KUFOS

2023 -2024 RESEARCH ACHIEVEMENTS

DIRECTORATE OF RESEARCH

Kerala University of Fisheries & Ocean Studies [KUFOS]
Panangad, Kochi- 682506

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Arun Das, Office Assistant cum Technical Associate

Prepared and Edited by:
Dr. Devika Pillai, Director of Research, KUFOS

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RESEARCH ACHIEVEMENTS 2023-2024

The research activities of the year were marked by severe financial constraints due to non-receipt of plan funds. Consequently, the research staffs working in university plan projects were reduced by more than 50%. In order to face the unprecedented challenge, it was decided to operate projects in revolving fund mode. Those projects that could generate revenue were taken up in this mode. Accordingly, guidelines were made for the revolving fund projects and it was approved by the Research Council and Governing Council. Three projects were initiated in the revolving fund (RF) mode. For operation of the Aquatic Referral Lab set up under the PMMSY scheme, a RF mode project was taken up. The second RF mode project was for facilitating the commercial production of ornamental aquarium plants that were standardized by tissue culture in the university plan project. In order to generate funds as well as maintain all the sophisticated equipment in the Centre for Food Processing and Packaging Technology (CEFPT), the third RF mode project was taken up. Regular training programmes are being undertaken at the Centre for faculty and researchers from other institutions.

During the year 2023-24, our faculty and researchers were highly productive, with 187 quality research publications in high-impact journals, 12 book chapters, and 27 papers presented at conferences/seminars, keeping the KUFOS flag flying high. The number of externally aided projects this year was 16.

This publication contains a summary of various research projects being carried out at KUFOS during the year 2023-24. It also includes a report of the research progress of post doctoral fellows, both external PDFs and KUFOS-PDF. Details of the PhD research scholars of KUFOS and approved research centres are also given.

We express our sincere thanks to the Research Council members for their valuable suggestions and guidance in our research activities.

PROJECT SANCTIONED DURING THE YEAR

1. **The Kerala State Council for Science, Technology and Environment (KSCSTE)-Kerala Biotechnology Commission YIPB Research Grant** for three years (2024-2027)
   Principal Investigator: Dr. Radhika Rajasree S R, Professor
   Research Grant of Rs. 24.82 Lakhs

2. **Atal Incubation Centre**
   Principal Investigator: Dr. Radhika Rajasree S R, Professor
   Funding Agency: NITI Aayog, Total Funding Rs. 1000 Lakhs
   Created Special Purpose Vehicle named AIC-KUFOS Kochi Foundation under Section 8 of the Companies Act,2013 under Ministry of Corporate Affairs, Govt. of India.
   Enrolled three Directors for AIC-KUFOS Kochi Foundation: Principal Investigator, AIC-KUFOS; Director of Research, KUFOS; Registrar, KUFOS
   AIC-KUFOS Kochi Foundation signed MoA with NITI Aayog, Govt. of India.
   AIC-KUFOS Kochi Foundation signed Letter of Intent with KIED, TIE Kerala and KSIDC.
   Recruited Chief Executive Officer for AIC-KUFOS Kochi Foundation.
3. **Progression of chronic pancreatitis to pancreatic cancer and the role of the vascular and neuronal niche in pancreatic stellate cell activation**
   PI: Dr. Unnikrishnan S, Assistant Professor
   Duration: 3 Years, Total Funding Rs. 24.82 Lakhs
   Funding agency: KSCSTE, Kerala

CENTRE OF EXCELLENCE FOR INDIGENOUS FISH PRODUCTION AND AQUATIC ANIMAL HEALTH MANAGEMENT (CIFPAAH)

Fund Alloted (INR): 100 Lakhs

1. *Standardisation of seed production techniques of indigenous ornamental fishes of India*

PI : Dr. Shyla G, Assistant Professor
Co-PI : Dr. Rameez Roshan PM, Assistant Professor
Project Staff : Rajanand S, JRF (Joined on August 23th 2023)
Ruksana Sofiya, Field Assistant (Joined on August 23th 2023)

Background: Ornamental fish keeping ranks as the world's second most popular hobby and serves as a significant economic activity in 125 countries (Day, 2010). Despite India's wealth of biodiversity in indigenous freshwater ornamental fishes, highly sought after in the international market, its contribution accounts for a mere 0.4% of total global ornamental fish trade. There is an impressive diversity of unexploited ornamental fishes reported from the inland waters of India, with over 195 indigenous varieties mostly reported from the North-East region and Western Ghats (Silas et al., 2011).

Notable among them are *Puntius denisonii, Tetraodon travancoricus, P. mahecola, C. dadyburjori, Mastacembalus armatus* and *P. fasciatus* (Sekharan, 2006). Mahapatra (2014), reported that merely 15% of indigenous ornamental fish traded in India are successfully raised in captivity, Pointing out the gap in the captive breeding of indigenous species. In the absence of substantial progress in the development of captive breeding techniques, a looming risk emerges due to over exploitation and ultimately lead to extinction of native species.

The escalating demand for indigenous fish species in the export market in India is primarily met through the unsustainable practice of wild collection, posing a threat to the long-term viability of the trade. The rapid decline in the availability of indigenous fishes in natural waters highlights the need for urgent attention to address this pressing issue (Talukdar, 2004). Another notable trend in Indian ornamental fish trade is that the dealers of indigenous fishes tend to rely heavily on harvesting a few highly demanded species rather than on wide varieties. In Kerala, despite the existence of over 100 varieties in the ornamental fish trade mainly depend on species such as *Puntius denisonii* and *Tetradon travancorrius* and there is high potential for introducing more varieties as ornamental fishes (Salim, *et al*., 2013). Raghavan et al. (2013) reported that approximately two dozen fish species are regularly exported from the Western Ghats of Kerala. In contrast, Liya and Ramachandran (2013) identified Tetraodon travancoricus, Dario dario, Sahyadria denisonii, Botia striata, and Carinotetraodon imitator as the major ornamental fish species traded from India during the years 2005-2010.

A well- organized program including, the collection, identification, domestication, captive breeding and mass rearing to ensure a consistent supply would be beneficial for both market development and conservation program. The current trade in freshwater indigenous fish relies on wild populations and no commercial- scale production of captive bred indigenous ornamental fishes (Gopakumar, 2004). To address these issues, it is essential to standardize the seed production techniques for the unexploited indigenous fishes, aiming to lessen the pressure on wild stock and facilitate introduction of new species into the ornamental fish trade. Implementation of mass scale production of seeds can help to meet the export market demand, thereby promoting sustainable practices in the industry.

Objectives

- Collection and acclimatization of different stocks of *Dawkinsia apsara*.
- Development and maintenance of brood stocks of *Dawkinsia apsara* and standardisation of breeding protocols of *Dawkinsia apsara*.
- Development of live feed culture facility for consistent supply of larval feed.

Research Progress:*Dawkinsia apsara*, recently discovered in the genus Dawkinsia and commonly known as Apsara barb, is a brightly colored schooling fish suitable for aquariums, similar to the Mascara barb. *Dawkinsia apsara* is currently known from the upper catchment areas of the Sowparnika River near Anejhari Butterfly Camp and the Sita River in Karnataka. They closely resemble *Dawkinsia assimilis* but differ in several ways: the corner of the mouth does not reach beneath the level of the posterior nostril, the maxillary barbel is short and does not reach the anterior margin of the eye, the kaadige blotch is broad and extends over the infraorbital and opercular bones (versus the kaadige blotch being absent in *D. assimilis*), the caudal-peduncle blotch covers the 14th to 20th scales of the lateral line, and the dorsal fin lacks filamentously extended rays.

A. Collection and acclimatization of *Dawkinsia apsara*:-*Dawkinsia apsara* were collected from Mangalore and brought to the hatchery. The fishes were kept in quarantine tanks for two weeks. Then the fishes were sorted and male and females were stocked separately in tanks. The fishes were fed with live feed initially followed by pelleted feed. Later the fishes are stocked into the planted aquarium tanks. The brood stocks are fed with egg yolk, Pellet diet and artemia flakes.

B. Sexual dimorphism and Brood Stock Rearing of *Dawkinsia apsara*:-Separation of sexes was challenging due to the lack of pronounced dimorphism. However, some dimorphic characteristics were noted: females are larger than males and exhibit a bulged and soft belly during the breeding season, with generally duller coloration. Males typically display a reddish coloration on the snout, deep blue iridescence over the opercular bones, cheeks, and sides of the body, and a deep scarlet snout. A deep scarlet dotted line runs along the lateral line scale row, and the dorsal fin is dark red (Fig. 1).

Fig. 1 Male and Female Fish

Later for brood stock development, males and females were stocked in separate recirculatory system, and fed with pellet diet and live feeds. Water quality parameters such as pH, ammonia, temperature, nitrite, nitrate, and hardness were analyzed. After one month of broodstock rearing, the mature fish were transferred to breeding tank.

C. Induced Breeding of *Dawkinsia apsara*:-A large glass tank (120 cm x 45 cm x 45 cm) equipped with a shower effect and aeration was used as the breeding tank (Fig. 2). Males and females were stocked at a ratio of 1:1. Breeding mops and aquatic plants were provided as substrates for egg attachment. The fish were fed hormone-coated feeds in the evening. Approximately 60 to 65% of the fish were found to breed

within 12-18 hours. The shower effect was identified as a crucial factor in triggering spawning. The parents were removed from the tank soon after breeding. The eggs measure approximately 0.95 ± 0.05 mm in size, with an incubation period of 24 hours. Different stages of egg development are shown in Figure 3.

Fig. 2 Breeding Tank

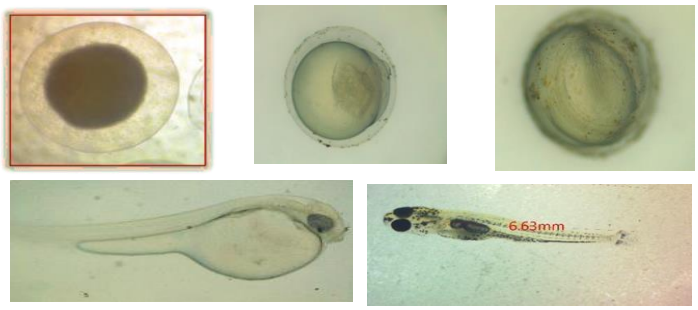


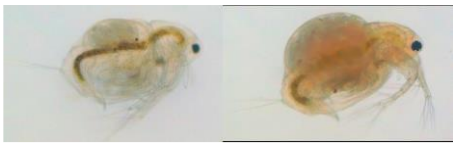
Fig. 3 Different stages of Egg development

D. Larval rearing:- Yolk absorption lasts for 6 days, with the larvae reaching a size of 6.65 ± 0.06 mm. Initially, the larvae were fed with Chlorella, followed by Artemia and Moina, and subsequently Daphnia. After 1 month, the larvae were transitioned to ground artificial feed.

Maintenance of optimum water quality parameters is crucial for successful breeding and should be maintained throughout the breeding period. The water quality parameters observed during successful breeding are given below:

- Temperature : 25±1 ◦C
- pH : 7.3-7.4
- Ammonia : 0-0.1 ppm
- Hardness : 35 ppm

E. Development of live feed culture facility for consistent supply of larval feed:- As live feed is crucial for the larval rearing phase, we developed a consistent supply of various live feeds for larval nutrition. Additionally, we are working on developing enriched feeds to further support larval growth and development.



2. *Germplasm inventory of indigenous aquatic plants of the Western Ghats of India and their propagation for resource conservation and commercial applications by utilizing modern propagation system*

PI : Dr.Devika Pillai , DR & Professor Chair (i/c), CIFPAAH
Co-PI : Dr.Shylaraj.K.S,Technical Consultant (w.e.f 5-01-2023)
Project Staff : i. Amrutha J Nair (Junior Research Fellow)
ii. Sheela P T (Lab Technical Assistant)

Objectives

- Establish a tissue culture facility at the University for the propagation of aquarium plants.
- Standardize the protocol for the propagation of high value slow growing aquarium plants which require low management care.
- Supply of the above plants at a reasonable rate to the hobbyists and entrepreneurs involved in ornamental fishery sector.

Methodology proposed: Mass propagation of high value slow growing plants which require low management care through tissue culture technique. Standardization of explants, surface sterilization techniques, selection of ideal medium (initiation, multiplication and rooting media) and hormonal combinations for culture initiation, multiplication and rooting and hardening technique.

Expected outcome

- Establishment of a tissue culture laboratory in the western campus of the University.
- Standardization of tissue culture protocols of about 12 species of highly demanded aquarium plants.
- Standardization of hardening techniques of the tissue cultured plants.
- Regular marketing of tissue cultured plants to the hobbyists and aquarium customers at a reasonable price.

3. *Developing improved strains of Karimeen, Etroplus suratensis through genetic selection*

PI : Dr. Binu Varghese, Assistant Professor

Objective

- Collect and rear Karimeen from different geographic locations.
- PIT tag fishes for breeding studies.
- Study the differential growth patterns in various stocks.
- Supply high quality seeds to farmers having improved growth characteristics.

Achievements

- Maintaining breeding population from six different locations viz Kollam, Alappuzha, Ernakulam, Thrissur.
- PIT tagging was successfully done on juveniles and adults.
- Mass breeding, egg incubation and larval rearing models developed.
- Designed and developed improved systems for Genetic Improvement Studies in Karimeen.

4. Developing captive breeding protocols for the threatened fishes of the Western Ghats

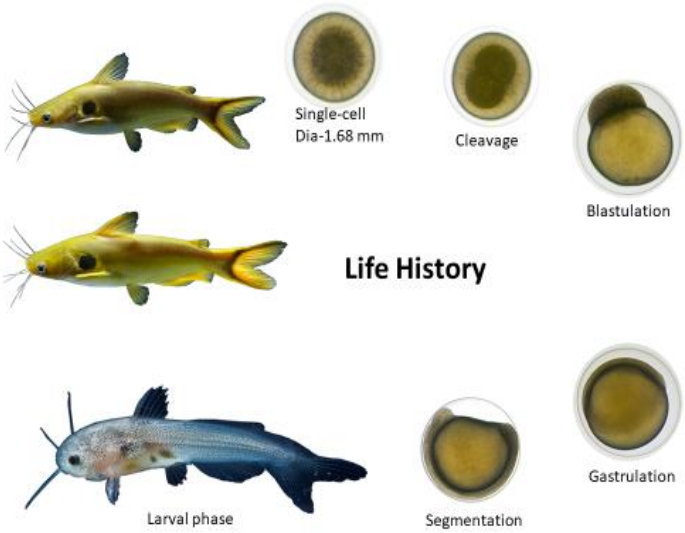
PI **:** Dr. Anvar Ali P H, Assistant Professor

Objective

- Develop captive breeding protocols for *Horabargus brachysoma*
- Conduct ranching of the yellow catfish in Sasthamkotta Lake
- Transfer the technology to stakeholders

Achievements

A total of 250 advanced fingerlings of yellow catfish (*Horabagrus brachysoma*) have been released into Sasthamcotta Lake. Additionally, 5,000 fingerlings have been produced for ranching in Sasthamcotta Lake, and another 5,000 fingerlings have been produced for ranching in the Chalakudy River.



5. *Development of sustainable aqua feed from wide spectrum raw materials and propagation of feed-based aquaculture in Kerala and development of larval feeds for selected species*

PI : Dr. Chiranjiv Pradhan, Assistant Professor
Project staffs : Ardra M – SRF

Objective

- To find out suitability of insect meals in the diet of fish as an alternative protein source against fishmeal.
- To find out the effect of insect meals (raw and processed) on growth, health nutrient metabolism, antioxidant status, histomorphometry and gut microbiota of selected species.
- To find out the suitability of insect meals as an ingredient in floating feed preparation through extrusion technology.

Expected Outcome

- Development of black solider fly larval meal-based feed for pangasius
- Development of yellow meal worm-based feed for pangasius
- Development of cricket meal-based feed for pangasius
- Development of black solider fly larval feed of zebra tilapia, *Heterotilapia buttikoferi*.

6. *Application of microbes in Aquaculture for sustainable production*

PI : Dr. Rejish Kumar V J, Assistant Professor
Project Staff : Greeshma James, SRF

Objective

- Isolation of the microbes from selected aquatic ecosystems having the potential to use as bioremediators/probiotics
- Screening the bioactivity potential of the isolated microbes against various aquatic pathogens
- Analyze the impact of micro/nano plastics on the physiology and health of fresh/brackish water culture fishes of Kerala

Achievements

- Identified 4 *Bacillus* spp. includes two strains of *B.cereus* and two strains of *B.amyloliquefaciens* with good bioactive and probiotic potential.
- Identified 6 Actinobacteria such as two strains of *Streptomyces*, two strains of *Nocardia*, *Actinobacterium bacteria and Prauserellamuralis*from 82 and 42 isolates respectively screened from mangroves located in Ernakulam district and they exhibits good bioactivity and probiotic potential.
- Identified 7 Lactic acid bacteria such as three *Lactococcus lactis* strains and four *Lactococcus* spp. from the biofloc systems which exhibits good probiotic potential and bioactivity and can be used alone or as consortium in aquaculture systems.
- Developed ammonia oxidising bacterial (AOB) consortium with an ammonia removal rate of 0.72 mg/l/day NH_3-N and ammonia oxidizing archaeal (AOA) consortium with a rate of 0.28 mg/l/day NH3-N were developed

- Analysed the accumulation and toxicity of polystyrene microplastics in *Oreochromis niloticus*. Histopathology, hematological analysis, serum biochemical analysis, oxidative stress, immunological analysis, cortisol level, AChE activity, gonadotropin-releasing hormone (GNRH) activity, vitellogenin level and gene expression were analysed to evaluate the toxicity of MPs
- Analysed the microplastic accumulation in different organs of *Etroplus suratensis*. Effects of MPs on haematological parameters, histology, general stress, growth, oxidative stress and immunological parameters of *Etroplus suratensis* were analysed.

7. *Development of Recombinasepolymerase Amplification assay for the rapid detection of Red seabream iridovirus (RSIV)*

PI : Dr. Safeena M P, Assistant Professor
Project Staff : Chovatia Ravi Kumar Mansukhbhai- SRF

Objective

- Identification of conserved region of RSIV genome across different fish species
- Development and Optimization of the Recombinase Polymerase Amplification (RPA) assay for the sensitive detection of RSIV
- Design and construction of RSIV-specific and dye-labeled RPA primers and probe for the target amplification and final validation of the developed RPA Assay and comparison with qPCR method

Methodology Proposed

- Collection of RSIV infected samples and RSIV –specific RPA Primer/probe designing and synthesis by finding out a conservative region of the genome of RSIV.
- Development and optimization of RPA reaction.
- Standardization of RPA method for the detection of RSIV in Fishes and detection accuracy is to be determined using traditional qPCR method in comparison to the validated RPA.

Expected Outcome

A robust and rapid detection method developed in this study could be used in field for the rapid and sensitive detection of RSIV infection in fish which will help;

- To implement best practices in aquaculture and allied practices to ensure that viral contamination is avoided
- To implement a robust surveillance and monitoring system to control this viral infection in aquaculture systems.

CENTRE OF EXCELLENCE IN AQUATIC RESOURCE MANAGEMENT &CONSERVATION (CARMC)

The final synthesis Report on Vembanad Wetland System was officially released by Sh. Pinarayi Vijayan, the Chief Minister of Kerala in September 2023. CARMC participated in several meetings held in connection with the revival of Vembanad Lake by the State Departments, District administrations and the State Wetland Authority of Kerala. Work on the bathymetry survey of North Vembanad (Kochi to Munnambam sector) has been completed in December 2023. Field validation of bathymetry is pending.

Fund Allotted (INR): 65 Lakhs

1. *Advisories for restoration of Vembanad wetland system including documenting the land-nearcoastal ocean interactions*

PI : Dr. V. N. Sanjeevan, Prof. Chair
Project staff : Dr. Gireesh R (Project Associate), Dr. Vimal Kumar, (Project Associate), Remya L Sundar (SRF), Sreebamol K S (TA), Jayesh Saseendran (TA)

Objectives: Long-term changes in the VembanadKol Wetland System (North Sector) and documenting the land – near coastal interactions.

Methodology

- Area shrinkage – MNDWI method
- Bathymetry – Fine resolution echo-sounding
- Water budget – Inflow, retention capacity, outflow
- Hydrography – CTD profiling, current measurements, sediment load, salinity regimes
- Hydrochemistry – pollution aspects, plastic load, nutrient load
- Biology – trophic status, primary & secondary production, fishery and bivalve resource assessments, biodiversity and microbial loop
- Land-ocean interactions
  - Impacts of groynes on coastal currents and stratification control on upwelling.
  - discharge efficiency of Munambam bar-mouth.
  - land-ocean exchange of plastic load and biota, tide-flux and its impacts
  - revalidation of benthic fauna in the 30 m depth profile, fish egg and larval distribution

Expected outcome

- Bathymetry of North Sector – Survey completed
- Tidal impacts in Chellanam – work in progress
- Phytoplankton Atlas – work in progress

2. Towards a management action plan for the conservation and sustainable management of aquatic bioresouces of Astamudi and Sasthamkotta lakes

PI **:** Dr. Rajeev Ragavan, Assistant Professor

The project was envisaged with an aim to generate baseline data to inform conservation and management plans for the two Ramsar Sites of Southern Kerala.

The major objectives were to assess the fish and shellfish diversity of Ashtamudi and Sasthamcotta lakes through an integrative taxonomic approach, to estimate the catch data and determine population dynamics of selected fish species from the Ashtamudi and Sasthamcotta lakes (target species in Ashtamudi was *Etroplus suratensis* and in Sasthamcotta were *Horabagrus brachysoma* and *Etroplus suratensis*).

Over the course of the field work at 12 selected sites in the Ashtamudi Lake (15 days a month from January to June 2023), around 91 species of fish and 23 species of shellfish were collected and identified. In addition, the length-frequency data of 500 individuals of Pearl Spot *Etroplus suratensis* (the most important landed species) were collected during the five-month period.

3. *Macrobenthic community structure of Vembanad Lake from Northern Vembanad Lake and adjacent off shore waters*

PI **:** Dr Prabhakaran M P, Assistant Professor

Objective

- Assess the sediment characteristics of Northern VL and sediment samples from Periyar and Chalakudy river beds by using PSA.
- Qualitative and quantitative estimates of benthic fauna: macro and meiofauna are to be described.
- Correlating benthic diversity and abundance with the environmental components.
- Facilitating studies on energy transfer and quantifying benthic production in carbon terms.
- Morphological adaptations of polychaetes particularly in polluted areas of Northern VL.
- Preparation of a complete database of benthic fauna of the Vembanad wetland system at CARMC compiling the results from South, Central, and North.

Methodology Proposed

The sediment samples will be collected using a standard van-Veen grab (Hydro-Bios) of size 0.025 m^2 in estuary and 1m^2 or above in the off shore waters. For quantitative sampling, sub samples (triplicate) for meiofauna will be taken from the undisturbed Van-Veen Grab samples by using a cylindrical glass corer of 2.5cm inner diameter and 30 cm long (Eleftheriou and Mclntyre, 2005).

Collected sediments will be transported to laboratory as such in Ziplock cover with 5-10 ml of buffered concentrated formalin, so that it could penetrate the sediment and could preserve the organism.

Particle size analysis of the sediment samples will be carried out to estimate the percentage composition of sand, silt and clay of sediment samples. Particle size distributions were obtained using a laser scattering particle size analyzer (Model: Horiba La 960V).

Expected outcome

- The primary goal of the study is to conduct a descriptive assessment of the macrobenthos populations in Northern Vembanad Lake and adjacent off-shore seas.
- In addition to physicochemical measurements of sediment samples collected alongside benthic fauna, data on water depths, temperature, water quality, and salinity will be added into the study of species and community distributions.
- In addition, we will employ existing ecological and hydrographic models for currents, bottom shear stress, and carbon intake, as well as information on habitat type distribution, to explain the observed distribution patterns.
- Given the extensive anthropogenic effects in wide parts of the Northern Vembanad Lake and nearby off-shore seas, studies of the link between the benthos (mostly large, long-lived, and fragile species) and anthropogenic effects will be conducted.

