural Resource Conservation and Management, Lucknow, KSN University of Agricultural and Horticultural Science, Shivamoga and University of Agricultural Sciences, Bengaluru during October 15-16, 2024
- Lecture on 'The sustainability approach in identifying significant environmental parameters meta structure and river landscape profiling' in National Workshop on 'Conservation of Indigenous Fishes of Jammu & Kashmir in the Changing Climate Scenario' organized by ICAR-NBFGR in collaboration with SKUAST-K at Faculty of Fisheries, Rangil during November 18–19, 2024
- Lecture on 'Time series meta structure of homoscedastic-environmental parameters in landscapes' profiling of Ganga river basin' in 2nd International Conference on 'Innovation in Science and Technology for Sustainable Development 2.0 (ISTSD)' organized by Department of Science, Maharishi School of Science and Humanities, Maharishi University of Information Technology, Lucknow during November 19-21, 2024

Dr. Mahender Singh

- Keynote address on 'Discovery of new fish species using integrative taxonomy' in National Scientific Hindi Seminar-cum-Workshop on 'New Directions in Fish Conservation Science' organized by ICAR-NBFGR on September 25, 2024
- Guest lecture 'Fish sample collection and preservation procedures' in '7th School in Aquatic Wildlife Biology and Conservation' organized by TSA Foundation India and Pilibhit Tiger Reserve during November 4-9, 2024
- Keynote address (virtual) on 'Fish species discovery by integrative taxonomy' in National Workshop on 'Conservation of Indigenous Fishes of Jammu & Kashmir in the Changing Climate Scenario' organized by ICAR-NBFGR in collaboration with SKUAST-K at Faculty of Fisheries, Rangil during November 18–19, 2024

Dr. Divya P.R.

- Invited talk on 'Genetics in aquaculture with a particular focus on Indian research' organized by KUFOS and College of Fisheries, Panangad Alumni Association in International Fisheries Congress and Expo 2024 (IFC 2024) at Kochi during January 12-14, 2024
- Invited talk on 'Fish conservation: A genetic approach' at National Research Conference on 'Emerging Opportunities and Challenges in Management of Aquaculture and Agriculture Productivity and Economic Resilience (EOCMAA-2024)' and 'Marine Bioresource Conservation and Sustainable Utilization of Marine Based Products (MBCSUM-2024)' organized by Vivekananda Educational Institutions, Salem, during March 15-16, 2024.

Dr. A. Kathirvelpandian

- Keynote address on 'Genetic resources of deep-sea fishes of India' at National Scientific Hindi Seminar-cum-Workshop on 'New Directions in Fish Conservation Science' organized by ICAR-NBFGR on September 25, 2024

Dr. Poonam J. Singh

- Online lecture on 'Harnessing Innovation: Cultivating intellectual property in agriculture by ploughing the field of creativity' at IIAST, Integral University on April 26, 2024

Dr. Charan R.

- Invited lectures/practical sessions on 'Induced breeding, hatching, larval feeding, live feed culture and milt cryopreservation protocol' in the Workshop on 'Ornamental fish keeping, breeding and marine entrepreneurship' organized by the School of Biological Science and Biotechnology, Goa University during February 8-10, 2024

- Resource person in National Seminar on 'Exploring entrepreneur skills in zoology', organized by Quaid-E-Millath Government College for Women, Chennai on March 02, 2024
- Oral presentations on 'Development of breeding protocol for ornamental fishes of the Western Ghats: For conservation livelihood enhancement' and 'Breeding of Zodiac loach, *Mesonoemacheilus triangularis*, from India's biodiversity hotspot, the Western Ghats' in National Workshop on 'Conservation of Indigenous Fishes of Jammu & Kashmir in the Changing Climate Scenario' organized by ICAR-NBFGR in collaboration with SKUAST-K at Faculty of Fisheries, Rangil during November 18–19, 2024
- Oral presentations on 'संरक्षण–संचालित रणनीतिरू जलीय कृषि सतत देशज मत्स्य प्रजातियों का परिप्रेक्ष्य 'दक 'मीठे पानी की सजावटी मछली पालन में जीवित (लाइव) फीड का विकास और सतत उपयोग' at National Scientific Hindi Seminar-cum-Workshop on 'New Directions in Fish Conservation Science' organized by ICAR-NBFGR on September 25, 2024

Dr. Rejani Chandran

- Invited lecture on 'Taxonomy: A key to map and unravel biological diversity' at the Workshop 'Advances in fish systematics: Morphological and molecular approaches' organized by the ZSI in association with ICAR-NBFGR at Hyderabad during January 18-19, 2024
- Invited lecture (virtual) on 'Taxonomy of butterflyfishes: A sea wonder under threat' in Hands-on training on 'Corals and coral associated faunal communities: Taxonomy & monitoring' organized Zoological Survey of India, Kolkata during April 15-23, 2024
- Invited lecture on 'Aquatic genetic resources of India: Status and prospects under changing climate scenario' as part of World Environment Day celebration at Bankers Institute of Rural Development (BIRD), Lucknow on June 05, 2024
- Oral presentation on 'Optimizing National Fish Museum and Repository for aquatic germplasm conservation and management' in International Hybrid Symposium on 'Changing Status of Ecosystem Health of the River Ganga: An Update and Review', organized by Aquatic Ecosystem Health & Management Society, South & Southeast Asia Chapter, in collaboration with ICAR-NBFGR, Central University of South Bihar, University of Delhi, ABCS, Lucknow and Vijnana Bharati during June 10-11, 2024
- Oral presentation on 'National Fish Museum and Repository: Lighthouse for ichthyodiversity research and sustainable management during Animal Taxonomy Summit organized by ZSI at Kolkata during July 1-3, 2024
- Oral presentation on 'Conserving Ramsar wetlands of Uttar Pradesh in the Gangetic basin: Importance, threats, and sustainable management approaches' at International Conference on Conservation of Aquatic Biodiversity and Ecosystem Services of Ganga Basin during October 21-23, 2024
- Oral presentation on 'Indigenous fish resources of Jammu and Kashmir: Conservation strategies and the way forward in a changing climate scenario' in National Workshop on 'Conservation of Indigenous Fishes of Jammu & Kashmir in the Changing Climate Scenario' organized by ICAR-NBFGR in collaboration with SKUAST-K at Faculty of Fisheries, Rangil during November 18–19, 2024

Dr. Murali S.

- Poster presentation on 'Unleashing the potential of Fibroblast Growth Factor Receptor 2 (FGFR2) for enhanced fish growth in aquaculture' 13th Indian Fisheries & Aquaculture Forum organized by ICAR-CIFRI at Kolkata during February 23-25, 2024
- Invited lecture on 'Harnessing genomics to uncover secrets of sea anemone adaptation' in Hands-on training on 'Corals and coral associated faunal communities: Taxonomy & monitoring' organized Zoological Survey of India, Kolkata during April 15-23, 2024
- Oral presentation (virtual) on 'National Repository of Fish Cell Lines: A valuable biological resource for *in vitro* research and conservation of fishes' in International Hybrid Symposium on 'Changing Status of Ecosystem Health of the River Ganga: An Update and Review', organized by Aquatic Ecosystem Health & Management Society, South & Southeast Asia Chapter, in collaboration with ICAR-NBFGR, Central University of South Bihar, University of Delhi, ABCS, Lucknow and Vijnana Bharati during June 10-11, 2024

- Oral presentation on 'NRFC: A depository maintaining cell lines of hill stream fishes for their conservation and *in vitro* applications' in National Workshop on 'Conservation of Indigenous Fishes of Jammu & Kashmir in the Changing Climate Scenario' organized by ICAR-NBFGR in collaboration with SKUAST-K at Faculty of Fisheries, Rangil during November 18–19, 2024

Dr. Arun Sudhagar S.

- Invited lecture on 'Emerging and transboundary diseases of fish: How to prevent them?' during the Walk with the Scientist program, organized by the Department of Fisheries and Aquaculture, St. Albert's College, Kochi on December 02, 2024

Dr. Anutosh Paria

- Oral presentation on 'Documenting the incidence of Tilapia parvovirus in apparently healthy Nile Tilapia' in 13th Indian Fisheries & Aquaculture Forum, during February 23-25, 2024
- Oral presentation on 'Aquatic animal disease management through systematic disease reporting using ReportFishDisease (RFD) mobile application' in International Conference on 'Sustainable Fisheries & Aquatic Resource Management: Life Below Water' (SFARM-2024), organized by Central Calcutta Science & Culture Organization for Youth at Kolkata during September 12-14, 2024
- Oral presentation on 'Developing strategies to manage emerging aquatic animal diseases amidst changing climatic scenario' in National Seminar on 'Augmenting production and disease mitigation strategies in food-animals under changing climatic scenario' organized by Indian Journal of Animal Health on September 14, 2024

Dr. Chandra Bhushan Kumar

- Oral presentation on 'New approaches of fish health management initiatives: A way forward for sustainable aquaculture' in National Workshop on 'Conservation of Indigenous Fishes of Jammu & Kashmir in the Changing Climate Scenario' organized by ICAR-NBFGR in collaboration with SKUAST-K at Faculty of Fisheries, Rangil during November 18–19, 2024

Mrs. Teena Jayakumar T.K.

- Oral presentation on 'Diversity of dragon nets of the family Callionymidae along the Indian Peninsular coast' in International Fisheries Congress & Expo on 'Charting sustainable horizons: Fisheries, blue economy and the global goals' organized by KUFOS, Kochi, during January 12-14, 2024
- Oral presentation on 'Diversity of stargazers of the family Uranoscopidae in Indian Peninsular coast' in Animal Taxonomy Summit organized by ZSI at Kolkata during June 30-July 3, 2024
- Oral presentation on 'भारतीय प्रायद्वीपीय तट पर स्टारगेजर्स (फैमिली यूरेनोस्कोपिडे) की व्यवस्था और विविधता. मत्स्य संरक्षण विञ्जन में नई दिशायेम्' at National Scientific Hindi Seminar-cum-Workshop on 'New Directions in Fish Conservation Science' organized by ICAR-NBFGR on September 25, 2024

Dr. Tarachand Kumawat

- Invited talk on 'Enhancing species identification of jellyfish in fisheries: navigating a gelatinous future' at the Workshop 'Advances in fish systematics: Morphological and molecular approaches' organized by the ZSI in association with ICAR-NBFGR at Hyderabad during January 18-19, 2024
- Invited talk on 'Systematic analysis and strategic management of invasive alien ichthyofauna in India: Status and challenges' in Satellite Symposium on Fish Genetic Resources and Conservation under 13th Indian Fisheries & Aquaculture Forum organized by ICAR-CIFRI at Kolkata during February 23-25, 2024

Dr. Kantharajan G.

- Oral presentation on 'Assessment of habitat status and its role in shaping fish community structure along selected stretches of the river Godavari' in Satellite Symposium on Fish Genetic Resources and Conservation under 13th Indian Fisheries & Aquaculture Forum organized by ICAR-CIFRI at Kolkata during February 23-25, 2024
- Poster presentation on 'Ichthyofaunal diversity and habitat assessment of the semi-arid river Banas in the Ganges basin for conservation and management' in Satellite Symposium on Fish Genetic Resources and Conservation under 13th Indian Fisheries & Aquaculture Forum organized by ICAR-CIFRI at Kolkata during February 23-25, 2024

- Oral presentation on 'Mapping of deep pools in the rivers of Bundelkhand region of Uttar Pradesh in Ganga basin for conservation and Management of fish genetic resources' in International Hybrid Symposium on 'Changing Status of Ecosystem Health of the River Ganga: An Update and Review', organized by Aquatic Ecosystem Health & Management Society, South & Southeast Asia Chapter, in collaboration with ICAR-NBFGR, Central University of South Bihar, University of Delhi, ABCS, Lucknow and Vijnana Bharati during June 10-11, 2024
- Invited lecture (virtual) on 'Conservation and management of fish genetic resources in India' for B.F.Sc. Final year students of Dr. M.G.R. Fisheries College and Research Institute, Thalainayru (TNJFU) on August 12, 2024
- Oral presentation on 'Spatio-temporal assessment of habitat quality in contrasting landscapes along the Godavari river, India for sustainable ecosystem management' in International Conference on 'Sustainable Fisheries & Aquatic Resource Management: Life Below Water' (SFARM-2024), organized by Central Calcutta Science & Culture Organization for Youth at Kolkata during September 12-14, 2024
- Oral presentation (virtual) on 'Mapping of potential fish habitats in Wular Lake of Jammu and Kashmir using Google Earth Engine for conservation and management' in National Workshop on 'Conservation of Indigenous Fishes of Jammu & Kashmir in the Changing Climate Scenario' organized by ICAR-NBFGR in collaboration with SKUAST-K at Faculty of Fisheries, Rangil during November 18–19, 2024

Ms. Tanwy Dasmandal

- Poster presentation on 'Artificial Intelligence (AI) for modelling Ganga river ecosystem health dynamics and climate change impacts: Towards sustainable management' International Hybrid Symposium on 'Changing Status of Ecosystem Health of the River Ganga: An Update and Review', organized by Aquatic Ecosystem Health & Management Society, South & Southeast Asia Chapter, in collaboration with ICAR-NBFGR, Central University of South Bihar, University of Delhi, ABCS, Lucknow and Vijnana Bharati during June 10-11, 2024
- Oral presentation on 'मछलियों के संरक्षण के लिए वृद्धिकारक जीन (Growth gene) के कार्य पर व्यावहारिक पहलू' at National Scientific Hindi Seminar-cum-Workshop on 'New Directions in Fish Conservation Science' organized by ICAR-NBFGR on September 25, 2024

Library and Information Services

View of ICAR-NBFGR Library

The Punyabrata Das Library serves as a comprehensive repository of literature and scientific information, offering up-to-date resources in the areas of fish diversity, conservation, genetics, health, fisheries, and related fields. It continues to provide valuable services not only to users at the institute's headquarters and its various centres/units, but also to students, researchers, and professionals from other institutions, state fisheries departments, universities, and colleges.

Resource development

The library has a total collection of 7,780 books, 15 e-books and 3,348 bound volumes of journals and other reference materials. In addition, many journals were received on gratis/exchange basis.

Library automation

The library functions in a fully automated mode, with its operations computerized using KOHA, an open-source library management system, implemented with technical support from CSIR–National Institute of Science Communication and Information Resources, New Delhi. Records of books, journals, maps, and other resources have been systematically entered into the database. Barcoding of books, periodicals, and maps has been completed to facilitate automated circulation. An Online Public Access Catalogue (OPAC) is also available to users for easy access to the library's collection.

Information and reference services

The library provided information and reference services to its users, including assistance in locating materials through the OPAC module of the KOHA system and utilizing basic reference resources. Access to journals and e-books on agriculture and allied subjects was facilitated through the ICAR-Consortium for e-Resources in Agriculture (CeRA) via the J-Gate Plus platform. Library users made extensive use of CeRA to access full-text online journals and e-books. In addition to online access, the library also offered Document Delivery Services to various institutions

Technical reports and reprography services

Library and documentation unit provided technical support to bring out departmental publications. The unit also provided active reprography services, comb binding, spiral binding, and lamination facilities.

Exchange services

Library continued exchange relationship and resource sharing with leading national and international research institutes and development organizations. To keep stakeholders informed about the Bureau's activities, the library distributed the ICAR-NBFGR Annual Report 2023 and other publications to a wide range of recipients, including international organizations, universities, state fisheries departments, Fish Farmers' Development Agencies, Krishi Vigyan Kendras, entrepreneurs, and fish farmers.

Promotion/Joining/Relieving/ MACP/Superannuation

Joining/Appointment

S. No.	Name of employee	Date of Joining
1.	Mr. Jaspreet Singh, Scientist (FRM) joined after transfer from ICAR-Research Complex for Eastern Region, Patna, Bihar	01.04.2024 (F.N.)
2.	Mr. Ashutosh Singh joined as Finance & Accounts Officer	22.04.2024 (F.N.)
3.	Mr. Nitish Kumar Patel joined as Technician (T-1)	24.04.2024 (F.N.)
4.	Mr. Aman Raj joined as Technician (T-1)	03.05.2024 (F.N.)
5.	Sh. Ritesh Kumar joined as Technician (T-1)	06.05.2024 (F.N.)
6.	Sh. Syed Kavish Abbas joined as Assistant	20.09.2024 (F.N.)
7.	Mrs. Ambily M.N. joined after transfer from ICAR-Central Inland Fisheries Research Institute, Barrackpore, Kolkata	30.12.2024 (F.N.)