4. Water quality and Pollution status of North Vembanad Lake and near coastal areas and Ashtamudi and Sasthamkotta Lake

PI **:** Dr. Anu Gopinath, Associate Professor

Vembanad Lake is the largest wetland system in India to be designated a Ramsar site. The anthropogenic interventions have had significant effect on the hydrodynamic aspects of the Vembanad Lake system leading to scattering of pollution and shrinking of the living resources of the system. The Vembanad Lake, an economically important system is undergoing a great deal of environmental alterations due to various activities instigated by economic gain and development.

The main objectives of study are 1) to understand the spatial and temporal variation of important physiochemical parameters like Temperature, pH, DO, and Salinity in the Southern and Central sector of Vembanad Lake. 2) to understand the variation in nutrient cycling in the Southern and Central sector of Vembanad Lake. 3) to study microplastics abundance and distribution in the Southern and Central sector of Vembanad Lake. 4) to quantify the spatial distribution of organochlorine pesticides and to assess the environmental, ecological and health risk posed by them.

5. Advisories for restoration of Vembanad Wetland System including documenting the land – near coastal ocean interactions

PI **:** Dr. Jayalakshmi K J, Assistant Professor

Objectives

- Mapping the clam beds in the north sector of VL and the near coastal waters.
- Studies on decapod crustacean resources of VL and near coastal waters with focus on life history traits of commercially important species

Methodology Proposed

- Seasonal sampling of black Clams will be conducted through dredge operations from the northern sector of VL.
- Numerical abundance and biomass will be estimated
- Collection of decapod crustaceans through seasonal survey in the VL and near coastal waters

Expected outcomes

- Maps of clam bed for the northern sector will be generated
- Update the diversity status of decapod resources (larval and adults) in the VL and near coastal waters
- Study the influence of salinity gradients on decapod (larval & adult) abundance and distribution.

6. Elucidation of the role of microbial loop in the trophic status of Vembanad Lake ecosystem

PI **:** Dr. V. P. Limna Mol, Assistant Professor

Objective

- Determination of spatio-temporal variability of picophytoplankton, nanophytoplankton, micro phytoplankton, autotrophic picoplankton, autotrophic nanoplankton, microzooplankton and microphytobenthos community structure and profile of coastal waters of Kerala.
- To evaluate phytoplankton and zooplankton interrelationship in a tropical estuarine system using a microcosm.

Methodology Proposed

- Estimation of pico-phytoplankton, nano-phytoplankton, and micro-phytoplankton in Vembanad lake: (Jyothibabu et al., 2015)
- Estimation of autotrophic picoplankton: (Garrison et al. 2000)
- Estimation of autotrophic nanoplankton: (Haas 1982)
- Estimation of Microzooplankton: (Jyothibabu et al., 2015) using identification keys (Kofoid and Campbell, 1939; Al yamani et al. 2011; Krishnamurty et al. 1995).
- Microcosm experiment: The study of plankton interrelationship in tropical estuarine systemutilizing an ex-situ microcosm containing water collected from the coastal waters of Kumbalam estuary to recordplankton dominance shift and related impacts of rise in temperature has been attemptedhere. One microcosm was set as temperature control where an external heating device provides an elevated 2°C temperature while the next tank was kept as control. During the seven days of microcosm experiment, the plankton samples from both tanks were collected and analysed.

Expected Outcome

- An understanding of the microbial loop system prevalent in the coastal waters of Kerala.
- The microcosm experiments envisage the possible impact of climate change on planktonic organisms and thereby, the interrelationships in the trophic estuarine system.

The observations of the present study are:

- Objective 1 could not be undertaken due to lack of funds and thereby, samples.
- The results of the 2ndobjective indicate a zooplankton dominance shift from mesozooplankton to microzooplankton in temperature elevated tank.
- This dominance shift can impact efficiency of trophic transfer since many microzooplankton are not as efficient as mesozooplankton in case of grazing and converting primary productivity into biomass available to higher organisms.
- In the phase of changing climatic conditions and subsequently warmerwater, the possible deficiencies in the new production could be effectively substituted by regenerated production channelled through the microbial food web.
- The fast formation of biofilm in the warmed microcosm points out the fouling activity will be faster in warming condition.

  This highlights the need for comprehensive monitoring and research efforts to better understand the interrelationships and the transformative shifts are crucial for maintaining the stability of the estuarine system.

CENTRE OF EXCELLENCE IN FOOD PROCESSING AND PACKAGING TECHNOLOGY (CEFPT)

Fund Allotted (INR) : 50 Lakhs

1. Centre of Excellence in Food Processing and Packaging Technology

PI **:** Dr. Lakshmi E Jayachandran, Assistant Professor

Project staff **:** Anupriya E A(SRF), Vipin Mohanan (TA)

Objective: Technology for low GI millet chocolates and Ultrasonication of jackfruit pulp

Methodology Proposed: Tempering and moulding, ultrasonication

Research activities completed:

- Ultrasound processing of jackfruit pulp
- Development of millet-based low glycemic index chocolates using palm sugar and coconut sugar.
- Development of health shots from green tomato
- Internships/Projects: 5 Students
- Equipment Use and Analysis: 48 Samples (Approx. INR 24,000)

2. Nutritional evaluation and consumer acceptance of seaweed- low value fish based functionalfood products

PI **:** Dr Radhika Rajasree S R, Professor

Objective

- To develop value added foods and functional foods formulated with seaweed powders and low value fishes to address the malnutrition of young children and women.
- To develop ready-to-cook, ready to eat, extruded and marinated food products with enhanced nutritional quality.
- To develop healthy bakery products and confectioneries for children and elder people.
- To transfer the technology and promote the utilization of seaweed and low value fish-based products among the public and to assess consumer acceptance for those products.

Achievements

- Development and characterization of seaweed marmalade incorporated with *Gracilaria crassa* (at 5 and 10% concentrations) and nutmeg. The protein content varied from 5.03-7.99%, pH level ranged- 6.53-6.81, water activity of 0.721-0.816 respectively.
- Prepared a booklet based on 'Seaweed based value added products'- Radhika Rajasree S R, Roopa Rajan and Vaishali Prakash A. P.
- Participation and 'seaweed pasta'-product showcasing in the branding challenge of Huddle Global 2023, start-up festival organized by Kerala Start Up Mission.
- Project Proposal submitted to MoFPI in collaboration with CFTRI and with industrial partner (under evaluation).
- Participation and poster presentation at two-day National Conference Biopolymers and Green Composites (BPGC) 2023 for the paper entitled "Bio-functional properties of seaweed based composite films blended with natural polymers for seafood preservation" -Roopa Rajan and Radhika Rajasree S R organized by Central Institute of Petrochemicals Engineering &Technology (CIPET) Kochi, page No. 46.
- Roopa Rajan and Radhika Rajasree S R. Physico-chemical and structural attributes of carrageenan/sago starch blend film incorporated with tea tree essential oil for active seafood packaging applications.IFC- 2024

3. Development of value-added food product using fruits native to Kerala-packaging and shelf-life studies

PI **:** Dr. Maya Raman, Associate Professor

Objective

- To isolate probiotics from dairy sources and to characterize and evaluate the shelf stability
- To encapsulate and develop probiotic rich-passion fruit beverage (other fruit beverages)

Methodology Proposed

Isolation and characterization of lactic acid bacteria

- Milk samples: cow milk (bovine) and goat milk (caprine) cultured on de Man Rogosa and Sharpe agar (MRS) agar (Holt, 1984).
- Gram staining, Catalase test, Endospore staining, Motility
- Molecular identification Probiotic

  Functionality

  pH tolerance: pH 2, 4, 6 and 8 (Ghaima, 2013).

  Temperature tolerance: 25 ◦ C, 30 ◦ C, 35 ◦ C, and 40◦ C (Terpou, 2019).

  NaCl tolerance: 1 ,3 ,5 and7% (Todorov, 2012). Auto-Aggregation

  Antibiotic Susceptibility Test:(Guan et al., 2017)

  Antimicrobial Activity: against five pathogens *Bacilluscereus, Salmonella typhimurium*, *Escherichia coli*, *Staphylococcus aureus,* and *Klebsiella pneumoniae* in Mueller-Hinton (MHA) agar (Ghaima, 2013)

  Phylogenetic tree and relationship with other species

  Antioxidant activity (DPPH and FRAP) Cytotoxicity (MTT Assay), Bioactive compounds detection (LCMS) Fortification of pasteurized fruit juice with probiotic organism
- 1 OD culture added, Incubated for 48 h at 37 ◦ C
- Storage study 21 d
- pH, Acidity, lactic acid, colour, TSS, phenol, reducing sugar, and viable cell counts comparedShelf stability studies for one month in PET bottles

Expected Outcome

- Shelf stable (extended stability) pasteurized passion fruit beverage incorporated with encapsulated probiotics will be developed.
- Improved wall materials integrity will and even distribution of probiotics.
- Improved viability due to incorporated prebiotics.

4. Development of Calcium supplement from fish bone wastes of tuna resources and characterization of nutritional quality

PI **:** Dr. Blossom K L, Assistant Professor

Objective

- Extraction of calcium from tuna bone collected from different processing plants.
- Standardization and development of calcium fortified food products viz., cookies, flakes, extruded food products etc. and assessing its nutritional and physico-chemical properties
- Sensory, biochemical and microbiological quality evaluation of the products during different storage periods in appropriate packaging material.

Achievements

- Calcium fortified pasta and nuggets also developed
- Published a revew article. Jisto Mathew, Lonappan Blossom, TK SrinivasaGopal; Ancy Thomas.2022. Nutritional and Quality Properties of Pasta and Noodles Incorporated with Fish/and Fishery- Derived Ingredients Using Extrusion Technology- A Review. Journal of Aquatic Food Product Technology.

5. Development and Standardisation of spice marinade as bio preservative for refrigerated seafoodproducts

PI : Dr. Shyni K, Assistant Professor

Objectives

- Analyse the antimicrobial antioxidant properties of different herbs and spices on aquatic animal products
- Development and standardization of spice marinade as biopreservative for refrigerated seafood products based on sensory and stability analysis.
- Analyse the effect of the prepared marination mix on shelf life extension of various chill stored finfishes (freshwater and marine species, white meat fish, red meat fish, lean and fatty fish etc.), crustacean (shrimps and crabs) and cephalopods (squids and cuttlefish) based on sensory, biochemical and microbiological analysis.
- Analyse the shelf life of the above developed spice marinade in packaging by using biochemical and microbiological analysis.

Achievements

- Presented a paper orally in National Technical workshop "Indian Perspective on Food Safety, Security and Standards", 07-08 June 2023 conducted by ICAR-CIFT, Kochi.
- Published a newspaper article, in Mathrubhumi online, published an article in a Malayalam monthly magazine Karshakan, published an article in a monthly online magazine Food Infotech titled "Emerging trends in Fish Processing".

6. Porphyridium sp. as a source of natural food colour: Process optimization

PI : Dr Jenny Ann John, Assistant Professor

Co-PI : Dr. Limnamol V.P, Assistant Professor

Objectives

- Optimization of culture parameters for maximum yield of phycoerythin
- Extraction and purification of the phycoerythrin pigment from *Porphyridium sp.*
- Evaluation of the properties and stability of phycoerythrin under different conditions.

Methodology Proposed

- Procuring the microalage *Porphyridium sp.*
- Optimization of culture parameters using response surface methodology (RSM)
- Extraction and purification
- Extraction methods: Classic Extraction: Solvent, Thermal (Freeze thaw method), Ultrasound
- Purification by Chromatography -Ion exchange, adsorption Precipitation using ammonium sulphate
- Analysis of properties: Stability Under Different pH Value Light Exposure Duration, Temperatures Storage studies (Gosh & Mishra, 2020).

Work done till date/Expected Outcome

- Sourcing and culturing of *Porphyridium sp.*
- Optimization of culture parameters using RSM
- Initiated the extraction of the pigment and its quantification

Expected Outcome: Results from this work is expected to optimize the process for the culturing of microalgae, Porphyridium and the extraction of the natural red pigment, phycoerythrin from the microalgae. This can be used as a natural red colour in the food industry; a product which is of great demand by the industry. However, at present the pigment is a big challenge with respect to its extraction and stability. A positive result from this study will be a great boon to the food industry.

State Referral Lab for Disease Diagnosis and Quality Control

PI : Dr. Devika Pillai, Professor and Head, Dept of AAHM

Project Staff : Dr. Divya V Haridas (Lab in charge – Molecular Biology)
Dr. Sneha K G (Lab in charge–Microbiology)
Remya T R (Lab in charge – Soil and water analysis)
Nimisha Alex (Lab Assistant)

Fund Allotted (INR) : 65 Lakhs

This plan project has been initiated to support the objectives for the establishment of the Aquatic Referral Lab under Pradhan Manthri Matsya Sampada scheme (PMMSY)

Objectives

- To establish a disease diagnosis and quality testing referral lab in Kerala State
- Regular disease surveillance and monitoring for emerging and re-emerging diseases in the state
- Provide diagnostic and quality assessment service to the farmers and entrepreneurs
- Conduct awareness programmes for farmers and entrepreneurs
- Capacity building training to fisheries department officials, researchers and prospective aquatic animal health entrepreneurs
- Provide skill development training to equip unemployed youth in the job role of 'Aquatic Animal Health Assistant'
- Attend to the research need of the aquaculture and fisheries sector for finding out emerging diseases if any and develop diagnostics

Progress during the period 2023-2024

- A total of 1128 fish/shrimp samples showing clinical signs from different regions of Kerala were tested at the lab by molecular diagnosis and/or microbiological analysis..
- A total of 865 samples were collected from different districts of Kerala for microbiological analysis and AMR testing.
- A total of 70 samples were collected from different districts of Kerala for Water Quality analysis.
- ICP-MS (Agilent 7850) successfully installed and standardized for Heavy Metal Analysis for fish and fishery products, water, soil, sediments etc.
- LC-MS/MS (Shimadzu 8045) successfully installed and standardized for the analysis of Antibiotics, Pesticide Residue, Dyes and Aflatoxins.
- The parameters for Drinking water and Construction water were standardized

Revenue generated: Rs. 4,82,575/- from diagnostic services for the period 2023-24.

Centre for Climate Resilience and Environment Management (CCREM)

PI : Dr. Shijo Joseph, Assistant Professor
Co-PI : Dr. Girish Gopinath, Professor
Project Staff : Mr. Sanjay B, Senior Research Fellow
Fund Allotted (INR) : 21 Lakhs

Objective: To analyse the climate variability experienced in the Vembanad-Kol wetland system, and to conduct attribution studies to devise mitigation and adaptation strategies to climate change.

Achievements

- A significant increase in temperature was observed over the past 71 years (29.5^{0}C to 31.9^{0}C) in the Vembanad-Kol wetland system. A consistent positive anomaly has been observed since 1980's.
- Long-term rainfall data from 1901 to 2021 showed an average of 3017 mm with a standard deviation of 467 mm.A negative anomaly has been prominent since 1960's.
- High-resolution mapping of land use land cover of four LSGs (South and North Punnapra, and South and North Ambalappuzha) in the Vembanad region has been completed.
- Greenhouse gas (CO_2, N_2O and CH_4) emissions from four land cover classes (i.e., paddy field, flooded paddy field, fallow lands, and homesteads) were measured, and found that CO_2, and N_2O emissions were high from paddy fields while CH_4emission was high from flooded paddy field.
- Developed allometric equations for Pneumatophores, and measured its relative contribution with respect to different carbon pools in the Mangrove Ecosystem in the Puduveypu.

Centre for Bioactive Substances from Marine Organisms (CBSMO)

PI : Dr. Nevin KG, Assistant Professor
Co PI : Dr. K. Manjusha, Assistant Professor
Fund Allotted (INR) **:** 10 Lakhs

Objectives

- Secondary metabolite analysis from marine fungi and potent actinomycete strains and molecular identification of strains
- Plant growth promoting activity analysis of bacterial consortium and product development
- Characterization of the Biosurfactant from yeast strain PV 37.
- Characterization of yeast polysaccharides
- Optimization of effective bioactive compound production.
- Screening of fungi for L- glutaminase free Asparaginase production.

Methodology proposed

- Antimicrobial activity screening and molecular identification of fungal and actinomycete strains based on PCR sequencing.
- In vitro screening for plant growth promoting activity using actinomycete strains.
- Characterization of the Biosurfactant from yeast strain PV 37 employing NMR, carrying out cell cytotoxicity assay. Confirming the hydrocarbon degradation using GCMS.
- Extraction of β-glucan from 122 yeast isolates and evaluation of its hypoglycaemic activity using α-amylase and α – glucosidase inhibition assay.
- Optimization of effective bioactive compound production by metabolic engineering in actinomycetes by optimising culture conditions and product extraction aspects.
- Melanin pigment production from actinomycete by submerged fermentation

Expected outcome: All the 16 pure cultures (MS1-MS16) of actinomycetes will be identified at the genus level. Secondary metabolites of biomedical importance will be purified and screened for their potential activity. Actinomycete isolates will be used to develop a product which can be used as bio fertilizer to promote plant growth. Identification of a bioactive compound with a potent antimicrobial activity which can be developed into a drug against multi- drug resistant *Staphylococcus aureus* human pathogen. Glycolipid biosurfactant from the GRAS strain *Geotrichumcandidum,* PV 37 can serve as an alternative to chemotherapeutics against bacterial pathogens in aquaculture. Strong crude oil degradation activity of

yeast strain PV 37 can be used in bioremediation. β-glucan extracted from 7 yeast isolates (PV5, PV12, PV21, PV28, PV56, PV60, PV62) were identified as potent as they exhibited antioxidant, α-amylase inhibition and antibacterial activity. Glutaminase free L-Asparaginase production from marine fungi.

Centre for Ocean Research (COR)

Study on near shore dynamics and coastal erosion processes along the Kerala coast and mitigation strategies

PI :Dr. Phiros Shah, Assistant Professor
Co-PIs :Dr. Suresh Kumar, Dr. Abish B
Fund Allotted (INR) **:** 31 lakhs

Objective: High resolution data collection on Coastal currents, nearshore currents, sediment transport, Sediment budget, wave and tide parameters in coastal systems.

Methodology Proposed

- To study the nearshore dynamics and sediment transport along the centralKerala coast.
- Understanding the influence of extreme oceanographic events on wavecharacteristics along the central Kerala coast

Work done

- WAVEWATCH III Data collected from INCOIS.
- Procured Leica TS10 Total station.
- Recruited Project staff

Achievements: Wave climate variability study presented in OSICON 2023.

Multispecies Hatchery, Puduveypu

PI : Dr. Linoy Libini, C, Assistant Professor
Fund Allotted (INR) **:** Rs. 15 lakhs

Objective

- Breeding and seed production of marine ornamental fish, clownfish to meet the increasing demand from domestic and export markets and to sustain the livelihood.
- Breeding and seed production of brackishwater and marine food fishes including mullets, red snapper, milkfish, and shellfishes such as mud crab and green mussel.
- Developing phytoplankton and zooplankton culture for fish larval food.

Achievements

- Broodstock of 9 species of clown fishes and 3 species of damsel fishes are developed. Started producing *Amphiprion percula* seeds and ready for sale
- Developed indoor and outdoor mass culture of9 marine microalgal species as live feed
- Stock and mass culture developed for Rotifer, *Brachionus plicatilis, and* 3 species of copepod, *Apocyclopscmfri*, *Oithona* sp. and *Tisbe* sp.
- Broodstock conditioning of mud crabs, *Scylla serrata and S. olivacea* is done and started the initial trial on larval rearing

- Broodstock conditioning of the green mussel, *Perna viridis* is done and started the initial trial on larval rearing

Central Instrumentation Facility (CIF)

Faculty i/c : Dr. Unnikrishnan Sivan, Assistant Professor
Fund Allotted (INR) **:** 113 Lakhs

The Central Instrumentation Facility at Kerala University of Fisheries and Ocean Studies has sophisticated instruments such as Gas Chromatography equipped with Mass Spectroscopy, High-Performance Liquid Chromatography, Ultracentrifuge, etc. Currently a Senior Research Fellow is allocated to Central Instrumentation Facility for operating the instruments. Researchers and students outside KUFOS are making use of our Central Instrumentation Facility by paying the fee fixed by the University. To facilitate the use by outside students, an online booking platform has been implemented. We are also offering Demonstrations and Hand-on Training to our Users on various aspects of Data interpretation and data presentation.

Research Centre at Payyannur

PI : Prof. (Dr.) K. Dinesh
Fund Allotted (INR) : Rs. 15 lakhs
Project staffs : Dr. Asha C V (Research Associate), Ashwini Gopi (SRF)

ACTIVITIES

- Evaluated the problems faced by mussel farmers along the Kasaragod districts in that context and prepared a manuscript entitled "Ecological and Socio-Economical Evaluation of Mussel Farming in the Kavvayi Estuarine System, Southwest Coast of India."
- Monitored the KUFOS cage culture unit in Thuruthi, Payyanur, and recorded harvest data of the cultured species (seabass).
- Diagnosed diseases in fish and shellfish samples from different farmers and provided a range of recommendations.
- Provided scientific guidance to the students of St Mary's Girls HS Payyanur on the topic of 'Primary productivity studies in various ponds along the Payyanur municipality'.
- Conducted a benthic fishery sampling in Kavvayi Backwaters.
- Analyzed and estimated physico-chemical and biological parameters of Kavvayi
- Prepared a report on the community structure of Mytella strigata along Kavvayi estuarine wetland based on the survey.
- Presented a paper on "An Inventory of Fish and Crustacean Species from Kavvayi Estuarine Wetland; South West Coast of India" in the National Conference on Reviving Wetlands (Recent Developments in Wetland Research) organized by the Centre for Water Resources Development and Management (CWRDM), Kozhikode, on October 11–13, 2023.
- Engaged in the stakeholder meeting on the export of green mussels from Kerala, organized by the MPEDA-Regional Division, Kochi, on March 12, 2024, at the Co-operative Rural Bank auditorium.
- Attended a four-day hands-on training on 'DNA barcoding and application of bioinformatics' organized by Marigenome Matsysevanakendra in collaboration with the Government of Kerala and the Pradhan Mantri Matsya Sampada Yojana (PMMSY) from May 28, 2024, to May 31, 2021.

- Introduced the lab facilities of the center to the first and second year B. FSc. students of Fisheries College Payyanur and provided practical sessions on DNA extraction, PCR, gel electrophesis, microbiology techniques, and hydrobiology.
- Guided students for their science projects under the STREAM ECOSYSTEMS, Ministry of Education (Government of Kerala).

Hands-ontrainingprogramonvalue-addedproductsfromseafood

REVOLVING FUND PROJECTS

Administrative and Technical Sanction has been accorded for implementation of three revolving fund projects with a total outlay of Rs. 10,80,000/- (Rupees Ten Lakh Eight Thousand Only) as corpus amount for operation of the RF projects with the individual project break up of project funds as mentioned below.

Sl. No.	Name of PI	Name of Co- PI	Title of proposal	Corpus Fund required (Rs.)
1.	Dr. Devika Pillai, Professor	Dr. Rahul Krishnan, Assistant Professor	***Aquatic Referral Lab, KUFOS***	5,00,000/-
2.	Dr. Lakshmi E Jayachandran, Assistant Professor	Nil	***Centre of Excellence in Food Processing and Packaging Technology***	80,000/-
3.	Dr. Devika Pillai, Professor	1. Dr. Binu Varghese, Assistant Professor 2. Dr. Shyla Raj KS, Technical Consultant	***High frequency micropropagation of commercially important aquatic plants through tissue culture***	5,00,000/-

EXTERNAL AIDED PROJECTS

1. *Systematics, Phylogeny, Life History Traits, Distribution and Stock Assessment of Cutlass Fishes andSnake Mackerels Occurring in Indian Waters*

PI : Dr. M.K Sajeevan, Professor
Funding agency : Ministry of Earth Science (MoES)
Budget : Rs. 90,43,752/-
Duration : 4 years (From 25/01/2019 to 25/06/2023)

Objectives

- To Understand the Systematics of the fishes belonging to Trichiuroids.
- To understand the food and feeding habits and life history of Trichiuroid fishes.
- To understandthe dynamics of its fishery.
- To study age and growth of major Trichiuroid fishes and carryout stock assessment of Snake mackerels and Cutlass fishes occurring in Indian waters

Research Problem: Comprehensive review for Trichiuroid fishes has never been attempted in Indian water. Study on the biological and fishery aspects of other Trichiuroid fishes is highly important for sustainable exploitation of these resources. Hence, present study proposes to carryout biology, fishery, age, growth and stock assessment of major Trichiuroid fishes inhabiting in Indian waters. Fishery of Trichiuroid fishes is limited to two to three coastal ribbonfishes. Deep-sea ribbonfishes and snake mackerels has got the potential to become major fishery resources. Lack of knowledge on their distribution, abundance and stock structure is a major lacuna for planning the exploitation strategy and popularization of the resources. This study will provide such vital information for identification and exploitation of resources.

Work Done: Present study collected samples from all 9 maritime states of India. During the study, 10 species from Trichiuridae and 7 species from Gempylidae were recorded. Field identification guide were prepared based on the species collected. For assessing the diversity and distribution of the cutlass fishes and snake mackerels, data were analysed in PRIMER software nationally and globally and also a checklist of the cutlass fishes and snake mackerels from the world were also prepared using secondary data. Detailed taxonomy of collected species was done based on morphology, meristics, and otolith were done. The species were also validated using molecular studies. Detailed osteology of each species was also done for taxonomic purposes. Feeding ecology, reproductive biology, age determination based on otolith, stock assessment and biochemical studies of Tentoricepscristatus and Rexea bengalensis were done from each family.

Achievements

- Established age and growth lab at Dept of FRM, KUFOS.
- Conducted training programme on "Age determination of fishes using otolith".
- Covered 37 landing centers and participated in cruise FORV SagarSampada for data collection.
- Recorded 10 species of Trichiurids and 7 Species of Gemylids from India out of 15 Trichiurids and 10 Gempylids reported.
- Length weight relationship and condition factor of 10 species of Trichiurids and 5 species of Gempylids were done.
- Age and growth studies were done for the species *Tentoricepscristatusand Rexea bengalensis.*
- Carried out studies on reproductive and feeding biology for 630 Gempylids and 917 Trichuirids.

- DNA barcoding of the Cutlass fishes and snake mackerels were done.
- Osteology of 10 trichiurids and 7 gempylids were done.
- Submitted 18 sequences of Trichurid and 10 sequences of Gempylids to NCBI.
- Field identification guide has been made for the cutlassfishes and snake mackerels of India.
- Biochemical composition of *T. cristatus* and *R. bengalensis* were done.
- Published 5 scientific papers in peer reviewed journals.
- Produced two Ph. D.
- Submitted 5 manuscripts in peer reviewed journals.

2. *Spatio-temporal variability of the environmental parameters in the Lakshadweep Coral ecosystems and their implications on the coral health – An integrated study*

PI : Dr Anu Gopinath, Assistant Professor, Dept. of AEM, FOST
Co-PI : Dr. M. P. Prabhakaran, Assistant Professor in Biological Oceanography
Abdul Raheem C.N, Range Forest Officer, Department of Environment and Forest, Kavaratti Island, Lakshadweep.
Prof. R. P. Sinha, Professor (Former Coordinator (Applied Microbiology & Industrial Microbiology) DAAD Fellowship Awardee), Centre of Advanced Study in Botany, Banaras Hindu University, Varanasi, India.
Funded : Indian National Centre for Ocean Information Services(INCOIS), Hyderabad
Duration : 3 years (2023-2026)
Budget : 52.34 Lakhs
Project staffs : Kirthiga S S (Project Fellow –I), Arya P Kumar (Project Fellow-II), Dhinesh R (T A)

Background: The term "climate emergency" was chosen as the Oxford Word of the Year 2019, highlighting the urgent need for action against climate change. Oceans, covering two-thirds of the Earth, have absorbed 93% of the excess heat generated by global warming, protecting land from overheating. However, a 50% increase in marine heat wave emissions over the past 30 years threatens ocean habitats. Coral reefs, though only 0.1% of the ocean, are crucial for marine biodiversity and human sustainability, providing coastal protection, pharmaceuticals, and ecosystem services.

Coral reefs' mutualistic symbiosis with Symbiodinium dinoflagellates is vital for their survival. Coral bleaching, driven by climate change, disrupts this symbiosis, leading to coral death and threatening marine ecosystems. Increased sea temperatures, dissolved CO2, and extreme weather events exacerbate coral bleaching, with significant economic, social, and health consequences. Effective monitoring and timely action are essential to protect coral reefs and associated ecosystems.

Aim: This proposal aims to understand the physical, chemical, and biological characteristics of reef environments in the Lakshadweep islands and their role in coral bleaching at a species level on a spatio-temporal basis.

The data collected will validate and complement the Coral Bleaching Alert Services (CBAS) provided by the Indian National Centre for Ocean Information Services (INCOIS) and develop models to predict bleaching events. The project seeks to enhance the effectiveness of monitoring and conservation strategies for coral reefs, with a focus on species resilience and areas more affected by bleaching.

Research Progress and Outcome: During 2023-2024, the project commenced with staff recruitment and a two-month sampling campaign in the Lakshadweep islands, covering five islands, including one uninhabited island. Physical, biological, and chemical parameters were collected through water sampling and instrument deployment.

Analysis of these parameters is currently underway. The collaborative effort with INCOIS aims to map bleaching events, formulate reef health policies, and identify resilient species, thereby complementing existing coral bleaching alert services and contributing to the conservation of coral reefs.

3. *Mycosporine-like amino acids from corals and associated dinoflagellates- their role in preventing coral bleaching -a case study of Lakshadweep archipelago*

PI : Dr Anu Gopinath, Assistant Professor, Dept. of AEM, FOST
Co- PI : Dr. RP Sinha, Prof. and Head, Dept. of Botany, Banaras Hindu University, Varanasi
Dr. Idrees Babu KK, Scientist, Department of Science and Technology, Kavaratti
Dr. Phiros Shah, Assistant Professor, FOST
Scientific staffs :Devika J (Junior Research Fellow), Devadas C R (Field Worker)
Funded : Department of Science and Technology (SERB- CORE), Govt. of India
Duration : 3 years (2022- 2025)
Budget : Rs. 34,28,360 /-
Fund received : Rs. 20,82,800/-

Objectives

- Quantification of MAAs from corals and associated Dinoflagellates in Lakshadweep islands - Kavaratti, Kadamat, Kiltan, Suheli - spatial and temporal (seasonal) variations.
- Quantification of chlorophyll a and zooxanthellae density in the corals.
- Characterization of active MAAs in corals, analysing its role in UV protection and hence bleaching – spatial, and temporal/seasonal variations in MAA content.

Works done

- A detailed review of literature done and published as book chapter.
- J. Devika, Anu Gopinath, Idrees Babu and R P. Sinha, 2022. Mycosporine-Like Amino Acids: Multipurpose Stress-Relieving Secondary Metabolites in Marine Ecosystems. Cyanobacteria: Life History, Ecology and Impact on Humans ISBN: 979-8-88697-169-9., NOVA Science Publishers, 169-188
- Completed two stages of sampling. Stage 1 sampling completed (September- October 2022). Stage 2 sampling – February 2023. Maximum number of samples collected from 3 islands of Lakshadweep Archipelago: Agatti, Kadmat and Kavaratti.
- Coral zooxanthellae samples collected from both healthy and bleached colonies. Areas susceptible to long range variations in hydrography also identified and collected samples from there.
- Preliminary analysis involving confirmation studies for the presence of MAAs and analysis of general hydrographic parameters done.
- Identified the presence of various MAAs commonly found in different reef ecosystems in the reefs of Lakshadweep archipelago by preliminary UV analysis (Thermo scientific Evolution 201 UV–Visible spectrophotometer). Results on comparing with literatures reporting the same from Great Barrier Reef like ecosystems shows similarity.
- Samples prepared and sent for further HPLC analysis to the Centre of Advanced Study in Botany,

BHU, Varanasi (HPLC system (Waters 996 photodiode array detector, Waters, Milford, MA; pump L-7100, Hitachi, Darmstadt, Germany)- BHU, Varanasi. HPLC Analysis results obtained and paper publishing work under progress.

- A further extended study on the clade identification of zooxanthellae is to be done.
- Received approval Fron Institutional animal ethics committee
- Confirmation of MAAs done through LCMS analysis
- One research paper submitted to Ecological Indicators journal.
- Participated and presented poster in OSICON 2023 at INCOIS
- Visited Department of Microbiology, Pondicherry University for Identification of zooxanthellae clades.

4. *Development of algorithms for monitoring carbon and nitrogen based productivity and distribution incoastal ocean Bay of Bengal and Arabian Sea and their role on biogeochemistry using in situ and satellite datasets*

PI : Dr. Anu Gopinath, Associate Professor
Co- PI : Dr. Phiros Shah, Assistant Professor
Funded by : Space Application Centre, ISRO, Ahmedabad.
Duration : 3 years (2022- 2025)
Budget : Rs. 30, 00,000/-
Project commenced : 03/01/2023
Project Staff : M. Vennila, N. Manimozhi.

Objectives

- Variability in dissolved and particulate organic and inorganic carbon and nitrogen compounds in selected transects along the South Eastern Arabian
- To observe seasonal and spatial variations in water quality parameters with reference to Temperature, chlorophyll, suspended matter, pH, dissolved oxygen, CDOM, salinity and nutrients
- Estimation of new production (15 N) and primary production (13 C)
- Development of the algorithms based on primary productivity and new production with special reference to the study area in coastal offshore waters and its validation.

Work Done

- Water and sediment samples were collected from off-Kochi and Calicut.
- Water quality parameters like Temperature, pH, salinity, alkalinity, dissolved oxygen, chlorophyll, TSM, Nutrients (ammonia, nitrite, nitrate, phosphate, silicate), POC, CDOM, TOCwere analyzed for all the water samples
- Water samples from the cruise Paradip to Chennai (72 stations) were collected and analyzedall the parameters mentioned above
- Participated in the SAC-ISRO Project Review meeting and discussed the research findings and future plan

Achievements

- Participated in"OSICON-23" organized by INCOIS, Hyderabad
- Attended radiometer training at SAC-ISRO, Ahmedabad
- Participated in the 10 days cruise program in Sagar Anveshika vessel from Paradip to Chennai
- Participated in the OTGA training program about "Ocean ColorRemote Sensing-Data, Processing and Analysis" organized by INCOIS, Hyderabad
- First review meeting over on 18/12/2023 at SAC, Ahmedabad.

5. *Unravelling signatures of growth and salinity adaptation in Etroplus suratensis through omics approaches*

PI : Dr. Anvar Ali P H, Assistant Professor
Co-PI : Dr. Chiranjiv Pradhan, Assistant Professor
Funding : Department of Biotechnology, Ministry of Science and Technology, GoI
Budget : 11.1 Lakhs – KUFOS component

Abstract: This multiinstitutional collaborative research project intends toSurvey of natural habitats of pearl spot to identify diverse salinity regions (KUFOS component) for the production and aquaculture of families of pearl spot to generate requisite specimens for RNA sequencing study (KUFOS component). Sanction has been accorded for the extension of the project for one more year.
Achievements: A comprehensive distribution map for Pearl Spot concerning the salinity gradient in the Kole Wetland, part of the Vembanad-Kole Ramsar site, has been created.

6. *Coastal hydrodynamics and sediment transport along Kerala coast- an integrated approach*

PI : Dr. Phiros Shah, Assistant Professor
Co-PI : Dr. Limnamol V.P, Assistant Professor
Funding : Department of Biotechnology, Ministry of Science and Technology, GoI
Project Staff : Athuldev A V, JRF
Budget : 11.1 Lakhs – KUFOS component
Duration : 4 years
Date of Sanction No. : MoES/NCCR/CP& SM/GIAK-UFOS/3/2022/472 Dated 29/11/2023
Date of completion : 06/07/2026
Total Project Cost : 10,05,000/-
Total Expenditure : 8,00,789/-
Unspent Balance : 2,04,211/-
Equipment sanctioned and purchased: Two Desktop and a laptop, Purchased on 31.03.2024
Summary of progress made so far against objectives: Coastal zones, being dynamic environments influenced by various factors, necessitate a thorough study for sustainable coastal management. The objective is to achieve sustainable management and utilization of coastal areas through observational and modeling studies. The initial work involved analyzing beach profile data at Valapu beach, calculating volume transport rates to understand coastal processes. Methodologies included data collection through topographic surveys and GPS measurements at five stations, data analysis for creating beach profiles, and volume transport calculation using established formulas from May to December.
The observed variations in beach profiles indicate dynamic sediment transport processes influenced by seasonal changes in wave energy and sediment availability, while calculated volume transport rates offer insights into sediment movement patterns and potential impacts on coastal morphology. Future work includes continued monitoring of beach profiles for long-term trends assessment, comparison with satellite data, integration of hydrodynamic models for simulating sediment transport processes, and field studies for model validation and refining coastal dynamics understanding.

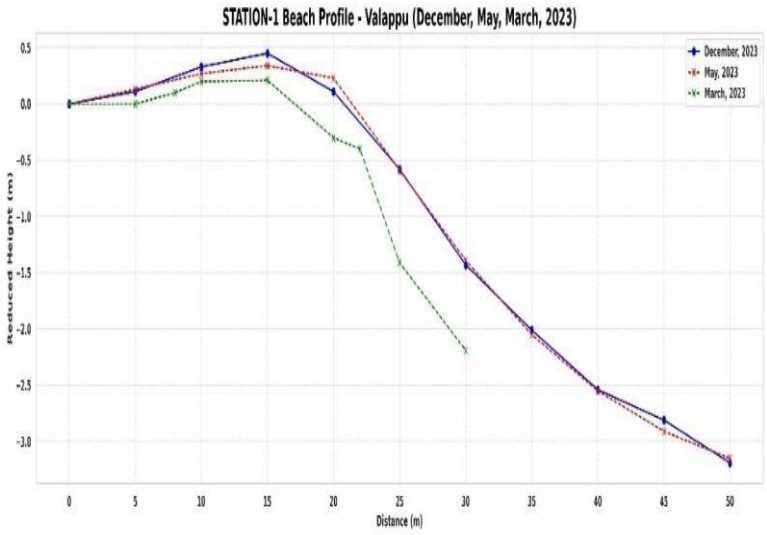


Figure: Station-1 Beach profile of Valappu during March, May and December

Additionally, started using CoastSat software for the work, which will enhance the analysis and modeling capabilities for this coastal management study.

Wave Climate Variability Along the Selected Erosional Hotspots of Kerala

Coastal communities across the globe are at the greatest risk of climate change induced coastal erosion and inundation. Wave climate variability is one of the major causes of coastal erosion/inundation processes, together with anthropogenic activities. Knowledge and better understanding of the variability of waves is essential to carry out coastal protection works and for the prediction and warning of extreme events. Many studies have reported changes in the global and regional wave characteristics but the assessment and evaluation of wave climate and its variability particularly for erosional/inundation hotspots are limited. Present study uses well validated data simulated by the third-generation wave model WAVEWATCH-III (WWIII) for a 15-year period from 2007–2021. Kerala, one of the densely populated coastal state in the south west coast of India has been selected for the study. Kerala coast is exposed to high waves and has the second largest percentage of coastal erosion (65%) after West Bengal. Unlike earlier studies the present study aims to understand the inter annual, seasonal and monthly wave climate variability of total wind-generated waves, wind-seas, and swell waves along the selected hotspots of Kerala.

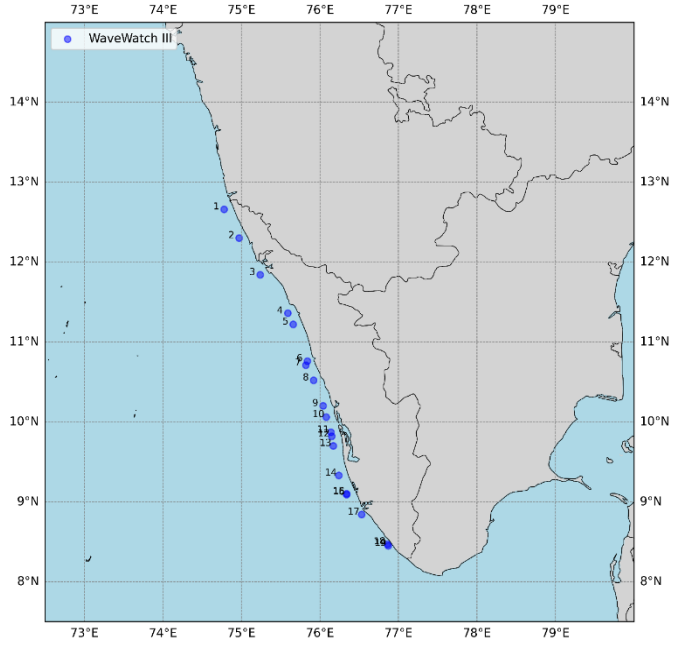


Figure: 19 Locations selected along the Kerala coast.

Microplankton Dynamics in Pollethai Mudbank Region of Alappuzha, Kerala, Southwest Coast of India

The southwest coastal waters of India, situated in the Arabian Sea, possess a notable ecological significance owing to the creation of mud banks during the months of the southwest monsoon. The current investigation centres on the Microplankton dynamics in the Pollethai Mudbank region of Alappuzha, Kerala, SW coast of India, specifically during the time period spanning from May to August. The Pollethai region portrays distinct and noticeable hydrological alterations in both space and time, and demonstrates a rich assortment of planktonic communities.

The primary dominance of the phytoplankton community is attributed to diatoms, followed by dinoflagellates. Asterionellopsis glacialis and a Thalassiosira sp. experienced blooming phenomena in the months of May (Pre- monsoon) and June (monsoon), respectively. The occurrence of Asterionellopsis glacialis bloom represents the first report on the western coast of India. The physical, chemical, and biological parameters, such as temperature, salinity, pH, dissolved oxygen, and chlorophyll a, were measured and recorded. A reduction in dissolved oxygen, salinity, temperature, and pH was observed during the southwest monsoon. Conversely, inorganic nutrients and chlorophyll a experienced an increase during the monsoon season in June.

The evident signatures of upwelling were thus exhibited during the study period in Pollethai, however a fully developed mudbank failed to occur. This could probably be due to the lack of sufficient rainfall in the study area during the monsoon season. There have been indications that the mudbank formation has shifted south of Pollethai towards Omannapuzha. Detailed scientific studies and periodic landing data are required to confirm the same.

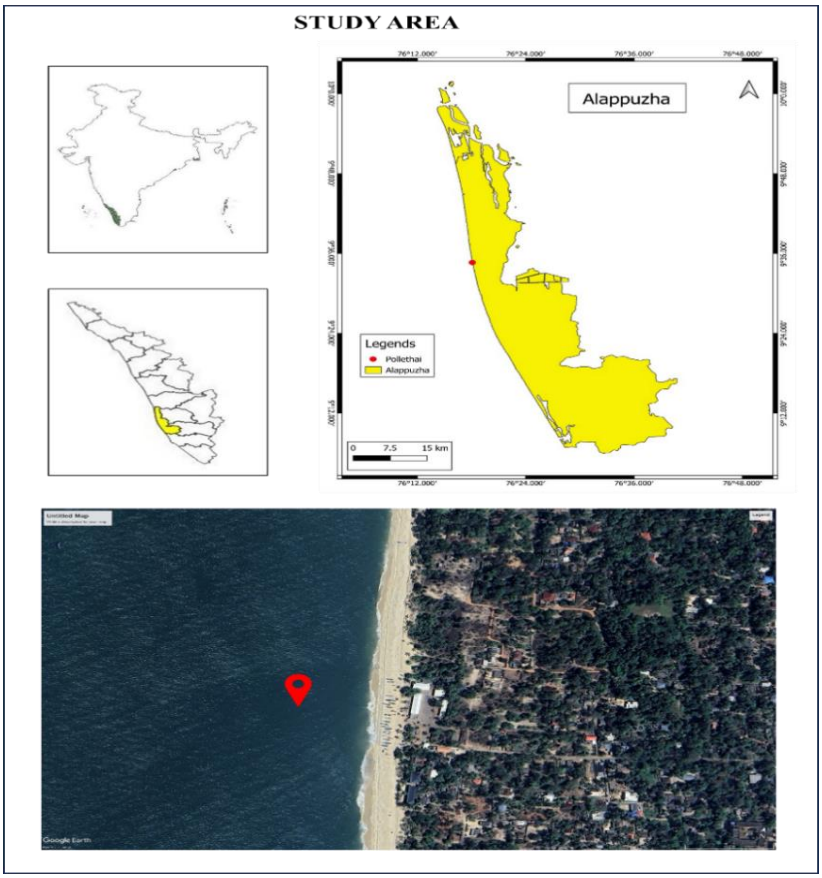


Figure: Map of the study area

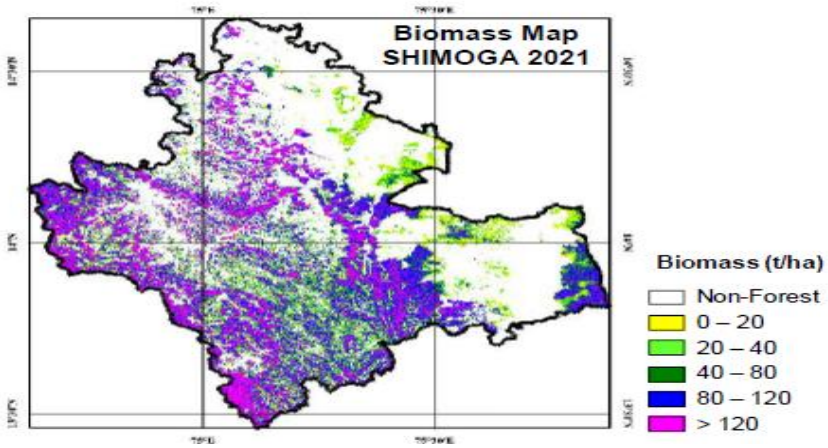
7. *Establishment of long term 1-hectare plots and its' inventory in Shimoga, Karnataka and Nilambur,Kerala and Hoshangabad, Madhya Pradesh for the validation of NISAR forest biomass products*

PI : Dr Girish Gopinath, Professor
Co-PI : U Surendran
Funding : SAC/ISRO, GoI
Budget : 27.50 lakhs

Accurate measurement of forest vegetation biomass and monitoring the changes in biomass is important for forest conservation and assessment of carbon stock and carbon fluxes from the forest ecosystems. In India, periodic estimation of forest above-ground biomass (AGB) in regional to national level has been a long-standing requirement as the country is gearing up for implementation of UN's REDD+ programme. There have been efforts to estimate forest AGB at local to regional levels by many using satellite remote sensing technology. However, estimation of forest AGB at state level or national level and production of forest aboveground biomass maps of India are yet to achieve maturity. Synthetic Aperture Radar (SAR) data has shown great potential in retrieval of forest AGB due to the capability of SAR to provide more dynamic range for vegetation growth variables as compared to optical data. SAR signals in longer wavelength (such as L and P-band) have ability to penetrate deeper inside the vegetation canopy and produce more sensitivity to the biomass of higher densities, hence are widely used for retrieval of forest AGB.There are several advanced level products (Level-4 products), also known as science products planned as NISAR data products by ISRO. These products will cater to the need of many applications and services as envisaged by various user agencies in India. Some of these products related to forest applications are the following:

- Forest above-ground dry biomass at hectare scale (1ha) generated annually within an RMS error of 20 Mg/ha for 80% of areas of biomass less than 100 Mg/ha over India.
- Mangroves types and cover map at 25m pixel generated on half-yearly basis with classification accuracy of 80% or more over regions of mangrove vegetation in India.
- Vegetation disturbance over Indian forests at 1-hectare resolution generated annually for areas losing at least 50% canopy cover with a classification accuracy of 80% or more.

Progress: Establishment of 1-hectare plots for long term monitoring is completed in Shimoga of Karnataka, Hoshangabad of MP and Nilambur of Kerala. Biomass of 1-hectare plots are estimated for Shimoga of Karnataka.