Superannuation

S.No.	Name of employee	Date of Superannuation/Retirement
1.	Sh. Gulab Chandra, Technical Officer	31.01.2024
2.	Sh. Phool Chand Verma, UDC	31.07.2024
3.	Dr. Ajay Kumar Singh, CTO	31.10.2024
4.	Sh. Samarjit Singh, Technical Officer	30.11.2024

Relieving

S.No.	Name of employee	Date of Relieving
1.	Sh. Raj Kumar Yadav, Administrative Officer relieved to join ICAR-IVRI, Izatnagar, Bareilly	27.12.2024

Promotion

S. No.	Name of employee
1.	Dr. A. Kathirvelpandian, Senior Scientist (FRM) promoted to Principal Scientist in the Pay Level-14 PB ₹ 37400-67000+RGP of ₹ 10,000/- w.e.f. 08.01.2023
2.	Smt. Raj Kumari, MTS promoted to the post of Technician (T-1) under 33.33% promotion quota in the Pay Level-3 of 7 CPC w.e.f. 04.01.2024
3.	Sh. Abhishek Kumar, Assistant promoted to the post of Assistant Administrative Officer Pay Level-7 w.e.f. 19.07.2024
4.	Dr. Kantharajan G., Scientist promoted to PB-3 (₹15,600-39,100+RGP of ₹7,000/) Level-11 w.e.f. 30.01.2023
5.	Dr. Ranjan Singh, Technical Assistant (T-3) promoted to Senior Technical Assistant (T-4) in PB-2 of Rs. 9300-34800+GP of Rs. 4200/- Pay Level-6 w.e.f. 18.12.2023
6.	Sh. Anshul Kumar Verma, Technical Assistant (T-3) promoted to Senior Technical Assistant (T-4) in PB-2 of Rs. 9300-34800+GP of Rs. 4200/- Level-6 w.e.f. 06.03.2024

Research Management

RAC Meeting in Progress

Research advisory committee

The 28th Research Advisory Committee (RAC) meeting of ICAR-NBFGR, Lucknow was held during March 13-14, 2024. The composition of the RAC is as under:

Dr. W. S. Lakra Former Vice-Chancellor, ICAR-CIFE, Mumbai and Former Director, ICAR-NBFGR, Lucknow	Chairman
Dr. M. H. Balkhi Former Dean, Faculty of Fisheries, Sher-e-Kashmir University of Agricultural Sciences and Technology (Kashmir), Srinagar	Member
Dr. A. D. Diwan Former ADG (Marine Fisheries), ICAR-New Delhi	Member
Dr. G. Gopikrishna Former Head and Principal Scientist, ICAR- CIBA, Chennai	Member
Dr. Shubhadeep Ghosh ADG (Marine Fisheries), ICAR, New Delhi	Member
Dr. Uttam Kumar Sarkar Director, ICAR-NBFGR, Lucknow	Member
Dr. Neeraj Sood Principal Scientist, ICAR-NBFGR, Lucknow	Member Secretary

Institute management committee

The 38th meeting of the Institute Management Committee was held on July 8, 2024 at ICAR-NBFGR, Lucknow with the following committee:

Dr. Uttam Kumar Sarkar

Director & Chairman ICAR-NBFGR, Lucknow, Uttar Pradesh-226002

Dr. Peyush Punia

Principal Scientist,
ICAR-Indian Institute of Farming Systems Research,
Modipuram, Siwaya- Jamalullapur, Uttar Pradesh-250110

Dr. R. S. Patiyal

Principal Scientist
ICAR-Directorate of Coldwater Fisheries Research, Anusandhan Bhawan, Industrial Area, Bhimtal, Uttarakhand-263136

Dr. M. Jayanthi

Principal Scientist & SIC
ICAR-Central Institute of Brackishwater Aquaculture
Santhome High Road, RA Puram, MRC Nagar, Chennai, Tamil Nadu-600028

Dr. Monika Sodhi

Principal Scientist
ICAR-National Bureau of Animal Genetic Resources, Makrampur Campus, G.T. Road Bypass, Karnal, Haryana-132001

Sh. Raj Kumar Yadav

Administrative Officer & Member-Secretary, ICAR-NBFGR, Lucknow, Uttar Pradesh-226002

Institute Research Council

The 37th Annual Institute Research Council (IRC) meeting was held during 29-30 April, 2024 at ICAR-NBFGR, Lucknow.

Distinguished Visitors

Visit of Prof. S.P. Singh Baghel, H'ble Minister of State for Fisheries, Animal Husbandry & Dairying and Panchayati Raj, GoI, New Delhi

S.No.	Dignitary	Visited at	Visit Date
1.	Prof. S.P. Singh Baghel H'ble Minister of State for Fisheries, Animal Husbandry & Dairying and Panchayati Raj, GoI, New Delhi	ICAR-NBFGR, Lucknow	June 19, 2024
2.	Dr. Himanshu Pathak Secretary, DARE & DG, ICAR, New Delhi	ICAR-NBFGR, Lucknow	April 14, 2024
		Agatti Facility of ICAR-NBFGR, Lakshadweep	April 22, 2024
3.	Dr. S. Ayyappan, Former Secretary (DARE) and DG (ICAR), New Delhi	PAGR Centre, ICAR-NBFGR, Kochi	March 11, 2024
4.	Dr. Bijendra Singh, Vice-Chancellor ANDUAT, Kumarganj, Ayodhya	ICAR-NBFGR, Lucknow	February 17, 2024
			July 5, 2024
			July 10, 2024
5.	Dr. Anand Kumar Singh Vice Chancellor, CSAUAT, Kanpur	ICAR-NBFGR, Lucknow	September 25, 2024
6.	Dr. Ashok Kumar Singh, Vice Chancellor, Rani Lakshmi Bai Central Agricultural University, Jhansi	ICAR-NBFGR, Lucknow	December 12, 2024
7.	Dr. A. Gopalakrishnan, Director, ICAR-CMFRI, Lucknow	ICAR-NBFGR, Lucknow	July 19, 2024
8.	Dr. V. K. Mishra, Director, ICAR Research Complex for NEH Region, Barapani, Meghalaya	ICAR-NBFGR, Lucknow	July 18, 2024
9.	Dr. W. S. Lakra Former Director, ICAR-NBFGR, Lucknow	ICAR-NBFGR, Lucknow	December 12, 2024
10.	Dr. A. G. Ponniah Former Director, ICAR-NBFGR, Lucknow	ICAR-NBFGR, Lucknow	December 12, 2024
11.	Dr. S. P. S. Khanuja Former Director, CSIR-CIMAP, Lucknow	ICAR-NBFGR, Lucknow	April 26, 2024
12.	Dr. V. B. Patel ADG, Horticulture Science, New Delhi	ICAR-NBFGR, Lucknow	April 14, 2024
13.	Dr. D. T. Selvam, Director, DGLS, DRDO, Ministry of Defence, New Delhi	PAGR Centre, ICAR-NBFGR, Kochi	December 16, 2024
14.	Dr. Sanjeev Kumar Registrar, Bihar Animal Sciences University	ICAR-NBFGR, Lucknow	May 1, 2024

Visit of Dr. Himanshu Pathak, Secretary, DARE & DG, ICAR, New Delhi

Release of ICAR-NBFGR publication by dignitaries

Visit of Dr. Himanshu Pathak, Secretary, DARE & DG, ICAR, New Delhi

Visit of Dr. Himanshu Pathak, Secretary, DARE & DG, ICAR, New Delhi at Agatti, Lakshadweep

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Visit of Dr. Bijendra Singh, Vice-Chancellor, ANDUAT, Kumarganj, Ayodhya

Dr. A. Gopalakrishnan, Director, ICAR-CMFRI, Kochi addressing ICAR-NBFGR staff

Dr. S. P. S. Khanuja, Former Director, CSIR-CIMAP, Lucknow addressing ICAR-NBFGR staff

Visit of Dr. Sanjeev Kumar, Registrar, Bihar Animal Sciences University

Swachh Bharat Activities

Walkathon on the occasion of Swachhta Hi Sewa campiagn

The institute has been actively promoting the Swachh Bharat Abhiyan to ensure a clean and green campus as well as surrounding areas, contributing to a cleaner and more beautiful India. Since the inception of the mission, the institute has consistently observed and supported the objectives of the Swachh Bharat Mission through various initiatives and activities. During the reporting period, numerous activities were conducted to emphasize personal hygiene, cleanliness within the institute, and awareness among public. Events like walkathon, sports, input distribution etc. centered around the theme of *Swachhta* were organized to engage and educate. In addition to the regular monthly initiatives, the institute also conducted 3 swachhta campaigns aimed at raising awareness about environmental responsibility and the objectives of the Swachh Bharat Mission. A summary of these programs is provided below:

1. Swachhta Hi Seva-2024 program with tag line, 'Swabhav Swachhta, Sanskar Swachhta' was organized during September 17- October 2, 2024. Various activities like Swachhta Pledge, Ek Ped Maa Ke Nam, Walkathon, human chain formation, cleaning of farm & laboratories, input distribution to fish farmers, etc. were conducted at Headquarters, ARTU, Chinhat and PAGR, Kochi, where more than 350 people participated. Mass awareness on Swachhta was created during Hindi Workshop held on September 25, 2024.

The daily activities of Swachhata Hi Seva-2024 program was uploaded on Government of India portal (*https://swachhatahiseva.gov.in*) for showcasing undertaken cleanliness works.

2. A special campaign 4.0 was conducted from October 2-31, 2024 as per instructions from Department of Administrative Reforms & Public Grievances (being Nodal department), Government of India, New Delhi. The campaign composed of daily reporting with respect to information on pending references by public representatives (MP, MLA etc.), official file review and closed status, river health maintenance activity, cleanliness campaign etc. Various activities like Walkathon, human chain formation, compost preparation, fish seed ranching for improving health of river Gomti at Kudia Ghat, Lucknow, awareness among school children about fish aquarium & museum, input distribution to fishermen, fish

feeding etc. were conducted.