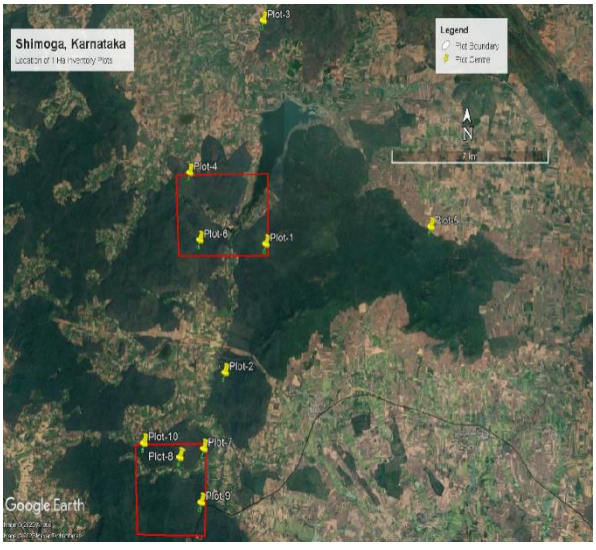


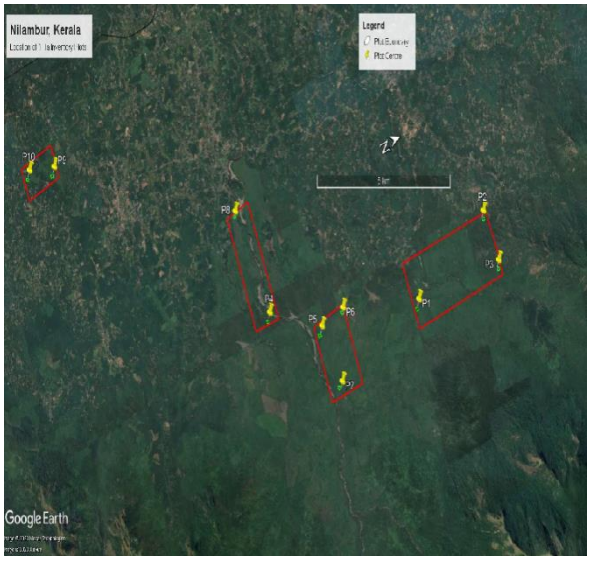
8. *Phase-II: Collection of Lidar/Optical and in situ data over longterm forest inventory plots inShimoga (Karnataka), Nilambur (Kerala) and Hoshangabad (MP) for validation of NISAR forest biomass products*

PI : Dr Girish Gopinath, Professor
Co-PI : U Surendran and Sreejith
Funding : NISAR Science, SAC/ISRO, GoI
Budget : 44 lakhs

NASA and ISRO are jointly developing a state of art L and S band space-borne Synthetic Aperture Radar (NISAR), planned for launch in January 2023. NISAR, through its repeat-pass interferometry orbits, will produce SAR data at high repeat cycle, high resolution and larger swath with capability of producing full-polarimetric data in L-band and hybrid polarimetric data in S-band. The NISAR systematic observation at L-band and S-band over Indian region will provide unprecedented time-series data through the ascending and descending orbits for the Ecosystems applications benefiting several operational activities related to agriculture, forestry, wetlands and soil moisture estimation as perceived by ISRO. NISAR data will address the critical issues of forest carbon stock estimation and monitoring carbon fluxes from vegetation disturbances; changes in the alpine vegetation tree-line; agriculture crop monitoring and changing cropping patterns; Spatio-temporal distribution of field-scale soil moisture and inundation dynamics of wetlands. As this projection is the continuation of Phase I, following are the objectives:

- Inventory of additional 1ha plots established in few regions of Kerala and re-inventory of 4 plots in Shimoga, Karnataka.
- Collection of drone-mounted optical and LIDAR data over inventory plots in Shimoga, Karnataka, Nilambur, Kerala and Hoshangabad, MP.
- Facilitate collection of drone data with concurrent field measurements and required permissions from the state forest department.
- Delivering ground measured inventory data, processed Lidar data and optical images as stated in the work plan.





9. *Observations on ocean state and pelagic fishery off Kerala coast for the validation of PFZ andSatellite data*

PI : Dr. S. Suresh Kumar, Professor
Co-PI : Dr. Anu Gopinath, Associate Professor and Dr. Phiros Shah, Assistant Professor
Project staff : Abhijith EK, Riys Rahman PK, Rahul Raj GR
Funding : INCOIS MOES (Govt. of India)
Duration : 4 years (August 22, 2022 to March 31, 2026)
Budget :₹ 1,13,00,000.00
Fund Received :₹ 51,68,491.00

Objectives

- Deploy and maintain the buoys and field data stations at Kollam and Kozhikode.
- Estimate the fishery of small pelagics in PFZ in terms of location, species and quantity.
- To collect In-aitu data for validation of observational products for PFZ advisories and other forecast models of INCOIS along with primary productivity.
- Disseminate PFZ advisories and ocean state forecasts on a regional basis.
- Carry out beach profiles and Littoral Environmental Observations (LEO) to understand and model the shoreline dynamics.
- Contribute to national capacity building in Ocean state Forecast and coastline dynamics and collect information from stakeholders through INCOIS feedback app.
- To provide logistic support local coordination to the Automatic Weather Stations and Tide Gauge observation stations of INCOIS.

Work Done

- Carried out survey of all landing centres across all coastal districts of Kerala
- Collection of landing data of small pelagic fishes from 17 major harbours across Kerala
- Collection of oceanographic parameters using data sonde from various locations
- Beach profiling of three beaches viz. Alappad (Kollam), Valappu (Ernakulam), and Nagaram (Kozhikkode)
- Carried out User Interaction workshops at various locations in Kerala
- Dissemination of PFZ advisories among fishers and creating awareness about PFZ and other advisories given by INCOIS
- Dissemination of INCOIS Feedback app to fishers
- Maintenance and redeployment of Wave Rider Buoys (WRBs) at Kollam and Kozhikkode
- Maintenance of HF Stations at Kollam and Kozhikkode

Achievements

- Identified major fish landing centres through an intensive all-Kerala survey
- Carried out 3 User Interaction Workshops at 3 locations in Kerala

10. *Molecular taxonomy and nutritional profiling studies of sea urchins from Gulf of Mannar coral reef ecosystem*

PI : Dr Radhika Rajasree S.R., Professor
Co-PI : Dr. S. Suresh Kumar, Dean i/c FOST, Professor (AEM)
Funding agency: Ministry of Earth Sciences (2022-2025)

Duration : 3 years
Budget : Rs. 60,80,000/-

- During the study period, *6 species of sea urchins* were collected and identified from the study area and DNA extraction protocol was standardized through trial-and-error method.
- PHNQ pigments from sea urchin roe were extracted and characterized.
- Pigments extracted from the shells *of Stomopneustes variolaris* containsPoly hydroxyl naphthoquinones.
- Presence of Spinochrome E in the shell extract of sea urchins
- Positive concentration-dependent results of the ABTS radical scavenging
- Experiment divulge a unique natural antioxidant.
- Significant cytotoxic effects of PHNQs on cervical carcinoma HeLa cell lines

Manuscripts: Radhika Rajashree S.R. and Praisy M Shaju (2023) Characterization and Isolation of Bio-Functional Lipids from Black SeaUrchin Stomopneustes variolaris andits Multi Potential In-vitro Activities, Uttarpradesh Journal of Zoology, Volume 44, Issue 23, Page 124-138, 2023.

Polyhydroxy naphthoquinone pigments from spines of black sea urchin *Stomopneusteus variolaris* as a novel antioxidant with cytotoxic effect on cervical cancer HeLa cell lines (Regional Studies in Marine Sciences – under review)

International conference: IFC 2024 submitted the abstract.

11. *Molecular Taxonomic Approach for the Development of Digital Catalogue of the Coral Reef- Biota of Lakshadweep to Enable Conservation Measures*

PI : Dr. S. Suresh Kumar, Professor
Co-PI : Dr. LimnaMol V P,Assistant Professor and Dr. Idrees Babu K K
Project staff : Ms. Minu Thomas
Funding Agency: SERB, DST (Govt. of India)
Budget :32.6 Lakh
Duration : 3 Years (2020 December 31 to 2024 April 30)

Objectives

- To provide exact taxonomic validation of the biota of coral reefs of Lakshadweep islands in multiple spatio-temporal scale
- To develop a comprehensive inventory of the major groups of animals in coral reefs of Lakshadweep Islands
- To propose the area for conservation based on the developed database and rigorous analysis using decision support systems.

Work Done

- Collected 152 samples from islands of Agatti, Bangaram and Thinnakara
- Sequences generated
  - Fishes-353
  - Softcoral-52
  - Bacterial isolates- 45
  - Crabs- 17
  - Jelly fish-1
  - Ascidians- 16
  - Sponge-1
  - Shrimp-1
  - Seaweed -1
  - Nudibranch- 1
  - Sea anemone-1

12. *Aquatic Animal Disease Diagnosis and Quality Testing Laboratory (Aquatic Referral Lab, KUFOS)*

PI : Dr. Devika Pillai, Professor
Co-PI : Dr. Rahul Krishnan, Assistant Professor
Funding : PMMSY, Government of India
Budget : Rs 975 lakhs
Duration : Project completed in 2024

Salient features: The Aquatic Referral Lab is first of its kind in the state.

- The laboratory covers 5000 sq. ft and is fully equipped with state of the art facilities for aquatic animal disease diagnosis and testing for antibiotic and pesticide residues in fish and fishery products as well as for heavy metal contamination in water and fish.
- Diagnostic services will be provided to aquafarmers, other stakeholders as well as to the state fisheries department.
- This facility, along with the mobile aquaclinic, will also help in regular disease surveillance and monitoring for emerging and re-emerging diseases in the state. Research on therapeutics will enable the centre to develop effective treatment options
- The facility will be used for providing capacity building training to fisheries department officials, researchers and prospective aquatic animal health entrepreneurs.
- State of the art laboratories provided in the Referral Lab will enable researchers to do high quality research on emerging diseases and to have international collaborations with acclaimed universities and labs.

Aquatic Referral Lab, KUFOS

a. LCMSMS facility at ARL

b. ICPMS facility at ARL

MOBILE AQUACLINIC

A 'state of the art' mobile aquaclinic, with all facilities for diagnosis of fish diseases and analysis of soil and water quality parameters, is ready for inauguration and for starting the service to reach all the 14 districts of Kerala. This mobile unit or 'aquaclinic on wheels' is intended to reach the aquafarmer's fields and enable the analysis of the different critical parameters and diagnosis of aquatic animal diseases for effective management of their farms and prevent/control diseases. The interior of the mobile lab has been designed to suit the work flow in case of disease investigation of fish kills or disease outbreaks. Facilities for transporting the fish/shrimp samples in live condition is also provided in the unit. Timely and prompt diagnosis of problems at the farm is critical in aquaculture to prevent loss due to diseases and enable the farmers to harvest their fish/shrimp successfully. It is also planned to conduct awareness classes for farmers in the vicinity during the farm site visits. The advanced lab facility provided is aimed to enhance the health management of aquatic animals and support the growing aquaculture industry. The Mobile Aquaclinic underscores the commitment of the Government and the university to support the farmers and stakeholders of the state in sustainable aquaculture practices. It has been funded under the Pradhan Manthri Matsya Sampada Yojana (PMMSY) scheme of the Central Government, with 60% funding from the Central Government and 40% from the State Government.

BIOSECURE WET LAB

A wet lab is integral to Aquatic Animal Health Research. This facility houses a dedicated space for quarantining the fishes, separate rooms for carrying vaccine trials, experimental trials and challenge facility. Detailed investigation on pathogens and research on vaccine development can be carried out here. Efficacy of products for disease prevention or control also can be tested in this facility.

13. *Development of vaccines against Tilapia lake virus (TiLV) and Cyprinid herepesvirus-2 of fish in Indian aquaculture system*

PI	: Dr. Devika Pillai, Professor
Co-PI	: Dr. Rejish Kumar V J, Assistant Professor& Dr. Rahul Krishnan, Assistant Professor
Funding	: Department of Biotechnology, Government of India
Budget	: 54.18 Lakhs
Duration	: 3 years (Project extended up to 11 September, 2024)

Approved Objectives:

- Study the efficacy of viral vaccines to protect the fish from viral pathogens in laboratory trials by parenteral and oral routes
- Study the immune response to vaccine in vaccinated fish at molecular levels and antibody response
- Field evaluation of vaccines to study their efficacy to protect the fish in fish farms in Tamil Nadu, Kerala and Odisha, and other states

Research Progress:

TiLV virus and its susceptibility: During the first 6 months of the project, an extensive sampling was done in 7 all districts of Kerala in tilapia and cichlids for TiLV but were not successful. Hence, TiLV propagated in cell lines obtained from our collaborating institute CAH College, Melvisharam were used for the study. In the meantime, experimental pathogenicity trials were also conducted to confirm the pathogenicity of the

samples obtained. In the experiments, TiLV was not showing much pathogenicity as in wild condition in both Nile tilapia and GIFT.

During laboratory trials of the obtained virus, the TiLV injected tilapia exhibited symptoms such as lethargy, loss of scales and skin hemorrhages and mortality recorded was less. Confirmed a positive case of TiLV infection in Natural pond from Thrissur, with typical clinical signs and PCR amplification of 491bp of TiLV. (Fig.1and Fig 2)

Fig. 1. (a) Tilapia infected with TiLV showing exophthalmia (b) Tilapia injected with TiLV by IP challenge with exophthalmic eyes.

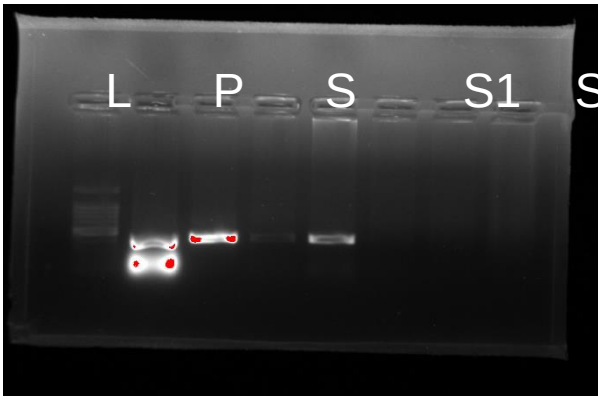


Fig. 2. Confirmation of TiLV infection using 491bp primer. Lane L- 100 bp ladder, Lanes P – PC, Lanes 3-5 – liver, gill and brain of tilapia injected with TiLV, Lane 5-NC.

2. Pathogenicity trial against TiLV: Experimental pathogenicity in tilapia were conducted with positive sample from Thrissur and obtained a mortality of nearly 90% in the laboratory trials in GIFT and Nile tilapia with typical clinical signs.

3. Vaccination trial against TiLV: Vaccination trials have been conducted to study the efficacy of the inactivated vaccine of TiLV in tilapia in response to TiLV infection given Intra-peritoneally. First set of vaccine trial has been performed with formalin inactivated TiLV ultra pellet procured from CAH College, Vellore for a period of 8 weeks. The material was treated with 0.006% formalin and incubated at 25 ^{0}C for 36 h for inactivation. The experiment consisted of three treatment groups with 60 nos. of tilapia in each group. In the first, the fish were injected intra-peritoneally with this inactivated vaccine without any adjuvant. In the second, the fish were injected with 1X PBS as control and the third set was maintained without injection. The booster was given after two weeks of first vaccination. Vaccinated and control fishes were challenged with TiLV virus (2.8×10^8 copy numbers in 100 µl/fish) 3 weeks after the booster.Second set of vaccine trial has been done with formalin inactivated TiLV ultra pellet procured from CAH College, Vellore for a period of 8 weeks. The material was treated with 0.006% formalin and incubated at 25 ^{0}C for

36 h for inactivation. Tilapia (60 no.) were injected intra-peritoneally with this inactivated vaccine without any adjuvant. Another 60 tilapias were injected with 1X PBS as control and another 60 tilapias were not injected and kept as control. The booster was given after 2 weeks of first vaccination. Vaccinated and control fishes were challenged with TiLV virus (2.8×10^8 copy numbers in 100 µl/fish) three weeks after the booster. The efficacy of the vaccine was evaluated by observing mortality for three weeks. The survival rate was 58.33% in the control group and 91.6% in the vaccinated group and thus, relative percent survival (RPS) was 86% indicating the effectiveness of the developed vaccine.

4. Immune gene expression post TiLV vaccination: Eleven immune genes primers (both adaptive and innate) namely IgM, IgT, IgD, CD4, IL 1β, MHC I, MHC II, MX, NFκβ, RSAD 2, IRF3 and TLR were procured and standardized for qPCR analysis prior to vaccine experiment. During vaccine trial, tissue samples of head kidney and spleen were collected at 0, 3, 7, 14, 17, 21, 28, 35 and 56 d and in addition serum were collected at 0, 1, 2, 3, 4 and 5 weeks post vaccination from both vaccinated and control tilapia. The modulation of expression of these innate and adaptive immune genes in vaccinated and control fish was analysed.

Upregulation of IgM and IgT post vaccination revealed the role of antibodies involved in the protective response elicited by the vaccine. Though IgM was expressed in both kidney and spleen tissues, IgT was expressed in kidney tissue only. Elevated expression of both the genes showed vitality of the candidate vaccine. Similarly, the expression of all other immune genes have been noticed and all of those showed upregulation in post-vaccination as compared to that of the control fish. CD4 and CD8 play important roles in detecting virus and eliminating virus-infected cells. Both genes showed upregulation in kidney compared with spleen. Thus, upregulation in the expression of both innate and adaptive immune genes following immunization suggested that the vaccine can activate both arms of the immune response in tilapia.

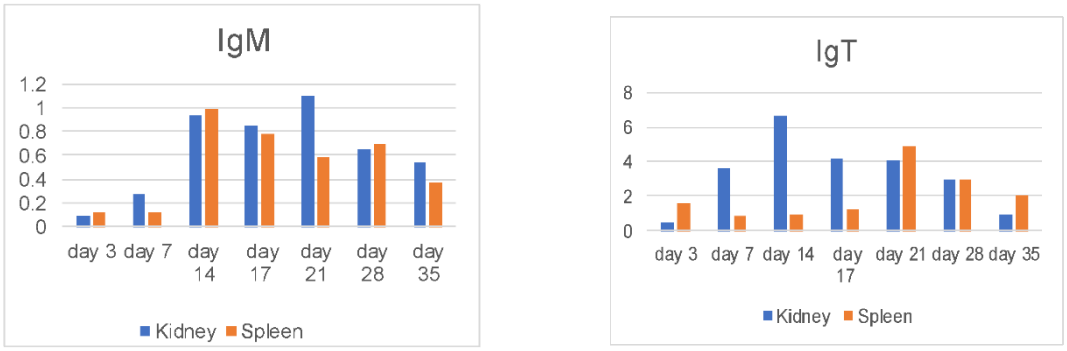
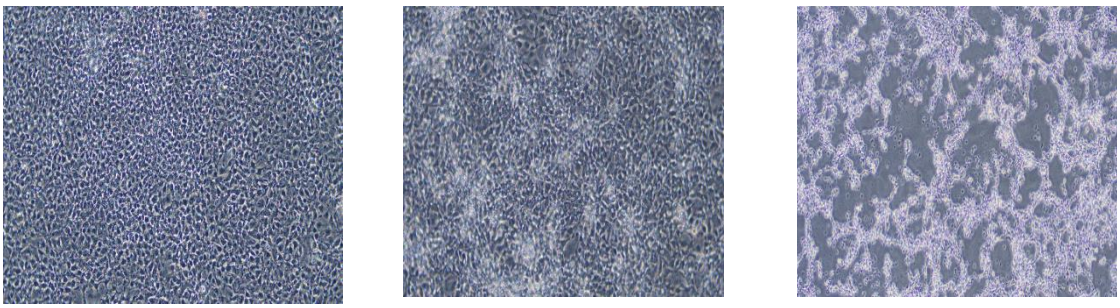


Fig3: Expression of IgM and IgT in Kidney and Spleen

Fig. 4 Expression of CD4 and CD8 in Kidney and Spleen

4. **Cell line study of TiLV:** TiLV was propagated in E-11 and CSK cell line (Obtained from CAH, Vellore) to study the virulence pattern of the virus and to produce TiLV samples enough for the vaccination trial. The virus has shown CPE in both cell lines with E-11.



A B C

Fig.5 TiLV infected E-11: a) Control b) 5dpi c) 9dpi

Outcome: An efficacious vaccine has been developed against Tilapia lake virus (TiLV), which showed 91.6% protection in the challenge study. The immunological effects in response to the vaccine were demonstrated. The vaccine development can be completed after further lab and field trials.

14. *National Surveillance Programme for Aquatic Animal Diseases-Phase II (NSPAAD-Phase II)*

PI	: Dr. Devika Pillai, Professor
Co-PI	: Dr. Safeena M.P, Dr. Rahul Krishnan and Dr. Gijo Ittoop
Funding and Budget	: PMMSY and Rs 47.7 lakhs
Duration	: July 2022 to March 2025
Project Staffs	: Shijina P. Nambiar, Aparna Ramanan

Objectives

- To conduct targeted surveillance on aquatic animal diseases of freshwater fishes like Snake Head (EUS), Tilapia (TiLV, TiPV and Streptococcus), Pangasius sp. (Edwardsiella) and Anabas, Brackishwater fishes - Seabass (RSIV, ASBIV), Pearlspot (EUS, Streptococcus), Shrimp (EHP,WSSV) from selected farms in Alappuzha, Ernakulam, Thrissur, Kannur districts of Kerala
- To conduct passive surveillance on aquatic animal diseases of both freshwater and brackishwater fishes in all the districts of Kerala (whenever diseases outbreaks are reported)
- To organize and conduct awareness programme on various existing or emerging diseases of both fresh and brackishwater fishes to the farmers of the selected districts

Significant findings during April 2023 to March 2024:

- The first evidence of the concurrent occurrence of Infectious Spleen and Kidney Necrosis Virus (ISKNV) and Red Seabream Irido Virus (RSIV) in cultured Asian Seabass (*Lates calcarifer*) from Kerala
- Detection of Tilapia parvovirus (TiPV) associated with massive mortalities of farmed Nile tilapia (*Oreochromis niloticus*) in Kerala
- First detection of Tilapia Parvo Virus (TiPV) from Kerala, Palakkad district
- Heavy infestation of Dactylogyrus sp and trichodina sp in *Horabagrus brachysoma* fingerlings
- Multiple infection of pond reared *Litopenaeus vannamei* with White spot syndrome virus (WSSV) and Enterocytozoon hepatopenai (EHP)

Awareness Programmes

Date	Place	No of stakeholders
22/06/2023	Thekkemala, Pathanamthitta	44
10/07/2023	Thrissur, Chalakkudy	78
3/01/2024	Madavana, Ernakulam	83

Number of disease cases

Total number of samples analysed - 285
Total number of disease cases reported- 61

District	Total number of disease cases in district
Thrissur	22
Ernakulam	10
Kannur	9
Alappuzha	8
Kottayam	4
Kozhikode	3
Wayannad	2
Idukki	2
Palakkad	1

Fig. 1a. WSSV infected L.vannamei

Fig. 1b. EHP infected L.vannameI

Fig. 2. TiPV infected in Tilapia

Fig. 3. EUS infected Channa

Fig.4. ISKNV infection in seabass

Fig.5Octalasmis parasite in mud crab

Fig.6 Trichodina in Etroplus

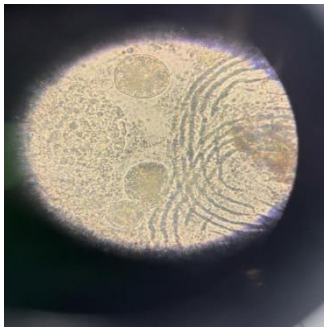


Fig. 7 Ich infestation in goldfish

15. *Development of value added product for amelioration of fatty liver and hyperlipidemia from fruits of Baccaurea courtallensis (Wight): A threatened underutilized fruit species from the forests of Kerala*

PI	: Dr Blossom K L, Assistant professor (Food Science & Nutrition)
Co-PI	: Dr. Suja Rani S, Assistant Professor, Dept. of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Sciences, Mannuthy
Funding Agency	: Kerala Forest Department (KFDF)
Location	: KUFOS, Kochi, KVASU, Mannuthy
Duration	: 2 years (2023-2025)
Budget	: Rs. 11,83,600 /-
Junior Research Fellow	: Minnu Rose Joy

Objectives

- Identification and collection of *Baccaurea courtallensis* from different forest areas of Kerala and preparation of its extract
- Assess the nutritional and phytochemical constituents of the fruit of *Baccaurea courtallensis* and its acute antihyperlipidemic evaluation in rat
- Development of value added product from *B. courtallensis* and assessing its nutritional and biochemical parameters
- Preclinical evaluation of *B.courtallensis* against fatty liver and hyperlipidemia in rats
- Shelf life evaluation of the product during different storage periods using appropriate packing material

Work Done

- Collected fruits from the forest areas of Kerala
- Assessed the biochemical composition of the fruit pulp and rind
- Analysed the phytochemical constituents in the aqueous and alcoholic extracts of fruit pulp and rind
- Antioxidant assays

16. *Mapping Mahseer (Tor spp.) species and their threats in Kerala for long-term monitoring and conservation*

PI	: Dr. Rajeev Raghavan, Assistant professor
Co-PI	: Dr. Sanjayan Kumar I.F.S., Chief Conservator of Forest (Southern Circle), Kerala State Forest and Wildlife Department
Funding Agency	: Kerala State Forest and Wildlife Department
Budget	: Rs. 11,00,000/-
First instalment	: Rs. 6,58,080/-

Mahseers are one of the most threatened and imperiled group of freshwater fishes of the Western Ghats. However, conservation efforts have been constrained by knowledge on the genus being heavily skewed towards aquaculture, with considerable knowledge gaps on their taxonomy, ecology, distribution and population status. Currently, there is no reliable database on the diversity and distribution of mahseers in various rivers and protected areas of Kerala. The broad aim of the project is to generate baseline information to secure the future of mahseer (Tor spp.) species of Kerala through science-based conservation and monitoring approaches. More than 40 field surveys were carried out in the various river systems and reservoirs of Kerala. As part of the project, 1) the microlevel distribution of the three species of mahseer throughout all districts of Kerala were generated and mapped on a GIS platform, 2) baseline genetic data in the form of barcodes for various populations of mahseers were generated and as many as 50 new sequences deposited in NCBI GenBank, and 3) major threats to the three species of mahseer found in Kerala were identified and mapped.

KUFOS AIDED RESEARCH PROJECTS (KARP)

1. *Improving fish viral infection tolerance by targeting cellular inflammation through anti-inflammatory nutraceuticals: a pilot study*

PI	: Dr. Rahul Krishnan, Assistant Professor
Fund allotted (INR)	: Rs 2.0 Lakhs

Objective

- In vitro determination of EC50 and CC50 of Quercetin, Epigallocatechin gallate, and Curcumin on Nile tilapia and Asian seabass cell lines
- In vitro anti-inflammatory activity analysis of quercetin, epigallocatechin gallate, and curcumin upon TiLV and RSIV infection in cell lines.
- In vitro analysis of the best compounds to identify synergetic effects.

Methodology Proposed

Objective 1: In vitro determination of EC50 and CC50 of Quercetin, Epigallocatechin gallate, and Curcumin on Nile tilapia and Asian seabass cell lines. Cytotoxicity of the flavonoid compounds will be accessed by MTT assay, and the 50% cytotoxicity concentration (CC50) will be derived. Antiviral activity against the TiLV and RSIV will be determined using three different assays: MTT cell viability; viral replication kinetics by qPCR. The EC50 will be defined as the effective drug concentration that reduced viral titers (in culture supernatants of infected cells) to 50%, when compared with those of virus controls.

Objective 2: In vitro anti-inflammatory activity analysis of quercetin, epigallocatechin gallate, and curcumin upon TiLV and RSIV infection in cell lines. To access the anti-inflammatory activity in cell lines infected with viruses, cells will be infected with TiLV and RSIV with or without the EC50 concentrations of Quercetin, Epigallocatechin gallate, and Curcumin. Parameters evaluated for the inflammatory responses includes ROS production by H2DCFDA fluorometric assay, cyclooxygenase activity colorimetric assay, NF-κB reporter luminometric assay, nitric oxide assay and transcriptional analysis of Caspase-1, iNOS, IFN-γ, TNF-α, IL-1β, and IL-6 by quantitative real time PCR. Antiviral responses will be analyzed using interferon sensitivity assay, viral copy number estimation, and transcriptional analysis of IFN-1, Mx and ISG-15 by quantitative real time PCR.For finding the synergistic effects of the compounds in ameliorating inflammatory response, 0.5 EC50 and EC50 concentrations compounds will be tested in pair on the cells to find the best combination in reducing inflammation and enhancing antiviral response using assays described in objective 2.

Expected Outcome: The proposed study will identify the best possible combination of anti-inflammatory nutraceuticals to improve tolerance towards TiLV and RSIV infection in Nile tilapia and Asian seabass. The outcome of the in vitro results can be directly translated into field evaluation. Besides developing an antiviral strategy, improving tolerance to support the host physiology and antiviral immune mechanisms will greatly benefit the aquafarmers in reducing mortality associated economic setbacks. This work constitutes only a pilot evaluation, however, further studies on the pharmacology and mechanisms of anti-inflammatory activities are warranted.

2. *Genetic monitoring of selected fish hatcheries across Kerala*

PI : Rameez Roshan, P.M, Assistant Professor
Fund allotted (INR) : 2 Lakh Rupees

Objective

- To survey the current genetic management practices in selected hatcheries
- To determine the effective population size at selected hatcheries
- To estimate the inbreeding based on the effective population size
- To determine the cumulative inbreeding rate based on multiple year data
- To develop statistical model to predict inbreeding
- To conduct the genetic study of selected hatchery stocks using selected molecular markers

Methodology Proposed

- Survey of hatcheries to collect demographic data to find out the number of fish used to produce offspring in each generation
- Calculation of genetic size of various hatchery populations from the number of fish used to produce offspring in each generation
- Calculation of population average inbreeding coefficients using effective genetic size for each hatcheries
- Calculation of accumulated inbreeding in the hatchery population over generations
- Estimation of suitable parameters to fit suitable model to predict the future inbreeding values
- Collection of fin clip from brooders for DNA isolation
- Isolation of total genomic DNA
- PCR amplification of suitable DNA marker
- Sequencing of amplified DNA marker for genotyping

- Molecular data analysis

Expected Outcome: The goal of this project is to monitor the overall genetic health of the selected hatchery stocks based on the demographic and molecular data. The result from this study will be useful to develop a framework for genetic management of the selected hatcheries. Genetic management of hatcheries is essential to keep inbreeding at minimum, to prevent accumulation of inbreeding and thereby possible inbreeding depression.

3. *Siltation and tranquility study of Chellanam harbour breakwater*

PI : Dr. Athul Krishna K R, Assistant Professor
Fund allotted (INR) : 2 Lakh Rupees

Objective

- To simulate the hydrodynamic processes at the harbour using the numerical modelling application.
- To quantify the accretion/erosion occurring on the harbour's current breakwaters' sides.
- To identify the best tranquil condition by model prediction

Methodology Proposed: Two-dimensional numerical models are set for the study area to understand the morphological behaviour of the harbour. The domain boundary will be created from satellite imagery. input files for the model are prepared from measured & secondary data. Using the input files, a flow-wave coupled model will be set up. The model will be calibrated for tide, wave, and morphological changes. Measured data will be used for validating the model. The validated model will run for one year to study the siltation and tranquillity of Chellanam harbour. As a one-year run is tedious and not so practical, a HPC (High Performance Computing) can be used to shorten the data-processing time.

The following step-by-step procedure showcases the numerical analysis part involved in the research:

- Data collection (Wave data)
- Land boundary creation from Satellite Images
- Bathymetry Creation using RGFGRID andFeeding Bathymetry to QUICKIN
- Sediment, wave, Tide, and current analysis using the (Flow+Wave) module
- Model setup and model calibration using satellite data & field observations
- Identifying the siltation rate and tranquility condition of harbour.

Expected Outcome

- The present siltation trend in the area of interest can be obtained
- The possible erosion/accretion trend in the area of interest can be obtained
- The effect of siltation after the widening of harbour mouth/entrance can be estimated
- The harbour tranquility conditions can be addressed.

POST- DOCTORAL RESEARCH

EXTERNAL FUNDED

Sustainable use of blue carbon from the mangroves in relation to climate change mitigation for the state of Kerala

PI : Dr. Rani Varghese
Mentor : Dr. Girish Gopinath, Professor
Funding : Kerala State Higher Education Council (KSHEC)
Budget : Fellowship- 50000.00/- month. Contingent Grant- 200000.00/ year
Duration : 2 years (2022-24)

Objective

- To find out hot spots of mangrove habitats with high carbon sequestration potential and habitats which need carbon sequestration enhancement
- To assess different drivers influencing the soil carbon burial mechanism
- To check the change in Soil C stock by introducing/changing the different drivers of carbon sequestration to the ecosystem in the field
- To develop strategies for carbon sequestration enhancement

Methodology Proposed: The structural analysis of the selected mangrove habitats of our state and biomass stock assessment will be done according to Kauffman & Donato (2012). Soil carbon burial rate or sequestration rate was assessed according to Anderson et al., 1988.Short-lived radioisotope geochronologies, based on excess ^{210}Pb ($^{210}Pb_{xs}$) were used to establish mass accumulation rates following methods described in Brooks et al. (2015), Schwing et al. (2017) and Larson et al. (2018). A portion of the core sediment samples were then analysed for total carbon using instrumental method. The carbon source in each interval of the core will be analysed on IRMS for $\delta^{13}C$ and $\delta^{15}N$ stable isotope ratio. Based on the results of carbon sequestration potential of mangrove habitats in different geomorphological settings, sequestration enhancement strategies will be planned for habitats with low sequestration potential. Through the change in topography, and introduction of crabs into the mangrove ecosystem, the change in soil carbon stock will be checked in selected mangrove habitats and thereby carbon sequestration enhancement will be possible in the future.

Expected Outcome: The study will give an estimate of biomass carbon stock of mangroves of the state and soil carbon sequestration potential of selected mangrove habitats of the state. This carbon stock estimation will directly depict the CO_2 equivalents or CO_2 removal potential of existing mangrove habitats of the state. This data can be extrapolated to predict the CO_2 reduction from the atmosphere through mangrove conservation and restoration programmes. Thus, by mangrove restoration programmes, the carbon sink capacity could be used in climate change mitigation. Since the research is proposed to check the enhancement of natural carbon sink potential of mangrove habitats, it could add carbon credits of our state in future and can be included in climate change policy making in national and regional level.

The outcome of the study could be best utilised in scientific management and conservation of mangroves in our state and could be included in Rebuild Kerala Plans and the research can be collaborated with various conservation strategies of our state even in the research period and in future.

Nanoemulsion of Coriandrum sativum oil and Asparagus racemosus to improve fish health and disease resistance: an alternate strategy to reduce antibiotic use in aquaculture

PI : Dr. Vineetha V.P.
Mentor : Dr. Devika Pillai, Professor
Funding : Kerala State Higher Education Council (KSHEC)
Budget : 22 Lakh
Duration : 2 years (2023-25)

Objectives

- Preparation, characterization, and standardization of *Coriandrum sativum* oil (CSO)-*Asparagus racemosus extract* (ARE) nanoemulsion
- Acute toxicity evaluation of CSO-ARE nanoemulsion supplemented feed and in exposure water in Nile tilapia.
- Long-term feeding and exposure study in Nile tilapia with CSO-ARE nanoemulsion to find its effect on growth promotion, immune response, and disease resistance against pathogen
- CSO-ARE product development and technology transfer

Research Problem: The aquaculture industry contributes significantly to the livelihood of many households in Kerala, and many farmers resort to antibiotics to combat infectious diseases that threaten production. Unfortunately, this contributes to the development of drug-resistant pathogens. The presence of AMR bacteria in aquafarms may decrease production as the fish's immune system gets affected, making it susceptible to new diseases.

Work Done: Emulsion preparation, characterization, and standardization
Achievements: A stable emulsion could be formulated
Work to be done

- Acute toxicity evaluation of CSO-ARE nanoemulsion supplemented feed and in exposure water in Nile tilapia.
- Long-term feeding and exposure study in Nile tilapia with CSO-ARE nanoemulsion to find its effect on growth promotion, immune response, and disease resistance against pathogen
- CSO-ARE product development and technology transfer

Genetic Diversity of Mangrove Rhizophora mucronata and the divergence of associated Microbiome to Better Understand, Protect, and Rehabilitate Mangrove Ecosystems

PI : Dr.Neema Job
Mentor : Dr. Nevin.K.G, Assistant Professor
Funding : Ujjwal PDF, Directorate of Environment & Climate change
Budget : 18,79,800/-
Duration : 3 years

Objectives

- Screening of SSR markers and analysis of genetic diversity in Rhizophora mucronata within the south west coast region of India.
- Biodiversity of microbial community within mangrove tree species.
- Exploiting the potential of mangrove-associated microbes to mitigate environmental impacts

Methodology Proposed: Population sampling from native mangrove forest was undergoing. Leaf samples of *Rhizophora mucronata* was collected from northern, and central parts of natural mangrove vegetations of Kerala (Kasargod, Kannur and Ernakulam). DNA was extracted from 100 mg of young leaves comprising 20 trees of *Rhizophora mucronata* from each geographical location. Twelve SSR loci was amplified using PCR (Shinmura et al., 2012; Wee et al., 2013). The similarity between the different samples were analyzed using NTSYS-pc Numerical Taxonomy and Multivariate Analysis System Version 2.10e. The binary data is been added manually to the software using NTedit 2.0 and saved. Then, the similarity matrix was generated using by SM Coefficient. From the similarity matrix generated, a phylogentic tree is constructed using UPGMA (unweighted pair group method with arithmetic mean); (Sokal and Michener 1958). The entities are grouped based on the similarities by using the similarity matrix as a input. Genetic diversity analysis was performed the using NTSYS-pc Numerical Taxonomy and Multivariate Analysis System Version 2.10e. The genetic distances were calculated with coefficient of NEI72 by NTSYS software. The UPGMA (unweighted pair group method analysis) tree-plot was generated based on the genetic distances calculated with coefficient of NEI72 by NTSYS software. Principal Coordinates Analysis (PCoA) was employed to explore patterns of similarity or dissimilarity among samples or individuals based on pair wise distance or dissimilarity matrices. The PCoA analysis was carried out using PAST software. To screen the biodiversity of microbial flora, a culture independent method by Whole genome Meta sequencing of sediment sample from Ernakulam region was carried out.

Expected outcome: SSR marker can be effectively utilized to clearly delineates the genetic diversity of *R.mucronata* within each geographic locations. Within this central region, a clear differentiation in genetic constitution of mangrove population from Mangalavam region (9.996211°N 76.272046°E) was noticed during the study. Thus, Whole metagenome sequence analysis of sediment samples from each eco protective zone clearly distinguishes the taxonomic distribution, and functional analysis of microbial communities, thereby helping to understand the underlying mechanisms in habitat loss and destruction, so that we can take preventive measures in the restoration of mangrove species and their ecological habitats. So exclusive extension activities, including alliance with local conservation and government organizations along with other non-government organizations will help to propagate the seedlings of *Rhizophora* sp., will add on the current efforts to conserve and restore mangroves thereby improving coastal management and support government bodies.

Quantification of methane emission and its fluctuations under the influence of environmental variables from the selected wetlands of Kerala

PI : Dr.Resmi. P
Mentor : Dr.Anu Gopinath, Associate Professor
Funding : Ujjwal PDF, Directorate of Environment & Climate change
Budget : 18,79,800/-
Duration : 3 years

Objectives: The evaluation of methane emissions from the wetlands of Kerala very limited in the literature. So, the objectives of the present study are to

- Analyse the amount of methane emission from the selected wetlands of Kerala
- Calculate the changes in the methane emission by the environmental parameters

Methodology Proposed: Samples for the proposed study will be collected from the selected wetlands such as mangrove ecosystems and paddy fields. The water and sediment samples will be collected from the selected mangroves ecosystemsin Kerala and Kole wetlands of Thrissur. Sediment samples will be collected using a Van Veen grab (0.042 m^2). The water samples were analysed following methods suggested by

Grasshoff, 1999 and APHA, 1999. General water quality parameters such as salinity, DO, hardness, alkalinity, nitrite, nitrate, phosphate, ammonia and silicate will be analysed. Sediment analysis will be carried out according to standard methods (Radojevic et al., 1999; Mudroch et al., 1996). General sedimentary parameters such as total carbon, nitrogen, texture, TP and exchangeable nutrients will be analysed. Water samples for methane will be collected in screw capped glass bottles with septum and were preserved with 3.5% $HgCl_2$ solution to inhibit methane oxidation (Utsumi et al., 1998). Equilibrated helium samples can be analysed for methane using gas chromatography. The uppermost 5 cm of the sediment for methane analysis can be retrieved from sediment cores and will be collected in screw capped glass bottles. The sediment will be stored at 4 ^{0}C in the dark. CH_4 concentrations can be analysed using gas chromatography with flame ionization detection (GC-FID).

Expected Outcome: Methane is a potent greenhouse gas with warming potential more than 26 times greater that of CO2 (Lelieveld et al., 1993) and have an atmospheric residence time of 12 years (IPCC 2011). Hence controlling methane is regarded as the single most potent way to combat global warming in short term. One of the lasting successes of the recently concluded 2021 United Nations Climate Change Conference (COP26) was the consensus arrived on the proposals of reduction of methane gas emission. The evaluation of methane emissions from the wetlands of Kerala is very limited in the literature. So, the aim of the present study is to determine the amount of methane emission from the selected wetlands of Kerala. The study also aims to estimate the changes in the methane emission by the environmental parameters.

Response studies on bivalves due to harmful algal exposure in the coastal waters of Malabar, Kerala

PI : Dr. Minu P
Mentor : Dr. Prabhakaran M P , Assistant Professor
Funding : KSCSTE-Back to Lab
Budget : Rs.13,38,000/-
Duration : 2 years

Objectives

- To understand the Physico-chemical drivers that trigger harmful phytoplankton blooms in coastal waters of the Malabar coast.
- To understand the post-bloom changes occurring in the tissue of edible bivalves.
- To understand the impact of toxic algal blooms on the edible bivalve beds.
- To assess the presence of domoic acid, paralytic shellfish toxins, tetrodotoxin and lipophilic toxins in edible bivalves.
- To contribute to the global ocean colour monitoring of Harmful algal blooms

Methodology and work progress: Hydrographic parameters: Regular monitoring were carried out prior to the occurrence of harmful algal blooms as well as during and after the incidence of bloom. Water and plankton samples collected from five locations. water temperature, pH, salinity was measured along with nutrients such as silicate, phosphate, nitrate, nitrite and ammonia. Qualitative and quantitative analysis of phytoplankton carried out.

Post-bloom changes in bivalves: Edible bivalves sampled to understand the histological changes in tissue during the pre and post-bloom.

Assessment of toxins in bivalves: Bivalve tissue homogenized and sub-samples were taken for the extraction. Ocean colour monitoring of blooms: To contribute to the global Harmful algal blooms (GHAB), in-situ bio-optical studies carried out along the five stations. This includes absorption by particulate matter, absorption by detrital matter, and absorption by phytoplankton, absorption by CDOM and chlorophyll concentration.

Nano and microplastics prevalence as source of trace metals: a tropical - polar evaluation

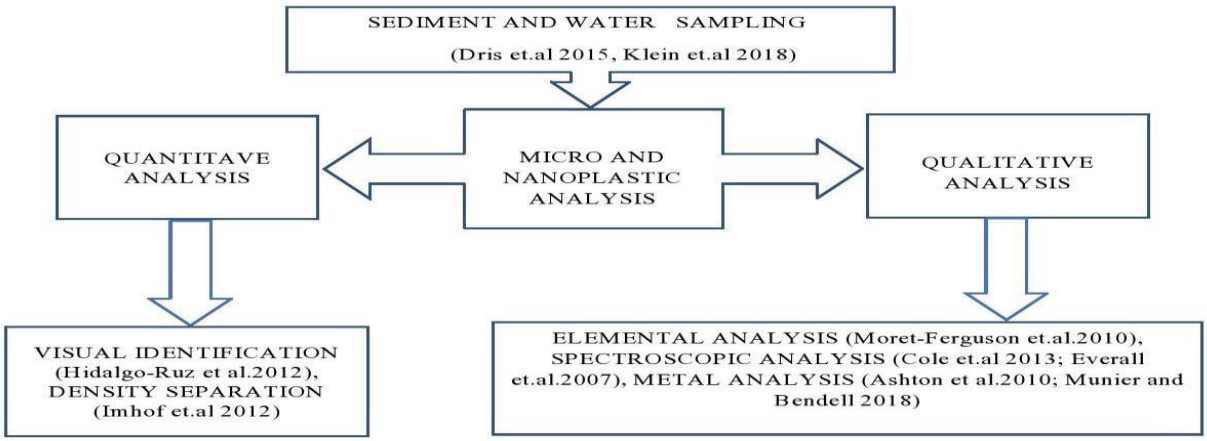
PI : Dr. Manju P Nair
Mentor : Dr. Anu Gopinath, Associate Professor
Funding : KSCSTE
Budget : Rs.14,17,200/-
Duration : 3 years (2021-24)

Objectives

- Quantitative and qualitative determination of micro and nanoplastics in the water and sediment samples from the selected stations of tropical and polar regions.
- Trace metal quantification in the water and sediments of the tropical and polar regions.
- Evaluation of micro and nanoplastics as a scavenger of trace metals from the study areas.

Methodology Proposed

Figure 1: Sampling and analysis



Expected Outcome: Micro and nanoplastics can act as a point source of trace metals in the ecosystem. Water and Sediment quality of the selected transects may exhibit vivid characteristics of the micro and nano plastics. The quantitative and qualitative determination of micro and nanoplastics brings out the status of plastic pollution and its pseudo action in the study area. More over the trace metal identification in the micro and nanoplastics shows the carrier capacity of these plastics. The trace metal scavenging capacity of micro and nanoplastic will lead to lethal effect to the ecosystem due to enhanced trace metal magnification in the food web. Comparison of micro and nanoplastic between the tropical and Polar Regions will reveal the mechanism of plastic intensification in the aquatic system. Outcomes include publications in referred journals and paper presentations. Three international papers and one internationalbook chapter published. Six papers presented in various international and national conferences.

RESEARCH STUDENTS- PhD PROGRAMME

Doctoral degree programme is conducted under four faculties namely, Faculty of Fisheries Science (FFS), Faculty of Fisheries Management (FFM), Faculty of Fishery Engineering (FFE), and Faculty of Ocean Science and Technology (FOST). A total of 447 students have registered in different faculties for programs leading to Ph.D., and 62 students have been awarded the Doctoral degree.

KUFOS has 188 research guides for facilitating research leading to Ph.D. with 41 of them from KUFOS and the remaining 147 from the Approved Research Centres.

APPROVED RESEARCH CENTERS

KUFOS has 14 approved research centres for facilitating research in areas coming under the mandate of the university. Research is undertaken at these centres by the students registered with KUFOS.