3. *Swachhta Pakhwada* was organized during December 16-31, 2024. The program was inspired by the Hon'ble Prime Minister's vision to make swachhata 'everyone's business'. The celebration composed of Swachhta pledge, Swachhta-Aagrah-Walk, review and weeding out old records, cleanliness and sanitation drive, educating school children about cleanliness, discarding single use plastics, recycling of waste water, shramdaan activity, community involvement work, Kisan Diwas celebration, fostering healthy competition through sports, swachhta runs etc. The celebration provided a golden opportunity to inculcate the habit of cleanliness and strengthen the concept of brotherhood. Around 650 people participated in this program.


भाकृअनुप-राष्ट्रीय मत्स्य आनुवंशिक संसाधन ब्यूरो
जलकृषि अनुसंधान एवं प्रशिक्षण इकाई
चिनहट, लखनऊ-226 028
ICAR - National Bureau of Fish Genetic Resources
Aquaculture Research and Training Unit
Chinhat, Lucknow - 226 028

राजभाषा गतिविधियाँ

राजभाषा हिंदी पत्रिका 'मत्स्य लोक' को नराकास (कार्यालय–3), लखनऊ द्वारा द्वितीय पुरस्कार

नगर राजभाषा कार्यान्वयन समिति पुरस्कार

भारत सरकार, राजभाषा विभाग, गृह मंत्रालय, नगर राजभाषा कार्यान्वयन समिति (कार्यालय–3), भाकृअनुप–भारतीय गन्ना अनुसंधान संस्थान, लखनऊ, द्वारा संस्थान को निम्नलिखित पुरस्कार प्रदान किए गए:

- संस्थान द्वारा प्रकाशित हिंदी राजभाषा पत्रिका मत्स्यलोक, अंक 12, 2023 को छमाही अवधि (अक्तूबर 2023–मार्च 2024) में द्वितीय पुरस्कार।
- संस्थान द्वारा प्रकाशित हिंदी राजभाषा पत्रिका मत्स्यलोक, अंक 13, 2024 को तृतीय पुरस्कार।
- संस्थान को छमाही अवधि (अक्तूबर 2023– मार्च, 2024) में उत्कृष्ट कार्यों के लिए तृतीय स्थान।
- संस्थान को अप्रैल –सितंबर, 2024 की छमाही अवधि में अपने उत्कृष्ट कार्यों के लिए चतुर्थ स्थान।

हिंदी सप्ताह का आयोजन

संस्थान में दिनांक 14–20 सितंबर के दौरान हिन्दी सप्ताह 2024 का आयोजन किया गया। इसके अंतर्गत कुल 08 प्रतियोगिताओं का आयोजन किया गया, जिसमें सभी कार्मिकों ने सक्रियता से भाग लिया। इसके साथ ही संस्थान के प्रायद्वीपीय जलीय आनुवंशिक संसाधन केंद्र (पीएजीआर), कोच्चि, में भी हिन्दी सप्ताह 2024 का आयोजन किया गया, जिसमें कुल 04 प्रतियोगिताओं का आयोजन किया गया। इन प्रतियोगिताओं में पीएजीआर के सभी कार्मिकों ने सक्रियता से भाग लिया।

हिंदी सप्ताह 2024 कार्यक्रम के समापन एवं पुरस्कार वितरण समारोह का आयोजन 3 अक्टूबर, 2024 को संस्थान के निदेशक की अध्यक्षता में किया गया। समारोह के मुख्य अतिथि डॉ. (ब्रिगेडियर) पी. जायसवाल, प्रमुख, एएमसी, लखनऊ थे। श्री सुभाष चन्द्र, प्रभारी, राजभाषा अनुभाग ने हिंदी सप्ताह 2024 के दौरान आयोजित विविध कार्यक्रमों पर प्रतिवेदन प्रस्तुत किया। इस अवसर पर मुख्यालय तथा पीएजीआर केंद्र, कोच्चि में आयोजित हिंदी सप्ताह कार्यक्रमों की प्रतियोगिताओं में भाग लेने वाले विजयी प्रतिभागियों को प्रमाण पत्र एवं पारितोषिक प्रदान किये गये।

हिंदी कार्यशालाओं का आयोजन

संस्थान के वैज्ञानिकों, तकनीकी, प्रशासनिक अधिकारियों व कर्मचारियों तथा मल्टी टास्किंग स्टाफ को अपना काम हिन्दी में करने और रोजमर्रा के कामकाज में राजभाषा के प्रयोग को बढ़ावा देने के लिए हिंदी में निम्नलिखित एक–दिवसीय कार्यशाला–सह–प्रशिक्षण कार्यक्रमों का आयोजन किया गयाः

1. दिनांक 11 मार्च, 2024 को 'महिला सशक्तिकरण' विषय पर हिन्दी कार्यशाला का आयोजन किया गया।
2. दिनांक, 24 जून, 2024 को 'राजभाषा कार्यान्वयन' पर हिन्दी कार्यशाला का आयोजन किया गया।
3. दिनांक 25 सितम्बर, 2024 को 'मत्स्य संरक्षण विज्ञान में नई दिशाएँ' विषय पर राष्ट्रीय वैज्ञानिक हिन्दी संगोष्ठी–सह–कार्यशाला का आयोजन किया गया।
4. दिनांक 31 दिसंबर, 2024 को 'राजभाषा का सत्यनिष्ठा पूर्वक कार्यान्वयन' विषय पर नराकास (कार्यालय–3) के लखनऊ स्थित सभी कार्यालयों को सम्मिलित करते हुए एक नगर स्तरीय राजभाषा हिन्दी कार्यशाला का आयोजन किया गया।

उपरोक्त कार्यशाला–सह–प्रशिक्षण कार्यक्रमों में संस्थान के सभी कार्मिकों ने बढ़ चढ़ कर हिस्सा लिया।

राजभाषा पत्रिका मत्स्यलोक का प्रकाशन

राजभाषा पत्रिका मत्स्यलोक, अंक 12, 2023 तथा मत्स्यलोक, अंक 13, 2024 का प्रकाशन किया गया। पत्रिका में संस्थान की गतिविधियों से संबन्धित वैज्ञानिक एवं लोकप्रिय लेख सम्मिलित किए गए, जो कि संस्थान के द्वारा राजभाषा के संवर्धन के प्रति सदैव ऊर्जावान एवं निरंतर प्रयासरत रहने की प्रतिबद्धता को दर्शाता है।

संस्थान राजभाषा कार्यान्वयन समिति की बैठक

राजभाषा विभाग, गृह मंत्रालय, भारत सरकार के निर्देशानुसार संस्थान राजभाषा कार्यान्वयन समिति की तिमाही बैठकें दिनांक 26 मार्च, 24 जून, 23 अगस्त व 30 दिसम्बर, 2024 को आयोजित की गयी। इन बैठकों में राजभाषा हिंदी के प्रगामी प्रयोग, राजकीय कार्य हिन्दी में करने के लिए राजभाषा विभाग द्वारा जारी वार्षिक राजभाषा कार्यक्रम, हिन्दी के प्रचार, प्रसार एवं कार्यान्वयन के बारे में चर्चा हुई।

नगर राजभाषा कार्यान्वयन समिति की बैठकों में संस्थान की सहभागिता

- निदेशक एवं प्रभारी, राजभाषा अनुभाग ने नगर राजभाषा कार्यान्वयन समिति (कार्यालय–3), लखनऊ की भाकृअनुप– भारतीय गन्ना अनुसंधान संस्थान, लखनऊ में दिनांक 25 जून, 2024 को सम्पन्न हुई वर्ष 2024–25 की प्रथम अर्धवार्षिक बैठक को में भाग लिया।
- निदेशक एवं प्रभारी, राजभाषा अनुभाग ने नगर राजभाषा कार्यान्वयन समिति (कार्यालय–3), लखनऊ की भाकृअनुप– भारतीय गन्ना अनुसंधान संस्थान, लखनऊ

में दिनांक 28 नवम्बर, 2024 को सम्पन्न हुई वर्ष 2024–25 की द्वि तीय अर्धवार्षिक बैठक को में भाग लिया।

अन्य क्रियाकलाप

- संस्थान के वार्षिक प्रतिवेदन 2023 के हिन्दी अनुवाद व सम्पादन का कार्य किया गया।

- संस्थान में आयोजित विभिन्न महत्वपूर्ण कार्यक्रमों से संबन्धित प्रेस विज्ञप्ति को हिन्दी में तैयार किया गया।

National Fish Museum & Repository

Facilities available at National Fish Museum and Repository Building

The ICAR-National Bureau of Fish Genetic Resources (ICAR-NBFGR), Lucknow, is designated by the National Biodiversity Authority (NBA), Government of India, as the Nodal repository for the transfer of fish resources under Section 39 of the Biological Diversity Act, 2002. ICAR-NBFGR has carried out extensive work to consolidate diverse collections, including vouchers, tissues, DNA, bacteria, cell lines, and fish milt, providing researchers with valuable resources and ensuring widespread accessibility for stakeholders. The institute established the National Fish Museum and Repository in 2014 to strengthen the repository activities. The museum, open from 9:00 AM to 4:30 PM, except Mondays and public holidays, features finfish and shellfish voucher specimens from freshwater, marine, and brackish environments, serving as an educational and research resource for students, teachers, scientists, and the general public.