S.No.	**Centers**	No. of Ph.D. guides
1	Central Institute of Fisheries Technology (CIFT), Kochi	31
2	Centre for Marine Living Resources and Ecology (CMLRE), Kochi	06
3	Central Institute of Fisheries Nautical and Engineering Training (CIFNET), Kochi	
4	Central Marine Fisheries Research Institute (CMFRI), Kochi	31
5	Govt. Law College, Ernakulam (Maritime Law)	02
6	Indian National Centre for Ocean Information Service (INCOIS), Hyderabad	20
7	National Bureau of Fish Genetic Resources (NBFGR), Kochi.	17
8	Indian Institute of Spices Research (IISR), Kozhikode.	06
9	Nansen Environmental Research Centre India (NERCI), Kochi	03
10	Sree Narayana Gurukulam College of Engineering (SNGCE), Kadayiruppu, Ernakulam	04
11	Holy Grace Academy of Management Studies, Thrissur.	05
12	Naipunya Business School, Thrissur.	04
13	St. Albert's College, Ernakulam (Department of Fisheries and Aquaculture & Department of Management)	07
14	Leads College of Management, Palakkad.	05
15	Centre for Water Resources Development and Management (CWRDM)	06

LIST OF PUBLICATIONS

JOURNAL PAPERS

1. Achu, A. L., Thomas, J., Aju, C. D., Remani, P. K., & Gopinath, G. (2023). Performance evaluation of machine learning and statistical techniques for modelling landslide susceptibility with limited field data. *Earth Science Informatics*, *16*(1), 1025-1039.

2. George, K. A., Sunil, P. S., Anish, A. U., Gopinath, G., & Mini, V. K. (2023). A Pilot Assessment of the Fatal Landslide on 29 August 2022 in Kudayathoor, Idukki, Kerala.

3. Gopi, A., TA, K., KV, D., VM, S., KC, S., K, J., ... & GB, S. (2023). Range Extension and New Occurrence of Yellowfin Toadfish Colletteichthys flavipinnis from Arabian Sea and First Report from Tropical Estuarine Wetland. *Thalassas: An International Journal of Marine Sciences*, *39*(1), 419-424.

4. Raj, B. M., & Sajeevan, M. K. (2023). Length-weight relationship of three deep sea fishes from the south coast of India. *Journal of Experimental Zoology India*, *26*(1).

5. Sreeraj, C. R., Sheethal, K. S., Sanu Sharbin, K. M., Sen, A., & Limna Mol, V. P. (2023). First Report on the Occurrence of Five Mangrove-Associated Fishes from Kerala, India. *Thalassas: An International Journal of Marine Sciences*, *39*(2), 1187-1198.

6. MC, C., & Sajeevan, M. K. (2023). Taxonomic validation on the occurrence of crested hairtail, Tentoriceps cristatus (Klunzinger, 1884) (Perciformes: Trichiuridae) in the Indian waters using morphological and molecular characterization. *Journal of Experimental Zoology India*, *26*(1).

7. Das, S., Pradhan, C., & Pillai, D. (2023). Dietary coriander (*Coriandrum sativum L*) oil improves antioxidant and anti-inflammatory activity, innate immune responses and resistance to Aeromonas hydrophila in Nile tilapia (*Oreochromis niloticus*). *Fish & Shellfish Immunology*, *132*, 108486.

8. Sreeraj CR, Sreelakshmi S, Haripriya TD, Nazar H, Mol VPL. First documentation of the Camptandriine crab *Baruna socialis* Stebbing, 1904 in the Arabian Sea from the mangroves of Kerala. Species 2023; 24: e80s1589 doi: https://doi.org/10.54905/disssi.v24i74.e80s1589

9. Ramvilas, G., Alderslade, P., & Ranjeet, K. (2023). The taxonomy of Indian gorgonians: an assessment of the descriptive records of gorgonians (*Anthozoa: Octocorallia: Alcyonacea*) recorded as occurring in the territorial waters of India, along with neighbouring regions and the Andaman and Nicobar Islands, and the highlighting of perceived unethical practice. *Zootaxa*, *5236*(1), 1-124.

10. Gopinath, G., Thodi, M. F. C., Surendran, U. P., Prem, P., Parambil, J. N., Alataway, A., & Mattar, M. A. (2023). Long-Term Shoreline and Islands Change Detection with Digital Shoreline Analysis Using RS Data and GIS. *Water*, *15*(2), 244.

11. Maqbool, H., Abubacker, Z., Safeena, M. P., Azhar, M., & Joshy, C. G. (2023). The combined effect of beetroot peel extract, chilling, and vacuum packaging on the shelf-life of deccan mahseer (Tor khudree) steaks. *Journal of Aquatic Food Product Technology*, *32*(1), 1-12.

12. Alnashiri, H., Thomas, L., Thaikkottathil, M., Philip, S., Kutty, R., Sivanpillai, S., & Abo Rasain, A. M. (2023). Phylogenetic Affinities of Acanthopleurinae Dall, 1889 Chitons (*Mollusca: Polyplacophora: Chitonidae*) from Jazan Coast in the Red Sea and Western Indo-Pacific. *Journal of Marine Science and Engineering*, *11*(1), 158.

13. James, G., Prasannan Geetha, P., Thavarool Puthiyedathu, S., & Vattringal Jayadradhan, R. K. (2023). Applications of Actinobacteria in aquaculture: prospects and challenges. *3 Biotech*, *13*(2), 42.

14. Job, N., Chandran, A. A., Augustine, A., Palliyalli, R. P., & Nevin, K. G. (2023). *Sargassum wightii Greville ex J. Agardh Grevilli* Extract with Macromolecular Protection Activity In Vitro: Prospecting for Novel Drug Leads Using GC-MS Based Metabolic Profiling. *International Journal*

on Algae, *25*(3).

15. Roshni, K., Renjithkumar, C. R., Sreekanth, G. B., Raghavan, R., & Ranjeet, K. (2023). Fish community structure and functional guild composition in a large tropical estuary (Vembanad Lake, India). *Environmental Science and Pollution Research*, *30*(11), 29635-29662.

16. Shalu, K., Thomas, L., Ramvilas, G., Shabeena, K. S., Philip, S., Sureshkumar, S., ... & Ranjeet, K. (2023). DNA barcodes for the pipefish genus *Corythoichthys* (*Actinopterygii: Syngnathiformes*) from the Indian Ocean provide insights into cryptic diversity. *Journal of Fish Biology*, *102*(3), 680-688.

17. Keerthika, K., Padmavathy, P., Rani, V., Jeyashakila, R., Aanand, S., Kutty, R., ... & Subash, P. (2023). Microplastics accumulation in pelagic and benthic species along the Thoothukudi coast, South Tamil Nadu, India. *Marine Pollution Bulletin*, *189*, 114735.

18. Kiranya, B., Sahadevan, P., Raghavan, R., & Sreekanth, G. B. (2023). Fish communities reveal the ecological quality of a small, temporarily closed tropical estuary in response to natural and anthropogenic interventions. *Marine Biodiversity*, *53*(3), 46.

19. Kumar, A. A., PH, A. A., & Giri Bhavan, S. (2023). A comprehensive record of the fishery resources of a tropical Ramsar wetland: Ashtamudi Estuary, India. *Marine Biodiversity*, *53*(4), 52.

20. Kumar, A. A., PH, A. A., & Bhavan, S. G. (2023). Finfish fishery of Ashtamudi Estuary, India-A Ramsar site of International significance. *Regional Studies in Marine Science*, *64*, 103020.

21. Kumar, A. A., Ph, A. A., & Sreekanth, G. B. (2023). Fish assemblage and guild structure in the Ashtamudi Estuary, a tropical Ramsar site in India. *Journal of Environmental Management*, *334*, 117401.

22. Nair, M. P., John, P. M., Nikhil, V. G., Gireesh, R., Sanjeevan, V. N., & Gopinath, A. (2024). Microplastics Records from the Southern Ocean Sediments. Soil and Sediment Contamination: An International Journal, 33(5), 526-542.

23. Dahanukar, N., Sundar, R. L., Rangad, D., Proudlove, G., & Raghavan, R. (2023). The world's largest cave fish from Meghalaya, Northeast India, is a new species, *Neolissochilus pnar (Cyprinidae, Torinae*). *Vertebrate Zoology*, *73*, 141-152.

24. Nikhil, V. G., Ranjeet, K., & Varghese, G. K. (2023). Spatio-temporal evaluation and risk assessment of microplastics in nearshore surface waters post-2018 Kerala deluge along the southwest coast of India. *Marine Pollution Bulletin*, *192*, 115058.

25. Nimsi, K. A., Manjusha, K., Kathiresan, K., & Arya, H. (2023). Plant growth-promoting yeasts (PGPY), the latest entrant for use in sustainable agriculture: a review. *Journal of Applied Microbiology*, *134*(2), lxac088.

26. Gayathri, P. V., Nair, D., Gopinath, G., Pilla, D., & Joseph, S. (2023). Solar photocatalysis for the decontamination of water from emerging pharmaceutical pollutant chloroquine using nano ZnO as the catalyst. *Water, Air, & Soil Pollution*, *234*(3), 146.

27. Parvathy, A. J., Das, B. C., Jifiriya, M. J., Varghese, T., Pillai, D., & Rejish Kumar, V. J. (2023). Ammonia induced toxico-physiological responses in fish and management interventions. *Reviews in Aquaculture*, *15*(2), 452-479.

28. Prabina, D., Swaminathan, T. R., Mohandas, S. P., Anjana, J. C., Manjusha, K., & Preena, P. G. (2023). Investigation of antibiotic-resistant vibrios associated with shrimp (*Penaeus vannamei*) farms. *Archives of Microbiology*, *205*(1), 41.

29. Raghavan, R., Sundar, R. L., Arjun, C. P., Britz, R., & Dahanukar, N. (2023). Evolution in the dark: Unexpected genetic diversity and morphological stasis in the blind, aquifer-dwelling catfish Horaglanis. *Vertebrate Zoology*, *73*, 57-74.

30. Radhalakshmi, V., Raman, M., & Joy, M. R. (2023). Physico-chemical characterization of betel leaf and its effect on oxidative stability and shelf-life of coconut oil. *Food Bioscience*, *52*, 102343.

31. Ratnakaran, A. P., & Abish, B. (2023). Role of warm ocean conditions in the genesis and rapid

intensification of tropical cyclone 'Tauktae'along the west coast of India. *Theoretical and Applied Climatology*, *153*(1), 417-430.

32. Nair, R. R., John, K. R., Krishnan, R., Gopi, A., & Safeena, M. P. (2024). PCR detection and phylogenetic analysis of the major capsid protein gene of Lymphocystis disease virus from cultured Asian seabass (Lates calcarife r Bloch, 1790) along the west coast of Kerala, India. *Aquaculture International*, *32*(2), 1041-1049.

33. Nair, R. R., Safeena, M. P., Benny, A. R., Rai, P., & Pillai, D. Incidence, virulence potential and antibiotic susceptibility of Vibrio parahaemolyticus associated with traditional shrimp culture systems of Ernakulam, Kerala.

34. Roshnath, R., Nisha, P. V., & Ali, A. Ichthyofaunal diversity of the Kattampally wetlands, Kannur and conservation challenges.

35. Sandra, S. M., Sreekanth, G. B., & Ranjeet, K. (2023). Trophic fingerprinting of a pristine but rapidly deteriorating downstream region of a Western Ghats River. *Environmental Monitoring and Assessment*, *195*(8), 1008.

36. Patel, S., Shyni, K., Safeena, M. P., & Vijayan, A. (2023). Formulation and optimization of soup powder from Skipjack tuna (*Katsuwonus pelamis*). *Journal of Experimental Zoology India*, *26*(2).

37. Pillai, D., & Kalasseril, S. G. (2022). Genetic diversity and prevalence of extended spectrum beta-lactamase producing *Escherichia coli* and *Klebsiella pneumoniae* in aquatic environment receiving untreated hospital effluents.

38. Sreekanath GB, Amritha Priya, Karthika B. and Pramila S., 2022. Stakeholder responses on biodiversity and ecosystem uses of Chettuva – a small tropical Indian Estuary. *Journal of the Andaman Science Association*, 27(1): 20-25.

39. Bhavan, S. G., Mujawar, S., Haragi, S., Rathod, J., Ingole, B., Mayekar, T., ... & Kumar, P. (2023). A multi-metric fish index to measure the ecological quality of tropical predominantly open estuaries along the western coast of India. *Environmental Monitoring and Assessment*, *195*(3), 421.

40. Surendran, U., Jayakumar, M., Raja, P., Gopinath, G., & Chellam, P. V. (2023). Microplastics in terrestrial ecosystem: Sources and migration in soil environment. *Chemosphere*, *318*, 137946.

41. Behera, S. S., KRISHNAMOORTHY, E., MP, S., & Mathew, S. (2023). Protein Isolate from Brown Seaweed, *Sargassum tenerrimum*: Extraction and Characterization.

42. Mar, A. P. I. E. (2022). Valorisation of Seaweed Waste from Agar Processing Industry.

43. Manjusha K, Nefla N, Nimsi K A, Sreedevi N K, Aneymol VS. 2023. A Comparitive study on the diversity of marine yeasts associated with sediment and water sample of two mangroves in Kochi, Kerala, India. Journal of Aquatic Biology & Fisheries. 11(S1). pp. 28-34.

44. Nimsi, K. A., Manjusha, K., & Krupesh, C. K. (2023). Diversity and hydrolytic potentials of manglicolous yeasts associated with mangrove trees Rhizophora and Avicennia found in Kerala, India. *Journal of Aquatic Biology & Fisheries*, *11*(S1), 1-7.

45. Vishnu, A. S., Lal, M., Tharian, J. C., Prabhakaran, M. P., & Ali, P. A. (2023). Diversity, distribution, and conservation status of fish species in Kallar Stream, Achankovil River, Western Ghats of Kerala, India. *Journal of Threatened Taxa*, *15*(5), 23164-23189.

46. Gayathri, P. V., Rayaroth, M. P., Aravindakumar, C. T., Pillai, D., & Joseph, S. (2023). Sunlight-Induced decontamination of water from emerging pharmaceutical pollutants using ZnO nanoparticles. *Chemosphere*, *343*, 140265.

47. Girijan, S. K., Pillai, D., & Devika, R. (2023). Complete genome sequence analysis of multi-drug resistant *Klebsiella pneumoniae* THK strain isolated from aquaculture farm in Kerala, India. *3 Biotech*, *13*(12), 394.

48. Suresh, K., Pillai, D., Soman, M., Sreenivas, A., & Paul, R. (2023). Isolation and identification of antimicrobial susceptibility, biofilm formation, efflux pump activity, and virulence determinants in multi-drug resistant *Pseudomonas aeruginosa* isolated from freshwater

fishes. *Journal of Water and Health*, *21*(12), 1858-1870.

49. Padhiary, S., Paul, A., Tripathy, D. K., Nayak, D., Mohanty, J., Pillai, D., ... & Sahoo, P. K. (2023). Current understanding of Cyprinid herpesvirus 2, and prospects in its management. *Indian J Anim Health*, *62*(2), 49-60.

50. Ramakrishnan, G. S., Pradhan, C., Singh, A. K., Das, S., Pillai, D., & Mohanta, K. N. (2023). Effect of alpha-ketoglutarate supplementation on growth, antioxidant capacity, gene expression and amino acid profile in Nile tilapia (*Oreochromis niloticus*) under varying protein diets. *Animal Feed Science and Technology*, *306*, 115808.

51. Vineetha, V. P., Tejaswi, H. N., Sooraj, N. S., Das, S., & Pillai, D. (2024). Implications of deltamethrin on hematology, cardiac pathology, and gene expression in Nile tilapia (*Oreochromis niloticus*) and its possible amelioration with Shatavari (*Asparagus racemosus*). *Veterinary Research Communications*, *48*(2), 811-826.

52. Sooraj, N. S., Vineetha, V. P., Sagar, S., Tejaswi, H. N., & Pillai, D. (2023). Variations in biomarkers at different biological levels in the wild fish species *Arius subrostratus* (Vallenciennes, 1840) from a polyaromatic hydrocarbon (PAH) contaminated estuary in India. *Regional Studies in Marine Science*, *68*, 103254.

53. Nambiar, S. P., Banuru, S. C., Vahab, R. A., Ittoop, G., Nair, S. N., & Pillai, D. (2024). Augmentation of the anesthetic potency of clove oil for immersion anesthesia in fishes. *Aquaculture International*, 32(3), 2599-2607.

54. Das, S., Pradhan, C., Singh, A. K., Vineetha, V. P., & Pillai, D. (2023). Dietary coriander (*Coriandrum sativum L*) oil improves growth, nutrient utilization, antioxidant status, tissue histomorphology and reduces omega-3 fatty acid production in Nile tilapia (*Oreochromis niloticus*). *Animal Feed Science and Technology*, *305*, 115774.

55. Das, B. C., Gorakh, S. S., Pillai, D., & Jayadradhan, R. K. V. (2023). Sub-chronic exposure of *Oreochromis niloticus* to environmentally relevant concentrations of smaller microplastics: Accumulation and toxico-physiological responses. *Journal of Hazardous Materials*, *458*, 131916.

56. Suresh, K., & Pillai, D. (2023). Prevalence and characterization of virulence-associated genes and antimicrobial resistance in *Aeromonas hydrophila* from freshwater finfish farms in Andhra Pradesh, India. *Biologia*, *78*(10), 2931-2939.

57. Nair, R. R., Safeena, M. P., Benny, A. R., Rai, P., & Pillai, D. Incidence, virulence potential and antibiotic susceptibility of *Vibrio parahaemolyticus* associated with traditional shrimp culture systems of Ernakulam, Kerala.

58. Gayathri, P. V., Joseph, S., Mohan, M., & Pillai, D. (2023). Advanced oxidation processes for the degradation of microplastics from the environment: A review. *Water and Environment Journal*, *37*(4), 686-701.

59. Girijan, S. K., Krishnan, R., Maniyappan, K., & Pillai, D. (2023). Isolation and identification of *Streptococcus agalactiae* in cage-cultured green chromide Etroplus suratensis in Kerala, India. *Diseases of Aquatic Organisms*, *154*, 1-6.

60. Nimsi, K. A., Manjusha, K., Hatha, A. A. M., & Kathiresan, K. (2023). Diversity, distribution, and bioprospecting potentials of manglicolous yeasts: a review. *FEMS Microbiology Ecology*, *99*(5), fiad044.

61. Abinaya, R., & Sajeevan, M. K. (2023). Stock status of kawakawa *Euthynnus affinis* (Cantor, 1849) fishery using surplus production model: An assessment from coastal waters of Tamil Nadu, Bay of Bengal, Southeast coast of India. *Aquaculture and Fisheries*.

62. Abinaya, R., Kanishkar, A., & Sajeevan, M. K. (2023). Observation of fish mortality in the mudflat of Siruthalaikadu Creek, Palk Bay, southeast coast of India.

63. Arjunan, V. M., Sajeevan, M. K., & Anvar, A. P. H. (2023). Broodstock management, induced breeding and the constraints in the larval rearing of an endemic Malabar butter catfish, *Ompok malabaricus* (Valenciennes, 1840). Journal of Aquatic Biology & Fisheries, 11(1), 87-94.

64. Sajeevan, B. M. R. M. Estimation of length at first maturity and sex ratio of three *Gempylidae* (Snake mackerels) species dwelling the south coast of India.

65. Chitra, M. C., & Sajeevan, M. K. An insight into the length at first maturity and sex ratio of four Hairtails from Indian waters.

66. Vishnu, A. S., Lal, M., Tharian, J. C., Prabhakaran, M. P., & Ali, P. A. (2023). Diversity, distribution, and conservation status of fish species in Kallar Stream, Achankovil River, Western Ghats of Kerala, India. *Journal of Threatened Taxa*, *15*(5), 23164-23189.

67. Roshnath, R., Nisha, P. V., & Ali, A. Ichthyofaunal diversity of the Kattampally wetlands, Kannur and conservation challenges.

68. Bella, K., Sahadevan, P., Raghavan, R., Ramteke, K. K., & Sreekanth, G. B. (2023). Trophic functioning of a small, anthropogenically disturbed, tropical estuary. *Marine Environmental Research*, *192*, 106189.

69. Priya, A., Bhavan, S. G., Bella, K., Biji, K., Velayudhan, P. K., Sahadevan, P., ... & Kutty, R. (2023). Delineating the fish-based ecosystem services of a small tropical Indian estuary: Identification, evaluation and management. *Estuarine, Coastal and Shelf Science*, *293*, 108506.

70. Kar, C., Mariyambi, P. C., Raghavan, R., & Sureshkumar, S. (2023). Mitochondrial phylogeny of fusilier fishes (family *Caesionidae*) from the Laccadive archipelago reveals a new species and two new records from the Central Indian Ocean. *Journal of Fish Biology*, *103*(6), 1445-1451.

71. Rajan, R., Durand, J. D., Thomas, L., Sidharthan, A., Rahman, M. A. U., Xavier, B., & Raghavan, R. (2023). Barcoding mullets (Mugilidae): Genetic characterization of exploited species in southern peninsular India. *Diversity*, *15*(12), 1193.

72. Sudasinghe, H., Ranasinghe, T., Dahanukar, N., Raghavan, R., Rüber, L., Pethiyagoda, R., & Meegaskumbura, M. (2023). Biogeography and evolutionary history of *Puntius sensu* lato (Teleostei: Cyprinidae) in Sri Lanka. *Scientific Reports*, *13*(1), 18724.

73. Konhamkakkada, I., Kinattumkara, B., Raghavan, R., & Sivanpillai, S. (2023). A new species of spiny eel of the genus Notacanthus Bloch 1788 (*Notacanthiformes: Notacanthidae*) from the Indian Ocean. *Journal of Fish Biology*, *103*(1), 113-117.

74. Britton, J. R., Lynch, A. J., Bardal, H., Bradbeer, S. J., Coetzee, J. A., Coughlan, N. E., ... & Pritchard, E. G. (2023). Preventing and controlling nonnative species invasions to bend the curve of global freshwater biodiversity loss. *Environmental Reviews*, *31*(2), 310-326.

75. Cooke, S. J., Harrison, I., Thieme, M. L., Landsman, S. J., Birnie-Gauvin, K., Raghavan, R., ... & Hanna, D. E. (2023). Is it a new day for freshwater biodiversity? Reflections on outcomes of the Kunming-Montreal Global Biodiversity Framework. *PLOS Sustainability and Transformation*, *2*(5), e0000065.

76. Lynch, A. J., Cooke, S. J., Arthington, A. H., Baigun, C., Bossenbroek, L., Dickens, C., ... & Jähnig, S. C. (2023). People need freshwater biodiversity. *Wiley Interdisciplinary Reviews: Water*, *10*(3), e1633.

77. Shalu, K., Thomas, L., Ramvilas, G., Shabeena, K. S., Philip, S., Sureshkumar, S., ... & Ranjeet, K. (2023). DNA barcodes for the pipefish genus Corythoichthys (*Actinopterygii: Syngnathiformes*) from the Indian Ocean provide insights into cryptic diversity. *Journal of Fish Biology*, *102*(3), 680-688.

78. Prabhakaran, G. K., Sunkara, M., Raghavan, R., & Umapathy, G. (2023). Development of a species-specific qPCR assay for the detection of invasive African sharptooth catfish (*Clarias gariepinus*) using environmental DNA. *Biological Invasions*, *25*(4), 975-982.

79. Dahanukar, N., Sundar, R. L., Rangad, D., Proudlove, G., & Raghavan, R. (2023). The world's largest cave fish from Meghalaya, Northeast India, is a new species, *Neolissochilus pnar* (Cyprinidae, Torinae). *Vertebrate Zoology*, *73*, 141-152.

80. Hani, P. M., & Jayalakshmi, K. J. (2023). Temporal variation in diversity, abundance and size class structure of planktonic copepods from a tropical estuary. *Aquatic Ecology*, *57*(1), 199-216.

81. Keezhedathu Chandroth, S., Kalarikkal Jayakesan, J., & Giri Bhavan, S. (2023). Fish community structure of two adjacent poorly known permanently open tropical estuaries Valapattanam and Dharmadam from the western coast of India. *Marine Biodiversity*, *53*(4), 56.

82. Swetha, K. C., Jayalakshmi, K. J., Parameswaran, U., & Sreekanth, G. B. (2023). First record of sea urchin *Temnopleurus toreumaticus* (Leske 1778)(*Echinoidea: Temnopleuridae*) from estuaries of west coast of India. *Indian Journal of Ecology*, *50*(5), 1545-1548.

83. Prasenan, P., & Suriyakala, C. D. (2023). Novel modified convolutional neural network and FFA algorithm for fish species classification. Journal of Combinatorial Optimization, 45(1), 16.

84. PM Hani, KJ Jayalakshmi, VF Sanu. 2023. First Record of Calanopia metu Uysal & Shmeleva, 2004, A Mediterranean Calanoid Copepod from Indian Waters. Indian Journal of Ecology (2023) 50(1): 257-261.

85. Radhalakshmi V, Maya Raman & Minnu Rose Joy (2023): Phytochemical profiles, potent antioxidant and antimicrobial activities of betel leaf extracts (Piper betel, Salem Cultivar), Journal of Herbs, Spices & Medicinal Plants, DOI: 10.1080/10496475.2023.2253761.

86. Radhalakshmi, V., Raman, M., & Joy, M. R. (2023). Development of active packaging film based on poly (lactic acid) incorporated with Piper betel leaf ethanolic extract and its application in the shelf-life extension of tuna meat. *International Journal of Biological Macromolecules*, *246*, 125751.

87. Suneela, S. S., Mathew, B., & Sureshkumar, S. (2023). The anomalous weather parameters that lead to the extreme rainfall of Kerala in August 2018. *Meteorology and Atmospheric Physics*, *135*(4), 37.

88. John, D., & Raman, M. (2023). Physicochemical properties, eating and cooking quality and genetic variability: a comparative analysis in selected rice varieties of South India. *Food Production, Processing and Nutrition*, *5*(1), 49.

89. Gayathry, K. S., & John, J. A. (2023). Phenolic profile, antioxidant, and hypoglycaemic potential of pseudostem and inflorescence extracts of three banana cultivars. *Biomass Conversion and Biorefinery*, 1-9.

90. Saleena, P., Jayashree, E., & Anees, K. (2024). A comprehensive review on vacuum impregnation: Mechanism, applications and prospects. *Food and Bioprocess Technology*, *17*(6), 1434-1447.

91. Suresh, K., Pillai, D., Sindhuja, P., & Preethi, A. (2023). Efflux Pump and Biofilm Forming Capabilities of Antibiotic Resistant, *Serratia marcescens* from Freshwater Fish Farms in Andhra Pradesh, India. *Fishery Technology*, *60*, 196-205.

92. Nivas, N., Kaippilly, D., & Gopalakrishnan, A. (2024). Efficacy of different wet feeds on the growth performance of mud crab *Scylla serrata* during fattening in cages. *North American Journal of Aquaculture*, *86*(1), 17-25.

93. Subash, P., Chrisolite, B., Sivasankar, P., George, M. R., Amirtharaj, K. V., Padmavathy, P., ... & Mageshkumar, P. (2023). White feces syndrome in *Penaeus vannamei* is potentially an *Enterocytozoon hepatopenaei* (EHP) associated pathobiome origin of Vibrio spp. *Journal of Invertebrate Pathology*, *198*, 107932.

94. Arunachalam, M., Saravanavel, J., & Joseph Kochuparampil, A. (2023). PCA-based approach for mapping social vulnerability to hazards in the Chennai metropolitan area, east coast of India. Annals of GIS, 29(4), 529-552.

95. Sureshkumar, S., & Idreesbabu, K. K. (2023). Checklist of Sand Perches (Pinguipedidae) in Indian Waters with a New Record of *Parapercis millepunctata* (Günther 1860) from Lakshadweep, India. *Thalassas: An International Journal of Marine Sciences*, *39*(2), 577-585.

96. Kar, C., PC, M., KS, S., & KK, I. (2023). On the Occurrence and DNA Barcoding of Darwin's Slimehead, *Gephyroberyx darwinii* (Johnson, 1866) in the Laccadive Archipelago, Western Indian Ocean. *Thalassas: An International Journal of Marine Sciences*, *39*(2), 1229-1235.

97. Bagde, P. S., Mathew, R., Jose, R., Ranjeet, K., & Nikhil, V. G. (2023). Characteristics and risk assessment of microplastic mediated heavy metal transport in black clam *Villorita cyprinoides* from a Ramsar wetland of South India. *Journal of Hazardous Materials Letters*, *4*, 100092.

98. SS, M., CG, J., & Sebastian, M. (2023). Statistical Models for Estimating Trend and Growth Rate of Shrimp Culture and Production in India.

99. Bhadran, A., Duarah, B. P., Girishbai, D., Raza, M. A., Mero, A., Lahon, S., ... & Gopinath, G. (2024). Soft sediment deformation structures from the Brahmaputra Basin: A window to the eastern Himalayan paleoseismicity and tectonics. *Journal of Asian Earth Sciences*, *259*, 105894.

100. Abinaya, R., & Sajeevan, M. (2022). Stock assessment of sin croaker *Johnius dussumieri* (Cuvier, 1830) fishery by different production model approach from Tamil Nadu, Southeast Coast of India. *Turkish Journal of Fisheries and Aquatic Sciences*, *23*(4).

101. Kodeeswaran, P., Kumar, T. A., & Lal, K. K. (2023). Length-Weight Relationship of Four Species of Deep-Sea Congrid Eel (Congridae) from the Southwest Coast of India, Arabian Sea. *Journal of Ichthyology*, *63*(4), 840-842.

102. Meena, B., Anburajan, L., Aryamol, K., Vinithkumar, N. V., & Dharani, G. (2023). Studies on biodiversity and bioprospecting of active mud volcano associated bacteria and actinobacteria from Baratang, Andaman Islands, India. *Systems Microbiology and Biomanufacturing*, *3*(2), 339-357.

103. Sajidh, C. K., & Chatterjee, A. (2023). Indian Ocean dynamic sea level, its variability and projections in CMIP6 models. *Climate Dynamics*, *61*(5), 2229-2252.

104. Tony, A., Rashmi, V., Anilakumar, K. R., & Semwal, A. D. (2023). Development and Evaluation of Ready to Reconstitute Mushroom Powder Mix as a Potential Functional Food. *Journal of Culinary Science & Technology*, 1-14.

105. Kalita, R., & Lotliker, A. A. (2023). Assessment of satellite-based Net Primary Productivity models in different biogeochemical provinces over the northern Indian Ocean. *International Journal of Remote Sensing*, 1-20.

106. Gayathri, P. V., Joseph, S., Mohan, M., & Pillai, D. (2023). Advanced oxidation processes for the degradation of microplastics from the environment: A review. *Water and Environment Journal*, *37*(4), 686-701.

107. Das, B. C., Gorakh, S. S., Pillai, D., & Jayadradhan, R. K. V. (2023). Sub-chronic exposure of *Oreochromis niloticus* to environmentally relevant concentrations of smaller microplastics: Accumulation and toxico-physiological responses. *Journal of Hazardous Materials*, *458*, 131916.

108. Venkatachalam, S., Gopinath, A., & Krishnan, K. P. (2023). Fjords of the western and northern regions of Svalbard harbour distinct bacterioplankton community structures. *World Journal of Microbiology and Biotechnology*, *39*(2), 57.

109. Madhavan, M., Purushothaman, P., Dhas, D. S., & Kumar, T. T. (2023). First observation of Alpheus soror Bruce, 1999 (Caridea: Alpheidae) from Gulf of Mannar, Southern India with notes on A. lottini Guérin, 1830 [in Guérin, 1829-1830].

110. Kodeeswaran, P., Kumar, T. A., & Lal, K. K. (2023). New Record of the False Pike Conger Eel, *Congrhynchus talabonoides* (Anguilliformes: Congridae) from the Arabian Sea. *Journal of Ichthyology*, *63*(2), 376-381.

111. Aju, C. D., Achu, A. L., Prakash, P., Reghunath, R., & Raicy, M. C. (2023). An integrated groundwater resource management approach for sustainable development in a tropical river basin, southern India. *Environmental Monitoring and Assessment*, *195*(9), 1129.

112. Abisha, C., Kutty, R., Gurjar, U. R., Jaiswar, A. K., Deshmuke, G., Sasidharan, A., & Xavier, K. M. (2024). Microplastic prevalence, diversity and characteristics in commercially important edible bivalves and gastropods in relation to environmental matrices. *Journal of Hazardous Materials Advances*, *13*, 100392.

113. Rajendran, R., Krishnan, R., Kim, J. O., & Oh, M. J. (2024). Regulatory effects of potassium channel blockers on potassium channel genes upon nervous necrosis virus infection in sevenband grouper Hyporthodus septumfasciatus. *Gene*, *890*, 147815.

114. Gopinath, G., Jesiya, N., Achu, A. L., Bhadran, A., & Surendran, U. P. (2023). Ensemble of fuzzy-

analytical hierarchy process in landslide susceptibility modeling from a humid tropical region of Western Ghats, Southern India. *Environmental Science and Pollution Research*, 1-18.

115. Keerthika, K., Padmavathy, P., Rani, V., Jeyashakila, R., Aanand, S., Kutty, R., ... & Subash, P. (2023). Ingestion of microplastics in commercially important species along Thoothukudi coast, south east India. *Environmental Monitoring and Assessment,* 195(4), 511.

116. Jose, S., Bharathi, S., Damodhar, A. T., Jayachandran, K. V., Kumar, T. A., & Kumar Lal, K. (2023). Reef-associated palaemonid shrimp fauna of Lakshadweep islands: special focus on Cuapetes Clark, 1919 (Decapoda; Caridea) with a description of new species and phylogenetic notes. *Marine Biology Research*, *19*(1), 25-47.

117. Chandra, S., Abhilash, R., Sidharthan, A., Raghavan, R., & Dahanukar, N. (2024). Complete mitogenome of *Lepidopygopsis typus*, an evolutionarily-distinct, endangered cyprinid fish from the Western Ghats Biodiversity Hotspot: Phylogenetic relationships and implications for conservation. *Gene*, *898*, 148098.

118. Sreejith, M., Remya, P. G., Praveen Kumar, B., Srinivas, G., & Balakrishnan Nair, T. M. (2023). Impact of southern annular mode on the Indian Ocean surface waves. *International Journal of Climatology*, *43*(16), 7606-7617.

119. Rajkumar, M., Pillai, S. L., Jose, J., Sobhana, K. S., & George, M. R. (2023). Relationship fecundity–morphometrics in the green tiger shrimp, *Penaeus semisulcatus* De Haan, 1844 (Decapoda, Penaeidae), along the Palk Bay, southern Peninsular India. *Crustaceana*, *96*(9), 853-865.

120. Naganandhini, V., Muthupandi, K., Vasanth, K., Neethiselvan, N., Padmavathy, P., & Radhakrishnan, K. (2023). Influence of Hook Number on Species Composition, Catch Rate, and Size of Needlefishes in the Gulf of Mannar, India. *Journal of Coastal Research*, *39*(3), 502-508.

121. Job, N., Sarasan, M., & Philip, R. (2023). Mangrove-associated endomycota: diversity and functional significance as a source of novel drug leads. *Archives of Microbiology*, *205*(11), 349.

122. Rajkumar, M., Pillai, S. L., Rameshkumar, P., Saravanan, R., Thirumalaiselvan, S., Jose, J., ... & George, M. R. (2023). Reproductive biology of green tiger shrimp *Penaeus semisulcatus* De Haan, 1844 in Palk Bay, southeast coast of India. *Regional Studies in Marine Science*, *66*, 103161.

123. Raj, A., Kumar, B. P., Remya, P. G., Sreejith, M., & Nair, T. B. (2023). Assessment of the forecasting potential of WAVEWATCH III model under different Indian Ocean wave conditions. *Journal of Earth System Science*, *132*(1), 32.

124. Ashraf, N., Anas, A., Sukumaran, V., Gopinath, G., Babu, K. I., & Kumar, P. D. (2023). Recent advancements in coral health, microbiome interactions and climate change. *Science of The Total Environment*, *878*, 163085.

125. Jofia, J., Girishkumar, M. S., Ashin, K., Sureshkumar, N., Shivaprasad, S., & Pattabhi Ram Rao, E. (2023). Mixed layer temperature budget in the Arabian Sea during winter 2019 and spring 2019: The role of diapycnal heat flux. *Journal of Geophysical Research: Oceans*, *128*(2), e2022JC019088.

126. Thomas, L., Anseeuw, B., Kutty, R., & Parambil, S. K. (2023). Redescription of *Acanthochitona mahensis* Winckworth, 1927 (Polyplacophora, Acanthochitonidae) from Indian Coasts. *Zootaxa*, *5244*(1), 41-50.

127. Yoon, S. Y., Jang, Y. S., Kim, S. J., Krishnan, R., & Oh, M. J. (2024). Determination of the minimum infective dose of viral hemorrhagic septicemia virus (VHSV) in juvenile olive flounder, *Paralichthys olivaceus* using an immersion challenge model. *Virus Research*, *340*, 199305.

128. Madhavan, M., Jayakumar, T. T., Kumar, T. A., & Sarkar, U. K. (2023). Mating behaviour and embryonic development of the marine ornamental shrimp, Stenopus hispidus Olivier, 1811 in captivity. *Aquaculture*, *574*, 739655.

129. Kuriakose, V., TS, D., & Hycinth, F. (2023). Family incivility and service delivery of frontline hotel employees: roles of negative rumination, psychological capital and perceived organisational support. *International Journal of Conflict Management*, *34*(4), 692-716.

130. Kodeeswaran, P., Mohapatra, A., & Kumar, T. T. P. A. (2024). A new species of deep-water snake

eel, *Ophichthus nigroventralis* (Anguilliformes: Ophichthidae) from the Arabian Sea, southwest coast of India. *Ichthyological Research*, *71*(2), 268-275.

131. Jang, Y. S., Kim, S. J., Yoon, S. Y., Krishnan, R., & Oh, M. J. (2023). The persistence of viral hemorrhagic septicemia virus (VHSV) mRNA in juvenile olive flounder, *Paralichthys olivaceus* following live VHSV vaccination. *Aquaculture Reports*, *33*, 101785.

132. Kodeeswaran, P., Mohapatra, A., Kumar, T. T. P. A., & Lal, K. K. (2023). A new deep-water conger eel of the genus Rhynchoconger (Anguilliformes: Congridae) from the south-west coast of India, Arabian Sea. *Journal of Fish Biology*, *102*(5), 1245-1252.

133. Harikrishnan, M. P., Thampi, A., Lal, A. N., Warrier, A. S., Basil, M., & Kothakota, A. (2023). Effect of chitosan-based bio coating on mechanical, structural and physical characteristics of microfiber based paper packaging: An alternative to wood pulp/plastic packaging. *International Journal of Biological Macromolecules*, *253*, 126888.

134. Gayathri, P. V., Joseph, S., Yesodharan, S., & Yesodharan, E. P. (2023). Fenton and solar Fenton processes: inexpensive green technologies for the decontamination of wastewater from toxic Rhodamine B dye pollutant. *Water Practice & Technology*, *18*(8), 1938-1958.

135. Alnashiri, H., Thomas, L., Philip, S., Thaikkottathil, M., Sureshkumar, S., & Kutty, R. (2024). Complete Mitochondrial Genome and Phylogenetic Relationships of the Red Sea Chiton *Acanthopleura vaillantii* Rochebrune, 1882 (Polyplacophora: Chitonida). *Thalassas: An International Journal of Marine Sciences*, *40*(1), 51-58.

136. Kodeeswaran, P., Kantharajan, G., Mohapatra, A., Kumar, T. A., & Sarkar, U. K. (2023). A new short brown unpatterned moray eel (Anguilliformes, Muraenidae) from the southeast coast of India, Bay of Bengal. *Zoosystematics and Evolution*, *99*(1), 253-260.

137. Sajikumar, K. K., Laxmilatha, P., Vargheese, S., Pranav, P., Venkatesan, V., Vidya, R., ... & Sasikumar, G. (2023). Hawaiian flying squid *Nototodarus hawaiiensis* (Cephalopoda: Ommastrephidae) in the Arabian Sea: range extension, age, and growth. *Marine Biodiversity*, *53*(1), 15.

138. Bhattacharya, T., Chakraborty, K., Ghoshal, P. K., Ghosh, J., & Baduru, B. (2023). Response of surface ocean pCO2 to tropical cyclones in two contrasting basins of the northern Indian Ocean. *Journal of Geophysical Research: Oceans*, *128*(4), e2022JC019058.

139. Kodeeswaran, P., Kathirvelpandian, A., Mohapatra, A., Ajith Kumar, T. T. P., & Sarkar, U. K. (2024). A new snake eel species of the genus Ophichthus (Anguilliformes: Ophichthidae) from the southeast coast of India, Bay of Bengal, with the taxonomic account of *Ophichthus chilkensis*. *Journal of Fish Biology*, *104*(3), 737-745.

140. Rani, V., Nandan, S. B., Jayachandran, P. R., Preethy, C. M., Sreelekshmi, S., Joseph, P., & Asha, C. V. (2023). Carbon stock in biomass pool of fragmented mangrove habitats of Kochi, Southern India. *Environmental Science and Pollution Research*, *30*(43), 96746-96762.

141. Athulya, K., Girishkumar, M. S., McPhaden, M. J., & Kolukula, S. S. (2023). Seasonal Variation of the Land Breeze System in the Southwestern Bay of Bengal and Its Influence on Air-Sea Interactions. *Journal of Geophysical Research: Oceans*, *128*(2), e2022JC019477.

142. Chettiyam Thodi, M. F., Gopinath, G., Surendran, U. P., Prem, P., Al-Ansari, N., & Mattar, M. A. (2023). Using RS and GIS Techniques to Assess and Monitor Coastal Changes of Coastal Islands in the Marine Environment of a Humid Tropical Region. *Water*, *15*(21), 3819.

143. Jifiriya, M. J., Preena, P. G., Rejish Kumar, V. J., Nair, A. J., & Joseph, V. (2024). Role of archaea in aquaculture: prospects and challenges. *Aquaculture International*, *32*(3), 3169-3194.

144. Kodeeswaran, P., Smith, D. G., DS, D. D., Kumar, T. A., & Lal, K. K. (2023). A new species of the congrid eel genus Conger (Anguilliformes: Congridae) from the southwest coast of India. *Zootaxa*, *5244*(5), 474-484.

145. Jang, Y. S., Kim, S. J., Yoon, S. Y., Krishnan, R., & Oh, M. J. (2024). Comparison of survival efficacy by rearing time after challenged with viral hemorrhagic septicemia virus (VHSV) in olive flounder (Paralichthys olivaceus) immersion-treated with live VHSV vaccine. *Aquaculture*

International, *32*(2), 1395-1407.

146. Bhavan, S. G., Bella, K., Kv, A., Mayekar, T., Vasudevan, C., Rajkumar, S., & Kumar, P. (2023). Spatio-temporal patterns in the distribution of juvenile elasmobranchs in a tropical Indian Ocean estuary, Zuari-India. *Marine Biodiversity*, *53*(3), 31.

147. Chandrababu, K., Radhakrishnan, V., Anjana, A. S., Rajan, R., Sivan, U., Krishnan, S., & Baby Chakrapani, P. S. (2024). Unravelling the Parkinson's puzzle, from medications and surgery to stem cells and genes: a comprehensive review of current and future management strategies. *Experimental Brain Research*, *242*(1), 1-23.

148. Fazal, A. M., Varikoden, H., & Reji, M. J. K. (2023). Long term trends and variabilities of rainfall of the global monsoon systems during boreal and austral summer seasons. *Global and Planetary Change*, *229*, 104251.

149. Achu, A. L., Aju, C. D., Di Napoli, M., Prakash, P., Gopinath, G., Shaji, E., & Chandra, V. (2023). Machine-learning based landslide susceptibility modelling with emphasis on uncertainty analysis. *Geoscience Frontiers*, *14*(6), 101657.

150. Venugopal, V., Sasidharan, A., & Rustad, T. (2023). Green chemistry to valorize seafood side streams: an ecofriendly roadmap toward sustainability. *Journal of Agricultural and Food Chemistry*, *71*(46), 17494-17509.

151. Aswathy, V. S., Girishkumar, M. S., & Athulya, K. (2024). Seasonal and intraseasonal modulation of near-inertial wind power associated with fluctuations in unidirectional wind speed in the Bay of Bengal. *Ocean Dynamics*, *74*(2), 81-95.

152. Bhattacharya, T., Chakraborty, K., Anthoor, S., & Ghoshal, P. K. (2023). An assessment of air-sea CO2 flux parameterizations during tropical cyclones in the Bay of Bengal. *Dynamics of Atmospheres and Oceans*, *103*, 101390.

153. Benjamin, L. V., Padua, S., & Bhavan, S. G. (2023). Fish diversity, composition, and guild structure influenced by the environmental drivers in a small temporarily closed tropical estuary from the western coast of India. *Environmental Science and Pollution Research*, *30*(50), 108889-108906.

154. Thekkeyil, A., George, A., Abdurazak, F., Kuriakose, G., Nameer, P. O., Abhilash, P. C., & Joseph, S. (2023). Land use change in rapidly developing economies—a case study on land use intensification and land fallowing in Kochi, Kerala, India. *Environmental Monitoring and Assessment*, *195*(9), 1089.

155. Kodeeswaran, P., Smith, D. G., Ajith Kumar, T. T. P., & Sarkar, U. K. (2023). A new species of the conger eel genus Macrocephenchelys from deep waters of the Arabian Sea. *Journal of Fish Biology*, *103*(1), 130-135.

156. Nimsi, K. A., Manjusha, K., Hatha, A. A. M., & Kathiresan, K. (2023). Diversity, distribution, and bioprospecting potentials of manglicolous yeasts: a review. *FEMS Microbiology Ecology*, *99*(5), fiad044.

157. Mohanan, S., Madhu, V. R., Kumar, M., Nafin, K. S., & Soumya, K. R. (2023). Impact of Coloured LED lights and Lunar Phase on Catches of Selected Shrimp Species in a Filtration Field at Kudappuram, Vembanad Lake. *Fishery Technology*, *60*, 247-253.

158. Babu, L., Mohan, R., Prasanth, R. S., Rajesh, S., Mohan, M., & Pradeepkumar, A. P. (2023). Mineral magnetism records shift in climate during the Kannur regolith formation, North Kerala, India. *Quaternary Science Advances*, *11*, 100090.

159. Dahanukar, N., Sundar, R. L., Rangad, D., Proudlove, G., & Raghavan, R. (2023). The world's largest cave fish from Meghalaya, Northeast India, is a new species, *Neolissochilus pnar* (Cyprinidae, Torinae). *Vertebrate Zoology*, *73*, 141-152.

160. Vrinda, P. K., Amal, R., Abhirami, N., Mini, D. A., Kumar, V. J. R., & Devipriya, S. P. (2023). Co-exposure of microplastics and heavy metals in the marine environment and remediation techniques: a comprehensive review. *Environmental Science and Pollution Research*, *30*(54), 114822-114843.

161. Thomas, G. A. J., Santha Ravindranath, R. R., Jeyagopal, S., & Thodhal Yoganandham, S. (2023). Statistical analysis of shoreline change reveals erosion and baseline are increasing off the northern Tamil Nadu Coasts of India. *Environmental Monitoring and Assessment*, *195*(3), 409.

162. Anand, P., Janardhanan, J., Nair, A. P., Suresh, I., Suneel, V., Gopika, S., & Thadathil, P. (2023). Role of subsurface layer temperature inversion in cyclone induced warming in the northern Bay of Bengal. *Dynamics of Atmospheres and Oceans*, *103*, 101389.

163. Asokan, K., Jha, P. N., Edwin, L., Krishnan, A. R., & Sebastian, M. (2023). Fuel use in small-scale fishing vessels along the southeast coast of India: a comparative study to ascertain possible reasons and potential recommendations for effective management. *Environmental Monitoring and Assessment*, *195*(2), 345.

164. Prithiviraj, M., Sasidharan, A., Krishna, B. M., Sabu, S., Sunooj, K. V., Anoop, K., & George, J. (2023). Characterization and qualitative evaluation of cassava starch-chitosan edible food wrap enriched with culinary leaf powders for eco-friendly food packaging applications. *Food Science and Technology International*, 10820132231179492.

165. Rajesh, R. O., Shruthy, N. S., Akhila, S., Godan, T. K., Dileep, N. R., de Carvalho, J. C., ... & Binod, P. (2023). Whole-cell synthesis of 2, 5-furandicarboxylic acid from pineapple waste under various fermentation strategies. *Bioresource Technology*, *386*, 129545.