Aquatic life interpretation centre

Aquatic Life Interpretation Centre is dedicated to educating the public about the rich diversity of fish species and aquatic resources, including India's rivers and streams. Key attractions include a statue of Matsyavatar, an artificial tunnel, scale models of commercially significant fish species, and replicas of state fish from 21 states across the country. Additionally, interactive

display panels featuring educational videos on sustainable fishing practices provide an engaging and informative experience for visitors.

Facilities

The National Fish Museum and Repository brings together diverse collections, including vouchers, tissues, DNA samples, bacteria, cell lines, and fish milt, providing valuable resources for researchers and ensuring their broad accessibility for the benefit of stakeholders. The museum showcases finfish and shellfish voucher specimens from freshwater, marine, and brackish water environments, serving as an avenue for research and education for students, teachers, scientists, and the general public. Additionally, it is equipped with a radiographic facility to enable a detailed study of fish vertebrae counts, fin rays, and other osteological features.

The National Fish Museum and Repository is designed to benefit research scholars, students, and the general public by offering opportunities to observe fish and deepen their understanding of fish morphology and biodiversity. The preserved samples serve both educational and research purposes. Through this effort, ICAR-NBFGR seeks to position India's fisheries research on a global platform and promote the sustainable conservation and utilization of prioritized species by fostering public awareness.

During the reporting period, various dignitaries visited the museum and appreciated the institute's efforts towards fish conservation through public participation. On the occasion of Independence Day and Institute Foundation Day the facility was open to the public free of cost to create awareness about the importance of the aquatic biodiversity conservation.

A total of 7304 visitors, including school children, university students, and other tourists, visited the aquarium, and a revenue of Rs. 1,19,195 was generated from entry ticket sales.

Ganga Aquarium: Citizen-science Knowledge Hub about Aquatic Diversity

Prof. S.P. Singh Baghel ji, Honorable Minister of State, GoI

Prof. S.P. Singh Baghel ji, Honorable Minister of State, GoI

The Ganga Aquarium, housed in the main premises of the institute in Lucknow, Uttar Pradesh, is recognized as one of India's premier public aquarium. Beyond serving as a center for recreation and education, the primary mandate of the aquarium is to enhance public awareness regarding the biodiversity of ornamental fishes and the importance of their conservation. To facilitate learning and environmental sensitization, each display tank is accompanied by a digital information panel providing taxonomic details and biological insights. This educational component plays a significant role in fostering ecological awareness and promoting responsible behaviour towards aquatic ecosystems.

The facility comprises 47 aquaria, exhibiting over 65 fish species representing more than 100 varieties across 30 taxonomic families. The collection includes a wide range of ornamental, food, sport, and medicinal fishes. Exotic ornamental species, including flowerhorn, arowana, Japanese koi carp, discus, oscars, tetras, silver shark, redtail shark and livebearers, like guppies and mollies as well

Release of State fish of Uttar Pradesh by Dr. Himanshu Pathak, Secretary DARE and Director General, ICAR


A group of specially abled kids along with their parents

Interaction with school and college students on aquatic diversity

as Indian ornamentals, such as denison barb, pearlspot and pengba, along with key food fishes, like catla, rohu, mrigal, mahseer, and catfishes, are displayed. Each aquarium is supported by a sophisticated aquatic life support system that mimics natural habitat, ensuring optimal care of the species. The aquarium also maintains marine species, such as clownfish, damselfish, wrasses, lionfish, and snowflake eel, in specially developed artificial seawater tanks. A notable feature is the mermaid-themed circular tank at the entrance, powered by a Recirculatory Aquaculture System (RAS) and adorned with a decorative glass dome and fountain, serving both as an aesthetic as well as technological highlight of the facility.

The aquarium also functions as a training and outreach centre, regularly visited by participants of various trainings programs, conferences and seminars, farmers, students, women of SHGs of various skill development etc. Programs, like Swachhta Pakhwada, Signature Campaigns, and Open House Days involving school students and the general public for strengthening science communication and conservation literacy, were also organized. A group of 40 specially-abled children, accompanied by their parents also visited on August 30, 2024, with the aim of nurturing sensory engagement, promoting curiosity, and enhancing the children's understanding of the aquatic world.

Many dignitaries visited the facility during the year. On April 14, 2024, Dr. Himanshu Pathak, Secretary, DARE & Director General, ICAR, released the State Fish of Uttar Pradesh, *Chitala chitala*, into the aquarium symbolizing the conservation and awareness initiative. Two public information posters entitled 'Diverse world of *Nishigikoi* or Koi Carp: Basic Group' and 'Single species with diverse forms: Gold fish (*Carrassius auratus*)' were also released. On June 19, 2024, Prof. S.P. Singh Baghel ji, Honourable Minister of State, Ministry of Fisheries, Animal Husbandry & Dairying and Ministry of Panchayati Raj, New Delhi, visited the facility.

Open day celebration

Foreign visitors at the aquarium

During the reporting year, the facility welcomed around 20,000 visitors, generated ₹3,10,092/- revenue. The increasing public engagement underscores the aquarium's pivotal role in bridging science, conservation and community awareness.

New Facilities

Inauguration of Central Lab facility by Dr. W. S. Lakra

Central Laboratory Facility at Lucknow

Central laboratory facility was inaugurated by Dr. W. S. Lakra, Former Vice Chancellor & Director, ICAR-CIFE, Mumbai and Former Director, ICAR-NBFGR, Lucknow at ICAR-NBFGR, Lucknow on March 14, 2024. The facility aims to provide central access to various scientific instruments like automated nucleic extraction assembly, digital microscopy, high-quality gel imaging, GIS mapping etc. to all the staff, research students and other visitors.

Display cum interpretation centre for marine ornamentals at Agatti, Lakshadweep Island

Display cum interpretation facility for marine ornamentals was inaugurated by Dr. Himanshu Pathak, Honourable Secretary, DARE & Director General, ICAR, at Agatti, Lakshadweep on April 20, 2024. The facility will serve as a knowledge hub for creating public awareness on conservation of the marine diversity, especially marine ornamental organisms, and also will provide additional income to the women islanders of Agatti. Further, *Cinetorhynchus himanshui*, a new ornamental shrimp discovered from the Lakshadweep islands, was launched for captive propagation on the occasion. The new species will be captively bred and brought into the ornamental trade for the livelihood enhancement of the local tribal women. Honourable Secretary also visited and observed the fish diversity associated with the coral reef of the island.

Marine Ornamental Fish Rearing RAS (MORR) facility at Kanyakumari

Marine Ornamental Fish Rearing RAS (MORR) facility, funded by the SCSP scheme, was inaugurated on June 15, 2024 at DIFST (St. Devasahayam Institute of Fisheries Science & Technology, Kanyakumari district, Tamil Nadu. The state-of-the-art marine ornamental fish production facility, using Recirculating Aquaculture System (RAS), is specifically intended for the cultivation of clownfish, the most popular and vibrant species in the marine ornamental sector. This facility will be useful to train the fisherwomen of the region for livelihood development and creation of awareness among the students.

Field Demonstration and Training Facility for Indigenous Fish Breeding at Ernakulam

A Field Demonstration and Training Facility for breeding indigenous fish was inaugurated by Dr. B. Madhusoodana Kurup, Former Vice-Chancellor, KUFOS, Kochi at Rayamangalam Panchayath, Ernakulam, on September 5, 2024. This initiative, undertaken through a Memorandum of Understanding with Rayamangalam Panchayath, aims to strengthen local fish breeding, conservation, and training capabilities. Dr. Kurup lauded the efforts of ICAR-NBFGR in taking conservation protocols to the grassroots level and emphasized the role of local governance in preserving indigenous fish species. Mr. N.P. Ajayakumar, President, Rayamangalam Grama Panchayath, expressed gratitude to ICAR-NBFGR for bringing this initiative to the region.

Floating cages at Gauhati University, Guwahati

A floating cage facility was established under the NEH component at Biodiversity and Conservation Centre, Department of Zoology, Gauhati University on October 24, 2024 for captive propagation and rearing of indigenous fishery resources of the NE region. The facility was inagruated by Prof. Nani Gopal Mahanta, Vice Chancellor, Gauhati University. The floating cages installed would enhance the breeding activities performed in the center, further enabling better conservation and protection of important indigenous fishery resources. Seeds of *Labeo rohita, L. bata, L. calbasu,* and *Anabas testudineus* were stocked in the cages. In the long run, the facility will provide training and demonstration facilities to stakeholders, thus, improving their livelihood and sustainability of indigenous fishery resources.


Marine Ornamental Fish Rearing
RAS Facility

List of Personnel

Research Management

Sl. No.	Name	Designation
Dr. Uttam Kumar Sarkar		Director

Scientific Staff

1.	Dr. T.T. Ajith Kumar	Principal Scientist & Head PAGR Centre, Kochi
2.	Dr. (Mrs.) Vindhya Mohindra	Principal Scientist & Head Genomics and Computational Resources Division
3.	Dr. Pravata Kumar Pradhan	Principal Scientist & Head Exotics and Aquatic Animal Health Division
4.	Dr. Rajeev Kumar Singh	Principal Scientist & Head Germplasm Exploration, Evaluation and Conservation Division
5.	Dr. Ravindra Kumar	Principal Scientist
6.	Dr. Basdeo Kushwaha	Principal Scientist
7.	Dr. Neeraj Sood	Principal Scientist
8.	Dr. V.S. Basheer	Principal Scientist (PAGR)
9.	Dr. Gaurav Rathore	Principal Scientist
10.	Dr. Sharad Kumar Singh	Principal Scientist & SIC, ARTU, Chinhat
11.	Dr. Lalit Kumar Tyagi	Principal Scientist
12.	Dr. Achal Singh	Principal Scientist
13.	Dr. Satish Kumar Srivastava	Principal Scientist
14.	Dr. Mahender Singh	Principal Scientist
15.	Dr. Ajey Kumar Pathak	Principal Scientist
16.	Dr. (Mrs.) Divya P.R.	Principal Scientist (PAGR)
17.	Dr. A. Kathirvelpandian	Principal Scientist (PAGR)
18.	Dr. Poonam Jayant Singh	Senior Scientist
19.	Dr. Santosh Kumar	Scientist
20.	Dr. Charan R.	Scientist (PAGR)
21.	Dr. Rejani Chandran	Scientist
22.	Dr. Murali S.	Scientist
23.	Dr. Aditya Kumar	Scientist
24.	Dr. Labrechai Mog Chowdhury	Scientist
25.	Dr. Arun Sudhagar S.	Scientist (PAGR)
26.	Dr. Anutosh Paria	Scientist
27.	Dr. Chandra Bhushan Kumar	Scientist
28.	Mrs. Rekha M.U.	Scientist (PAGR)
29.	Dr. Raghvendra Singh	Scientist
30.	Mrs. Teena Jayakumar T.K.	Scientist (PAGR)
31.	Dr. Tarachand Kumawat	Scientist
32.	Dr. Monika Gupta	Scientist
33.	Dr. Kantharajan G.	Scientist
34.	Mr. Jaspreet Singh	Scientist
35.	Ms. Tanwy Dasmandal	Scientist

Technical Staff

Sl. No.	Name	Designation
1.	Dr. Ajay Kumar Singh	Chief Technical Officer
2.	Shri Prem Chandra	Chief Technical Officer
3.	Shri Ramashankar Sah	Assistant Chief Technical Officer
4.	Shri Subhash Chandra	Assistant Chief Technical Officer
5.	Dr. Akhilesh Kr. Mishra	Assistant Chief Technical Officer
6.	Dr. Ranjana Sinha	Assistant Chief Technical Officer
7.	Shri Ravi Kumar	Assistant Chief Technical Officer
8.	Shri S. K. Singh	Assistant Chief Technical Officer
9.	Shri Amit Singh Bisht	Assistant Chief Technical Officer
10.	Shri Satyavir Chaudhary	Assistant Chief Technical Officer
11.	Shri Vijay Kumar Singh	Senior Technical Officer
12.	Shri Vikas Kumar	Senior Technical Officer
13.	Shri Deva Narayan	Senior Technical Officer
14.	Shri B. N. Pathak	Technical Officer
15.	Shri Samarjit Singh	Technical Officer
16.	Shri Om Prakash	Technical Officer
17.	Shri Rajesh Kumar	Technical Officer
18.	Shri Om Prakash-II	Technical Officer
19.	Dr. Vikash Sahu	Technical Officer
20.	Shri Gulab Chandra	Technical Officer
21.	Shri Krishna Kumar Singh	Technical Officer
22.	Dr. Ranjan Singh	Technical Assistant (T-3)
23.	Shri Anshul Kumar Verma	Technical Assistant (T-3)
24.	Shri Anil Kumar	Technician (T-1)
25.	Shri Sidhnath	Technician (T-1)
26.	Smt. Raj Kumari	Technician (T-1)
27.	Shri Nitish Kumar Patel	Technician (T-1)
28.	Shri Aman Raj	Technician (T-1)
29.	Shri Ritesh Kumar	Technician (T-1)

Administrative Staff

Sl. No.	Name	Designation
1.	Shri Raj Kumar Yadav	Administrative Officer
2.	Shri Ashutosh Singh	Finance & Accounts Officer
3.	Shri Ram Sakal	Private Secretary
4.	Shri Pramod Kumar Awasthi	Assistant Administrative Officer
5.	Smt. Kaneez Fatima	Assistant Administrative Officer
6.	Smt. Sunita Kumari	Assistant Administrative Officer
7.	Shri Abhishek Kumar	Assistant Administrative Officer
8.	Shri Sandeep	Personal Assistant
9.	Shri Harivilas	Personal Assistant
10.	Shri Vinay Kumar Srivastava	Assistant
11.	Shri Shreelal Prasad	Assistant
12.	Shri Santosh Kumar Singh	Assistant
13.	Shri Syed Kavish Abbas	Assistant
14.	Shri Phool Chand Verma	Upper Division Clerk
15.	Shri Rajan Kr. Malhotra	Upper Division Clerk
16.	Shri Vikrant Gupta	Upper Division Clerk
17.	Shri Balram Babu Bajpai	Lower Division Clerk
18.	Shri Anwar Husain	Lower Division Clerk
19.	Shri Sanjay Kumar	Lower Division Clerk
20.	Smt. Seema Devi	Lower Division Clerk

Multi-tasking Staff

Sl. No.	Name	Designation
1.	Shri Dukhi Shyam Deo	Multi-tasking Staff
2.	Shri Indrajit Singh	Multi-tasking Staff
3.	Shri Ashok Kumar	Multi-tasking Staff
4.	Shri Dinesh Kumar	Multi-tasking Staff
5.	Shri Ashok Kumar Awasthi	Multi-tasking Staff
6.	Shri Ram Lakhan	Multi-tasking Staff
7.	Shri Sunit Kumar Srivastava	Multi-tasking Staff
8.	Shri Jai Narain Tiwari	Multi-tasking Staff
9.	Shri Mayank Pratap Singh	Multi-tasking Staff
10.	Shri Sushil Kumar	Multi-tasking Staff
11.	Shri Vicky Kumar Prajapati	Multi-tasking Staff

Linkages

ICAR-NBFGR signs MoU with Shri Ramswaroop Memorial University, Barabanki on February 2, 2024

A. Organizations at Lucknow

- Amity University
- Aquatic Biodiversity Conservation Society
- Babasaheb Bhimrao Ambedkar University
- Biotechnology Park
- CSIR-Central Drug Research Institute
- CSIR-Central Institute of Medicinal and Aromatic Plants
- CSIR-Indian Institute of Toxicological Research
- CSIR-National Botanical Research Institute
- Department of Fisheries, Government of Uttar Pradesh
- Dr. A.P.J. Abdul Kalam Technical University
- ICAR-Central Institute of Subtropical Horticulture
- ICAR-Central Soil Salinity Research Institute (Regional Station)
- ICAR-Indian Institute of Sugarcane Research
- Integral University
- King George's Medical University
- Maharishi University of Information Technology
- Sanjay Gandhi Post-Graduate Institute of Medical Sciences
- University of Lucknow

B. Organizations outside Lucknow

- Acharya Narendra Dev University of Agriculture & Technology, Kumarganj, Ayodhya
- Assam Agricultural University, Jorhat, Assam
- Bundelkhand University, Jhansi, Uttar Pradesh
- Abdul Hakeem College, Melvisharam, Tamil Nadu
- Central Agricultural University Imphal Manipur
- Centre for Aquaculture Resource & Extension, St. Xavier College, Palayamkottai, Tamil Nadu
- Centre for Marine Living Resources & Ecology, Kochi, Kerala
- Centre of Advanced Study in Marine Biology, Annamalai University, Chidambaram, Tamil Nadu
- Chandra Shekhar Azad Agricultural University, Kanpur, Uttar Pradesh
- Cochin University of Science and Technology, Kochi, Kerala
- College of Fisheries, Assam Agriculture University, Raha, Nagaon, Assam
- College of Fisheries, Central Agriculture University, Lembucherra, Tripura
- College of Fisheries, Chaudhary Charan Singh Haryana Agricultural University, Hisar
- College of Fisheries, Dr. Balasaheb Sawant Konkan, Krishi Vidyapeeth, Ratnagiri, Maharashtra
- College of Fisheries, G.B. Pant University of Agriculture & Technology, Pantnagar, Uttarakhand
- College of Fisheries, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana
- College of Fisheries, Junagadh Agricultural University, Veraval, Gujarat
- College of Fisheries, Karnataka Veterinary, Animal and Fisheries Sciences University, Mangaluru, Karnataka
- College of Fisheries, Maharana Pratap University of Agriculture & Technology, Udaipur, Rajasthan
- College of Fisheries, Odisha University of Agriculture & Technology, Berhampur, Odisha
- College of Fishery Sciences, Sri Venkateswara Veterinary University, Nellore, Andhra Pradesh
- CSIR-National Institute of Oceanography, Panaji, Goa
- Department of Fisheries, State of Telangana
- Department of Life Sciences, Manipur University, Imphal, Manipur
- Department of Marine and Coastal Studies, Madurai Kamaraj University, Ramanathapuram, Tamil Nadu
- Department of Zoology, Chaudhary Mahadeo Prasad Degree College Mg Marg, Prayagraj
- Department of Zoology, Gauhati University, Guwahati, Assam
- Department of Zoology, Goalpara College, Goalpara, Assam
- Department of Zoology, Haflong Government College, Assam
- Department of Zoology, Kohima Science College, Jotsoma, Nagaland
- Department of Zoology, University, Lumami, Nagaland
- Department of Zoology, Lady Keane College, Shillong
- Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar
- Dr. Ram Manohar Lohia Avadh University, Ayodhya, Uttar Pradesh
- Fisheries Survey of India, Mumbai, Maharashtra
- Gautam Buddha University, Gautam Budh Nagar, Uttar Pradesh
- HNB Garhwal University,

Srinagar, Uttarakhand
- ICAR- Indian Agricultural Statistics Research Institute, Pusa, New Delhi
- ICAR- National Institute for Plant Biotechnology, Pusa, New Delhi
- ICAR Research Complex for Eastern Region, Patna
- ICAR-Agricultural Technology Application Research Institute, Kanpur, U.P.
- ICAR Research Complex for NEH Region, Tripura Centre, Tripura
- ICAR-Central Coastal Agricultural Research Institute, Goa
- ICAR-Central Inland Fisheries Research Institute, Barrackpore
- ICAR-Central Institute of Brackishwater Aquaculture, Chennai
- ICAR-Central Institute of Fisheries Education, Mumbai
- ICAR-Central Institute of Fisheries Technology, Kochi
- ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar
- ICAR-Central Island Agricultural Research Institute, Port Blair
- ICAR-Central Marine Fisheries Research Institute, Kochi, Kerala
- ICAR-Complex for NEH Region, Barapani, Shillong
- ICAR-Directorate of Coldwater Fisheries Research, Bhimtal, Uttarakhand
- ICAR-Indian Agricultural Research Institute, Pusa, New Delhi
- ICAR-National Academy of Agricultural Research Management, Hyderabad, Telangana
- ICAR-National Bureau of Agriculturally Important Microorganisms, Kushmaur, Uttar Pradesh
- ICAR-National Bureau of Animal Genetic Resources, Karnal
- ICAR-National Bureau of Plant Genetic Resources, New Delhi
- ICAR-National Institute of Veterinary Epidemiology and Disease Informatics, Bengaluru
- Kerala Forest Research Institute, Thrissur, Kerala
- Kerala University of Fisheries and Ocean Studies, Panangad, Kochi
- Maharaja Agrasen University, Solan, Himachal Pradesh
- Nanaji Deshmukh Veterinary Science University, Jabalpur
- National Remote Sensing Centre, Hyderabad, Telangana
- Professor Jayashankar Telangana State Agricultural University, Hyderabad
- PVNR Telangana Veterinary University, Khammam, Telangana
- Rajiv Gandhi Centre for Aquaculture, Sirkazhi, Tamil Nadu
- Ranchi University, Ranchi
- Rani Lakshmi Bai Central Agricultural University, Jhansi, Uttar Pradesh
- Rayamangalam Grama Panchayat Perumbavoor, Kerala
- School of Life Sciences, NEHU, Shillong
- Sher-e-Kashmir University of Agricultural Sciences & Technology, Jammu & Kashmir
- Shri Ramswaroop Memorial University, Barabanki
- State Institute of Fisheries Technology, Kakinada, Andhra Pradesh
- Tamil Nadu Dr. J. Jayalalithaa Fisheries University, Tamil Nadu
- The Neotia University, West Bengal
- Udalguri College, Udalguri, Assam
- West Bengal University of Animal and Fishery Sciences, Kolkata
- Wildlife Association of South India, Bengaluru
- Wildlife Institute of India, Dehradun
- Zoological Survey of India, Kolkata

C. International organizations

- Asia Pacific Associations of Agricultural Research Institutions (APAARI), Bangkok, Thailand
- Asian Fisheries Society, Malaysia
- Bioversity International, South and South-East Asia Office, New Delhi
- Food and Agriculture Organization, Rome, Italy
- Network of Aquaculture Centers in Asia Pacific (NACA), Bangkok, Thailand
- World Wide Fund for Nature, India Office, New Delhi
- WorldFish, Malaysia

D. Extension and development agencies

- Agency for Development of Aquaculture Kerala, Thiruvananthapuram, Kerala
- Aquaculture & Biodiversity Centre, Gauhati University, Guwahati and District Administration, Bongaigaon, Assam
- Department of Animal Husbandry, Dairying and Fisheries, Government of India, New Delhi
- Department of Biotechnology, Ministry of Science and

Technology, New Delhi

- Department of Science and Technology, Ministry of Science and Technology, New Delhi
- Dhaanyaganga Krishi Vigyan Kendra, RKMA, Sargachhi, Murshidabad, West Bengal
- Hemnagar Sundarban Dream, Sundarban, West Bengal
- Krishi Vigyan Kendra, Thoubal, Manipur
- Mangrove and Marine Biodiversity Conservation Foundation, Maharashtra
- Marine Products Export Development Authority, Kochi
- MS Swaminathan Research Foundation, Chennai
- National Biodiversity Authority, Chennai
- National Fisheries Development Board, Hyderabad
- North Eastern Council, Shillong, Meghalaya
- Science and Engineering Research Board, Ministry of Science and Technology, New Delhi
- State Department of Fisheries, Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Jharkhand, Kerala, Karnataka, Punjab, Madhya Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tamil Nadu, Tripura, and Telangana
- Uttaranchal Swar Sangam, Lucknow
- VGP Marine Kingdom, Chennai

Human Resource Development Initiatives

The HRD Cell actively engaged in promoting its staff for attending various training programme for capacity building. The trainings acquired by ICAR-NBFGR staff from other ICAR & Non-ICAR Institute were as follows:

A. Physical targets and achievements

S. No.	Category	Total No. of employees	No. of trainings planned as per ATP	Number of employees undergone training during Jan-June, 2024	Number of employees undergone training during July -Dec, 2024	Number of employees undergone training during Jan -Dec, 2024	% realization of trainings planned 2024
1	Scientist	33	16	2	1	3	18.7
2	Technical	27	8	1	0	1	12.5
3	Administration & Finance	17	8	-	1	1	12.5
4	MTS	10	10	--	--	--	--

B. Financial targets and achievements (All employees)

RE for HRD (2024- 2025) in lakhs			Actual Expenditure (January 1- December 31, 2024) in lakhs			% Utilization
Plan	Non-plan	Total	Plan	Non-plan	Total	100
3.59	0	3.59	3.59	0	3.59	

ICAR-NBFGR in Media

ICAR-NBFGR scientist find new species of catfish from Arunach

LUCKNOW: Scientists from the ICAR-National Bureau o Fish Genetic Resources (NBFGR), Lucknow, have identified a new species of catfish, 'Glyptothorax punyabratai,' from the Brahmaputra River drainage in Arunachal Pradesh.

"The species was collecte from Tung Stream, a small tributary of the Tissa River i the Brahmaputra River basin," said the institute's

Experts discuss health of Ganga

Lucknow: A two-day inter- national symposium on 'Changing status of ecosy- tem health of river Gan an update and review' o nized in hybrid mod

ICAR-NBFGR honoured with National E-governance Award

Indian Council of Agricultural Research (ICAR) and National ...ean of Fish Genetic Resources ...BFGR, Lucknow, recently ...the national award for ...2024 (silver) for ...ance Programme ...al Diseases ...ment of e-gov- Animal Disease ...itizen centric ser- ...partment of adminis- ...ent of India. The award ...ated by Eknath Shinde,

ICAR-NBFGR conducts cleanliness programme

The birth anniversaries of Mahatm Gandhi and former Prime Minister La ...lahadur Shastri were celebrated wit ...he conclusion of 'Swachhta Hi Seva ...ogramme observed with the thems ...vabhaav Swachhta-Sanskar ...achhta' from September 14- October ...t ICAR-National Bureau of Fish ...tic Resources (NBFGR), Lucknow, ...e programme began with Dr ...Kumar Sarkar, director, ICAR- ...R, paying floral tributes to ...na Gandhi and former Prime ...r Lal Bahadur Shastri.

Book on fish released

LUCKNOW: The minister of envi- ...ronment, forest, and climate ...change, GoI, Bhupender Yadav, ...on Monday unveiled the book ...'Barcode Atlas of Indian Fishes' ...during the 109th Foundation ...Day of Zoological Survey of ...India (ZSI) in Kolkata.

"The book is a pioneering ...effort of Indian Council of Agri- ...cultural Research-National ...Bureau of Fish Genetic Resour- ...ces (ICAR-NBFGR), ... and Zoological ... diversity of f... strategies the Indian ...

एनबीएफजीआर और जेडएसआई द्वारा तैयार बारकोड एटलस ऑफ इंडियन फिश नामक पुस्तक का विमोचन

एनबीएफजीआर में 10 वां अंतर्राष्ट्रीय योग दिवस मनाया गया

मत्स्य पालन व पशुधन मे रोगाणुरोधी प्रतिरोध ...की निगरानी करेगा एनबीएफजीआर

Minister launches application deta...

Training programme held at ICAR-NBFGR

A three-day IND supported training ...gramme on Antimicrobial Susceptibility Testing and WHONET software for data management of Antimicrobial Resistance (AMR) ...began at ICAR-National Bureau of ... Fish Genetic Resources (NBFGR), Lucknow, from October 15. The train- ...ing is being organized under All India Network Project on Antimicrobial Resistance in Fisheries and Livestock (AINP-AMRFL), also termed as INFAAR. The objectives of the INFAAR are to undertake surveillance of anti- ...microbial resistance (AMR) in farmed animals and fish/ shellfish and to improve awareness and understanding of AMR among stakeholders.

Dr Uttam Kumar Sarkar, director, ICAR-NBFGR, called upon the scien- ...tists to explore the use of AI in mini- ...mizing the risk of AMR in fisheries and livestock. This training pro- ...

आईसीएआर-एनबीएफजीआर में सतर्कता जागरूकता सप्ताह का आयोजन

ICAR-NBFGR World AMR Awaren... ICAR-NBFGR, Lucknow ...ing World Antimicrobial ... Awareness Week (WA... ...ber 18-24, with ... Advocate, Act ... creating awaren... ...chers, students, ... the general comm... effective strategies ... ...ing concern of AMI

ICAR-NBFGR celebrates Foundation Day

The ICAR-National Bureau of Fish Genetic Resources (ICAR-NBFGR) cel- ...ebrated its 41st anniversary of Foundation Day. The chief guest of the ...event was Dr AK Singh, VC, Rani Lakshmi Bai Central Agricultural ...University, Jhansi; and special guest, Dr WS Lakra, secretary, NAAS and ...

...director of ICAR-NBFGR ...honour lin...

Social Media

- Institute activities showcased in X (Twitter) platform - 89 posts
- Regular coverage and updates in newspapers (213 news), ICAR website (72 news highlights) & Institute website.
- Connected to farmers through WhatsApp groups for technical guidance and advisory

Mass Media Support

Radio Talk

S. N	Broadcast/ Telecast agency	Date	Program (Resource person)
1	DD Hello Kisan, New Delhi	January 19, 2024 at 10:30-11:30 AM	Live Phone-in programme on Fish Culture in Winter (Dr. Sharad Kumar Singh)
2	DD Hello Kisan, New Delhi	January 19, 2024 at 06:00 – 07:00 PM	Re-telecast Phone-in programme on Fish Culture in Winter (Dr. Sharad Kumar Singh)
3	DD Hello Kisan, New Delhi	January 20, 2024 at 10:00-11:00 AM	Re-telecast Phone-in programme on Fish Culture in Winter (Dr. Sharad Kumar Singh)
4	DD Hello Kisan, New Delhi	May 24, 2024	(Dr. U.K. Sarkar)
5	All India Radio, Lucknow	August 26, 2024 at 06:50 PM	जलकृषि और मिश्रित मत्स्य पालन broadcasted through Kheti Kisani programme (Dr. Sharad Kumar Singh)
6	Akashvani, Lucknow	September 24, 2024 at 2.40 PM	जलकृषि और मिश्रित मत्स्य पालन repeat broadcasted through Kheti Kisani programme (Dr. Sharad Kumar Singh)

Contact

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Centre for Peninsular Aquatic Genetic Resources
CMFRI Campus, Post Box No. 1603, Ernakulam North P.O.
Kochi- 682018, Kerala, India
Email: nbfgrcochin@gmail.com

Unit
Aquaculture Research & Training Unit
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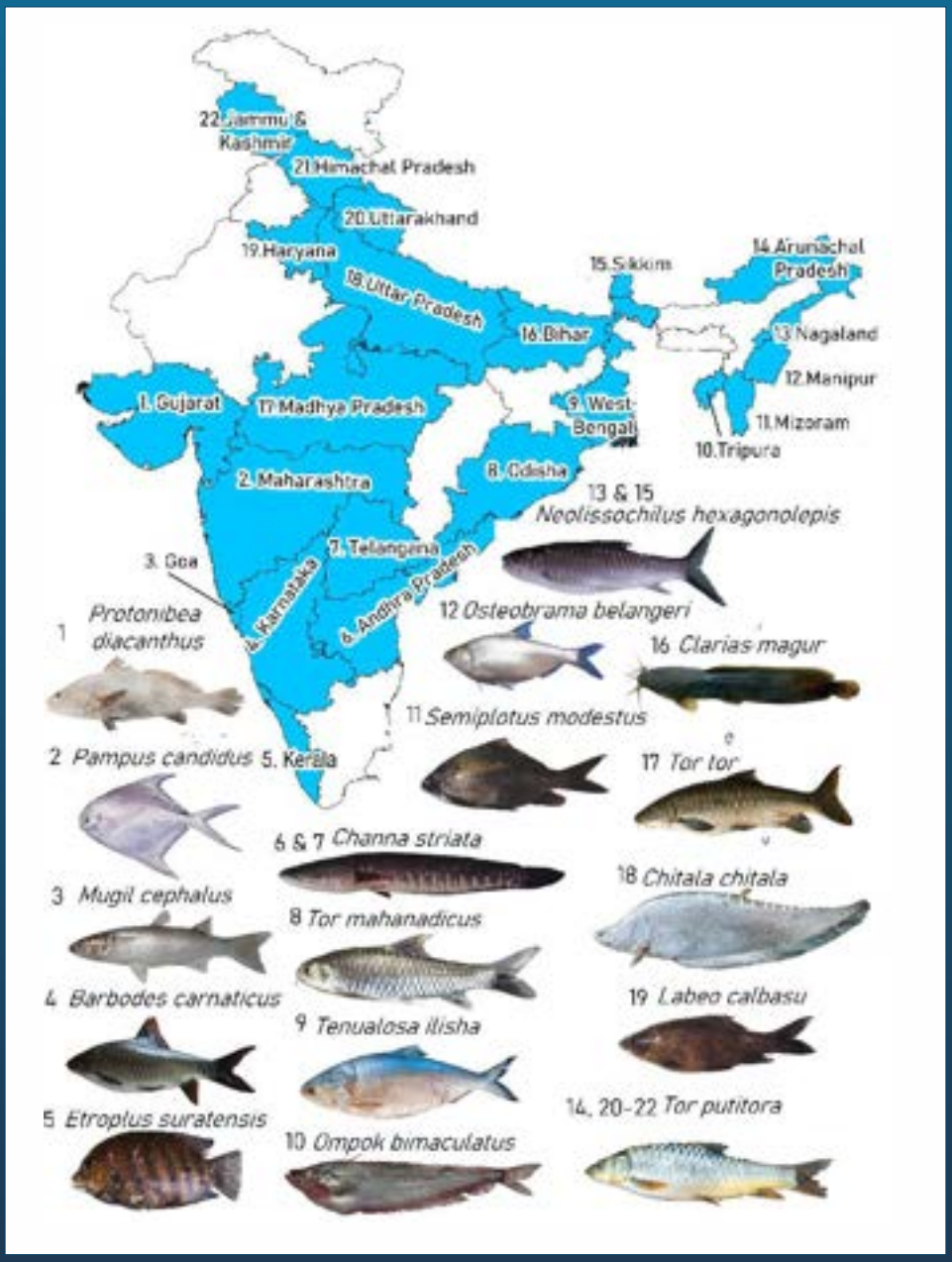

ICAR-National Bureau of Fish Genetic Resources

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