166. Siswanto, E., Sarker, M. L. R., Peter, B. N., Takemura, T., Horii, T., Matsumoto, K., ... & Honda, M. C. (2023). Variations of phytoplankton chlorophyll in the Bay of Bengal: Impact of climate changes and nutrients from different sources. *Frontiers in Marine Science*, *10*, 1052286.

167. Pandiselvam, R., Joseph, L. T., Manikantan, M. R., Khanashyam, A. C., Beegum, P. S., Ramesh, S. V., ... & Hebbar, K. B. (2023). Physical, chemical and functional attributes of Neera honey infused extrudates. *Bioengineering*, *10*(1), 114.

168. Ashin, K., Girishkumar, M. S., D'Asaro, E., Jofia, J., Sherin, V. R., Sureshkumar, N., & Rao, E. P. R. (2023). Observational evidence of salt finger in the diurnal thermocline. *Scientific Reports*, *13*(1), 3627.

169. Gopinath, G., Resmi, T. R., Karunakara, N., Manjula, P., Jesiya, N. P., Sudeep Kumara, K., & Srinivas, R. (2023). How Long a Tropical Mountainous Lake Can Survive? Inferences from Geochemistry and Radiometric Measurements of Pookode Lake, Kerala, India. *Journal of the Geological Society of India*, *99*(6), 840-846.

170. Anjana, S., Chatterjee, A., Han, W., Prerna, S., & Sajidh, C. (2023). Role of Oceanic Internal Instability in the Generation of Low-Frequency Variability in the Indian Ocean. *Geophysical Research Letters*, *50*(9), e2022GL102489.

171. Salma, Nikhil, S., Danumah, J. H., Prasad, M. K., Nazar, N., Saha, S., ... & Ajin, R. S. (2023). Prediction capability of the MCDA-AHP model in wildfire risk zonation of a protected area in the Southern Western Ghats. *Environmental Sustainability*, *6*(1), 59-72.

172. Siddiqui, S. A., Lakshmikanth, D., Pradhan, C., Farajinejad, Z., Castro-Muñoz, R., & Sasidharan, A. (2023). Implementing fermentation technology for comprehensive valorisation of seafood processing by-products: A critical review on recovering valuable nutrients and enhancing utilisation. *Critical Reviews in Food Science and Nutrition*, 1-28.

173. Abdulaziz, A., Sathyendranath, S., Vijayakumar, S. K., Menon, N., George, G., Kulk, G., ... & Platt, T. (2023). The distribution of fecal contamination in an urbanized tropical lake and incidence of acute diarrheal disease. *ACS ES&T Water*, *3*(6), 1561-1573.

174. Afroosa, M., Rohith, B., Paul, A., Durand, F., Bourdallé-Badie, R., & Shenoi, S. S. C. (2023). The MJO-driven Indo-Pacific barotropic see-saw. *Deep Sea Research Part i: Oceanographic Research Papers*, *199*, 104104.

175. Sherin, V. R., Girishkumar, M. S., Shivaprasad, S., Sureshkumar, N., Farrar, J. T., Athulya, K., ... & Ravichandran, M. (2023). Importance of seasonally evolving near-surface salinity stratification on mixed layer heat budget during summer monsoon intraseasonal oscillation in the northern bay of bengal in 2019. *Journal of Geophysical Research: Oceans*, *128*(11), e2023JC019800.

176. Lakshmi, S., Rubeena, A. S., Subramaniyan, S. B., Raman, T., Vaseeharan, B., Arockiaraj, J., ... & Preetham, E. (2023). Hybrid of *Metapenaeus dobsoni* lectin and platinum nanoparticles exert antimicrobial and immunostimulatory effects to reduce bacterial bioburden in infected Nile tilapia. *Scientific Reports*, *13*(1), 525.

177. Midhun Dominic, C. D., Neenu, K. V., Mohammad Sajadi, S., Sabura Begum, P. M., Gopinath, A., Ragi, A. S., ... & Parameswaranpillai, J. (2023). Coral derived nano calcium carbonate incorporated acrylonitrile butadiene rubber composites: Green look at properties. *Journal of Polymer Research*, *30*(5), 176.

178. Chakraborty, K., Joshi, A. P., Ghoshal, P. K., Ghosh, J., Akhand, A., Bhattacharya, T., ... & Valsala, V. (2023). Mechanisms and drivers controlling spatio-temporal evolution of pCO2 and air-sea CO2 fluxes in the southern Java coastal upwelling system. *Estuarine, Coastal and Shelf Science*, *293*, 108509.

179. Sudasinghe, H., Dahanukar, N., Raghavan, R., Ranasinghe, T., Wijesooriya, K., Pethiyagoda, R., ... & Meegaskumbura, M. (2024). The loach genus Lepidocephalichthys (Teleostei: Cobitidae) in Sri Lanka and peninsular India: multiple colonizations and unexpected species diversity. *Hydrobiologia*, *851*(5), 1113-1133.

180. Cooke, S. J., Piczak, M. L., Nyboer, E. A., Michalski, F., Bennett, A., Koning, A. A., ... & Taylor, W. W. (2023). Managing exploitation of freshwater species and aggregates to protect and restore freshwater biodiversity. *Environmental Reviews*.

181. Shaginimol, C., Manojkumar, B., & Kaliraj, S. Application of remote sensing and GIS in site selection for Sustainable Aquaculture in India-A Review.

182. Shabeena, M., Idreesbabu, K. K., & Sureshkumar, S. (2023). Assessment of the spatial variation in the macro-algal resources of Lakshadweep, India. *Journal of the Marine Biological Association of India*, *65*(1), 70.

183. Radhalakshmi, V., Raman, M., & Joy, M. R. (2023). Development of active packaging film based on poly (lactic acid) incorporated with Piper betel leaf ethanolic extract and its application in the shelf-life extension of tuna meat. *International Journal of Biological Macromolecules*, *246*, 125751.

184. Kodeeswaran, P., Smith, D. G., Ajith Kumar, T. T. P., & Sarkar, U. K. (2023). A new species of the conger eel genus Macrocephenchelys from deep waters of the Arabian Sea. *Journal of Fish Biology*, *103*(1), 130-135.

185. Kodeeswaran, P., Mohapatra, A., Kumar, T. T. P. A., & Lal, K. K. (2023). A new deep-water conger eel of the genus Rhynchoconger (Anguilliformes: Congridae) from the south-west coast of India, Arabian Sea. *Journal of Fish Biology*, *102*(5), 1245-1252.

186. Kodeeswaran, P., Dhas, D., Kumar, T. T. P. A., & Lal, K. K. (2023). Description of a new congrid eel, *Ariosoma albimaculata sp*. nov. (Anguilliformes: Congridae), from the southwest coast of India, Arabian Sea. *Ichthyological Research*, *70*(2), 233-242.

187. Gopinath, G., Resmi, T. R., Karunakara, N., Manjula, P., Jesiya, N. P., Sudeep Kumara, K., & Srinivas, R. (2023). How Long a Tropical Mountainous Lake Can Survive? Inferences from Geochemistry and Radiometric Measurements of Pookode Lake, Kerala, India. *Journal of the Geological Society of India*, *99*(6), 840-846.

BOOKS PUBLISHED

1. Divya P. R., Sreenath K. R., Gijo Ittoop, Anuraj A., Rajeev Raghavan, Madhu V. R., Binsi P. K., Remya S., Unnikrishnan S., Sreekanth G. B., Muhammed Safeena P., Ratheesh Kumar R., Afsal E. M., Daisy Kappan (2024). Book of abstracts of International Fisheries Congress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS) College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81-969118-2-9, 244 pp.

2. Dr. Gijo Ittoop, Assistant Professor: Divya et al (2024) Souvenir International Fisheries Congress &Expo 2024 12 to 14 January 2024, Panangad, Kochi 94pp.
3. Anu Gopinath and G D Gem Mathew. Fundamentals of Chemistry –I (2024) for the Discipline Specific Course (DSC) of B.Sc. (Honours) Chemistry of Mahatma Gandhi University Undergraduate Programme (FYUGP). Vishal Publishers, Jalandhar.
4. Aquatic Pollution Concerns and Abatements - Imtiyaz Qayoom, Adnan Abubakr, Anu Gopinath, Shabir A Dar and Keezia Khurshid (2024) Taylor and Francis ISBN 978-93-58999-70-9.

BOOK CHAPTERS

1. Achu,A. L., Girish Gopinath, and U. Surendran (2023) Machine Learning Framework for Flood Susceptibility Modeling in a Fast-Growing Urban City of Southern India. In Editors P. V. Timbadiya et al. Geospatial and Soft Computing Techniques, Springer, pp 535-542, https://doi.org/10.1007/978-981-99-1901-7_43
2. Arjun, P., N. P. Jesiya, Girish Gopinath, and T. R. Resmi (2023) Emanation of Radon from Coastal and Inland Groundwater of Northern Kerala, India. In Editors P. V. Timbadiya et al. Fluid Mechanics and Hydraulics, Springer, pp 501-510, https://doi.org/10.1007/978-981-19-9151-6_41
3. Jesiya, N. P, M. V. Shyamkumar, and Girish Gopinath (2023) A GIS-Based Multi-criteria Decision-Making Technique for Groundwater Potential Zones of a Tropical River Basin, Northern Kerala, Southern India. In Editors P. V. Timbadiya et al. Geospatial and Soft Computing Techniques, Springe, pp 195-210, https://doi.org/10.1007/978-981-99-1901-7_17
4. Swetha T. V., R. Remitha, and Girish Gopinath (2023) Groundwater Quality Assessment and Water Quality Index (Wqi) Mapping of Phreatic Aquifer, Palakkad District, Kerala. In Editors Timbadiya et al. Fluid Mechanics and Hydraulics, Springer, pp 511-532, https://doi.org/10.1007/978-981-19-9151-6_42
5. Nair, D., Gayathri, P.V., Vandhana, T.V., Gopinath, G. (2024). Occurrence and Transport Modelling of Chloroquine in Riverine Environment. In: Satheeshkumar, S., Thirukumaran, V., Karunanidhi, D. (eds) Modern River Science for Watershed Management. Water Science and Technology Library, vol 128. Springer, Cham. https://doi.org/10.1007/978-3-031-54704-1_28
6. Gopinath, G., Sabitha, A.R., Fasil, C.T.M., Jesiya, N.P. (2024). GIS-Based Comparative Assessment of Erosional Status in Two Tropical River Basins. In: Satheeshkumar, S., Thirukumaran, V., Karunanidhi, D. (eds) Modern River Science for Watershed Management. Water Science and Technology Library, vol 128. Springer, Cham. https://doi.org/10.1007/978-3-031-54704-1_16
7. S Dhanasekaran, R Arunadevi, M Nandan, KChandrababu, BChakrapani, Unnikrishnan Sivan (2024) Animal Model for Alzheimer's Disease, Parkinson's Disease, and Schizophrenia. Book chapter in Animal Models in Research (Springer) 283-317. *https://doi.org/10.1007/978-981-97-0048-6_11*
8. Ajay Valiyaveettil Salimkumar, Mary Carolin Kurisingal Cleetus, Judith Osaretin Ehigie, Cyril Oziegbe Onogbosele, P. Nisha, Bindhi S. Kumar, M. P. Prabhakaran and V. J. RejishKumar, 2024. Adsorption behavior and interaction of micro-nanoplastics in soils and quatic anvironment. S. A. Bhat et al. (eds.), Management of Micro and Nano- plastics in Soil and Biosolids, https://doi.org/10.1007/978-3-031-1967-3_11- Springer Nature Switzerland AG 2024.

9. Jenny Ann John, Chinthu Udayarajan, Sanu Jacob and Jose Joseph (2024). SensoryEvaluation of Foods. In: Textbook of Fish Proessing Technology, K. Gopakumar and T.V. Shankar (Eds). Second Edition, Directorate of Knowledge Management in Agriculture, ICAR, New Delhi Publication. Pp. 551-575. ISBN-978-81-7164-277-9.

10. Valiyaveettil Salimkumar A, Carolin Kurisingal Cleetus M, Osaretin Ehigie J, Oziegbe Onogbosele C, Nisha P, Kumar B.S, Prabhakaran M.P, and Rejish Kumar V.J (2024). Adsorption Behavior and Interaction of Micro-Nanoplastics in Soils and Aquatic Environment. In: Bhat, S.A., Kumar, V., Li, F., Kumar, S. (eds) Management of Micro and Nano-plastics in Soil and Biosolids. Springer, ISBN No. 978-3-031-51967-3.pp 283-311.

11. Recent Advances in the Biosynthesis of Noble Metal Nanoparticles Using Marine Macroalgae (2024) K. F. Princy, Sreeja E. S., and Anu Gopinath in Functional Nanocomposites and their Applications. Apple Academic press.

12. S Dhanasekaran, R Arunadevi, M Nandan, KChandrababu, BChakrapani, Unnikrishnan Sivan (2024) Animal Model for Alzheimer's Disease, Parkinson's Disease, and Schizophrenia. Book chapter in Animal Models in Research (Springer) 283-317. https://doi.org/10.1007/978-981-97-0048-6_11

LIST OF PAPERS PRESENTED IN INTERNATIONAL SEMINAR

1. Avanish Dixit, Gijo Ittoop, Devika Pillai, Rehna A, Leena Chandrasekhar, Suresh N Nair 2023), Toxicity of chemotherapeutics hydrogen peroxide and formalin in Nile tilapia (Oreochromis niloticus) in Strategies and Challenges in Agriculture and Life science for Food Security and Sustainable Environment (SCALFE-2023) April 28-30, 2023, at Himachal Pradesh University, Summer Hill, Shimla, HP, India ISBN: 978-93-91872-31-1.

2. Ishwar Chandra, Gijo Ittoop, Devika Pillai, Rehna A, Leena Chandrasekhar, Suresh N Nair (2023) Toxicity of Epsom Salt (Magnesium Sulphate) In Oreochromis niloticus; in Strategies and Challenges in Agriculture and Life science for Food Security and Sustainable Environment (SCALFE-2023) April 28-30, 2023, at Himachal Pradesh University, Summer Hill, Shimla, HP, India ISBN: 978-93-91872-31-1.

3. Shailendra Kumar, Gijo Ittoop, Devika Pillai, Rehna A, Leena Chandrasekhar and Suresh N Nair (2023). Role of Alkalinity In The Toxicity Of Copper Sulphate In Anabas Testudineus; in Strategies and Challenges in Agriculture and Life science for Food Security and Sustainable Environment (SCALFE-2023) April 28-30, 2023, at Himachal Pradesh University, SummerHill, Shimla, HP, India ISBN: 978-93-91872-31-1.

4. Gowtham Kumar E, Madeena S[1], Gijo Ittoop, Devika Pillaiand Suresh N Nair (2023). In Silico Characterization and Homology Modelling of Bam A Protein Of Aeromonas hydrophila; in Strategies and Challenges in Agriculture and Life science for Food Security and Sustainable Environment (SCALFE-2023) April 28-30, 2023, at Himachal Pradesh University, Summer Hill, Shimla, HP, India ISBN: 978-93-91872-31-1.

5. Neha Padole, Lekshmi S.R., Bharath Jayaram, Gijo Ittoop and Devika Pillai (2023), Phytogenics In Aquaculture -A Review; in Strategies and Challenges in Agriculture and Life Science for Food Security and Sustainable Environment (SCALFE-2023) April 28-30, 2023, at Himachal Pradesh University, Summer Hill, Shimla, HP, India ISBN: 978-93-91872-31-1.

6. Theja Kannan, Athul S Kumar, Emmanuel Joseph Antony, Meril Mary Mathew, Aliya S, Anitta Antony, and Gijo Ittoop* (2024) Unveiling nature bounty: Piscicidal plants in tribal. Book of

abstracts of International Fisheries Congress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS) & College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81-969118-2-9, p. 28

7. Abdullah Bin Abdul Nazar, Anusree Suraj, Gijo Ittoop (2024) Salinity adaptation of Heteropneustes fossilis: A histopathological investigation. Book of abstracts of International Fisheries Congress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS); College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81-969118-2-9, P. 95

8. Bharath Jayaram, Lekshmi S. R, Gijo Ittoop* (2024) Growth performance and toxicity evaluation of Etroplus suratensis fed with aqueous leaf extract of Murraya koenigii. Book of abstracts of International Fisheries Congress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS) College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81-969118-2-9, p. 112

9. Archana C, Ayush Chandravanshi, Adarsh Jayanth A B, Avanish Dixit, Bharath Jayaram, Gijo Ittoop, Rahul Krishnan (2024) Phytochemical analysis and evaluation of antibacterial, anti inflammatory and anti oxidant activities of methanolic extract of Coleus amboinicus. Book of abstracts of International Fisheries Congress 2024. Kerala University ofFisheries and Ocean Studies (KUFOS) & College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81-969118-2-9, p. 115

10. Eldho J. Paul., Sreekanth G.B., Renjith R. and Gijo Ittoop (2024) Experimental cage culture of Asian Seabass, Lates calcarifer and Pearlspot, Etroplus suratensis in a tropical estuary- Kodungallur-Azhikode. Book of abstracts of International Fisheries Congress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS); College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81- 969118-2-9, P. 125

11. Padole Neha Narendra, Gowtham Kumar E., Ankitha, C. S., Gijo Ittoop (2024) Immune gene expression and haematological profiling of Anabas testudineus fed with aqueous leaf extract of Psidium guajava and Murraya koenigii and its survivability against Aeromonas hydrophila. Book of abstracts of International Fisheries Congress 2024. KeralaUniversity of Fisheries and Ocean Studies (KUFOS); College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81- 969118-2-9, p. 148

12. Gowtham Kumar E., Madeena Raheem, Padole Neha Narendra, Gijo Ittoop and Devika Pillai. (2024) In silico pharmacokinetic and drug likeness screening of phytochemicals from Murraya koenigii and Psidium guajava for potential drug development against BamA protein of Aeromonas hydrophila. Book of abstracts of International Fisheries Congress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS) & College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81-969118-2-9, p. 149

13. Gowtham Kumar, Padole Neha Narendra, Gijo Ittoop, Devika Pillai, Suresh N Nair (2024) Computational Approach for Virtual Screening of Murraya koenigii and Psidium guajava Phytochemicals Against D-alanyl-D- alanine Ligase Enzyme of Streptococcus agalactiae. Book of abstracts of International Fisheries Congress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS) & College of Fisheries PanangadAlumni Association (COFPAA), Panangad, Kochi, ISBN 978-81-969118-2-9, P. 153.

14. Gowtham Kumar E1, Padole Neha Narendra1, Gijo Ittoop, Devika Pillai1, Suresh N Nair (2024) Deciphering Phytochemicals of Murraya koenigii as Potential Therapeutic Agents targeting Pir A

and Pir B Proteins of Vibrio parahaemolyticus. Book of abstracts of International Fisheries Congress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS) & College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81-969118-2-9, P. 154.

15. Gowtham Kumar E., Madeena Raheem, Padole Neha Narendra, Gijo Ittoop and Devika Pillai (2024) Structural Elucidation and in Silico Drug Screening of Aeromonas hydrophila BamA Protein: Targeting β-Barrel Outer-Membrane Proteins for Therapeutic Intervention. Book of abstracts of, International Fisheries Congress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS) & College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81-969118-2-9, P. 154.

16. Gowtham Kumar E., Gijo Ittoop, Devika Pillai, Suresh N Nair (2024) Phytochemical Profiling of Psidium guajava for identification of potential drug candidates for Treatment of Acute Hepatopancreatic Necrosis Disease: An in silico approach. Book of abstracts of International Fisheries Congress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS) & College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81-969118-2-9, P. 155.

17. Rahul Hansraj Thaware, Gijo Ittoop, Devika Pillai, Suresh N Nair (2024) Temporal Dynamics of Oxytetracycline Residue in the Muscle Tissue of Anabas testudineus Following Oral Administration and Assessment of its Withdrawal Period. Book of abstracts of International Fisheries Congress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS) & College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81-969118-2-9, P. 156.

18. Avanish Dixit, Bharath Jayaram, Adarsh Jayanth, A. B., Archana, C., Ayush Chandravansi and Gijo Ittoop (2024) Qualitative phytochemical screening and antibacterial activity of aqueous extracts of Phylanthus niruri and Asparagus racemosus against five bacterial pathogens of fish fisheries In: Book of abstracts of International Fisheries Congress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS) & College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81- 969118-2-9, p. 157.

19. Suresh N. Nair, Angel Benny, Gijo Ittoop and Sanis Juliet(2024) Strategies for development of sustainable antibiotic delivery systems in, aquaculture for therapeutic efficacy and preservation of ecosystem. Book of abstracts of International Fisheries Congress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS) & College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81- 969118-2-9, P. 161

20. Ayush Chandravansi, Adarsh Jayanth, A. B., Archana, C., Avanish Dixit, Bharath Jayaram and Gijo Ittoop (2024) Exploring antibacterial, anti- inflammatory and antioxidant property of methanolic extract of whole plant of Boerhaavia diffusa and determination of minimum inhibitory concentration against some bacterial pathogens of fish. Book of abstracts of International Fisheries Congress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS) & College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81-969118-2-9, P. 167.

21. Seetha Lekshmi D.S, Archa S Prem, Amrutha S., Gijo Ittoop (2024) Evaluation of Calcium Oxide toxicity in Nile Tilapia Oreochromis niloticus. Book of abstracts of International Fisheries Congress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS); College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81-969118-2-9, p. 173

22. Srilekshmi A S, Sneha M Romieo, Thulasi Soman, Gijo Ittoop (2024) Evaluating the toxicological profile of formalin in Pangasius (Pangasianodon hypophthalmus) In: Book of abstracts of

International Fisheries Congress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS); College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81-969118-2-9, p. 173.

23. Anjana Pradeep, Anjana V, Arya J .V, Dhanusha K. P, Shijina P. Nambiar, Gijo Ittoop (2024) Evaluating the use of potassium permanganate in Pangasius (Pangasianodon hypophthalmus) culture systems. In: Book of abstracts of International Fisheries Congress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS); College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81- 969118-2-9, P. 174

24. Angel Benny 1, Suresh N Nair 1, Gijo Ittoop 2, Sanis Juliet3 (2024) Estimation of Acute Toxicity of Doxycycline in Artemia salina. In: Book of abstracts of International Fisheries Congress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS); College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81- 969118-2-9, P. 176

25. Adarsh Jayanth, A. B., Archana, C., Ayush Chandravansi, Avanish Dixit, BharathJayaram and Gijo Ittoop*, Rahul Krishnan (2024) Evaluation of therapeutic potential of methanolic extract of whole plant of Cyanthillium cinereum and its minimum inhibitory concentration against some fish bacterial pathogens. In: Book of abstracts of International FisheriesCongress 2024. Kerala University of Fisheries and Ocean Studies (KUFOS); College of Fisheries Panangad Alumni Association (COFPAA), Panangad, Kochi, ISBN 978-81-969118-2-9, P. 178

26. Safeena M. P, Gijo Ittoop, Shijina. P. Nambiar, Ardhra Vijayan, Rahul Krishnan, Devika Pillai (2023) Concurrent Occurrence of Infectious Spleen and Kidney Necrosis Virus (ISKNV) and Red Seabream Irido Virus (RSIV) incultures Asian Seabass (Lates Calcarifer from Kerala: First Evidence: In Book of Abstracts 3 rd International Conference on Aquatic Animal Epidemiology (AquaEpi III) at ICAR NBFGR Lucknow Nov 29 to Dec 1 2023

27. Shijina. P. Nambiar, Ardhra Vijayan, Divya Haridas, Rahul Krishnan, Safeena M. P, Gijo Ittoop, Devika Pillai (2023) First detection of Tilapia parvovirus (TiPV) associated with massive mortalities of farmed Nile tilapia (Oreochromis niloticus) in Kerala. In Book of Abstracts 3 rd International Conference on Aquatic Animal Epidemiology (AquaEpi III) at ICAR NBFGR Lucknow Nov 29 to Dec 1 2023

CONFERENCES/ SEMINARS

1. Aavani Sunil P, Rathesh Ramakrishnan, Girish Gopinath. (2023). Retrieval of wave parameters from ICESat 2 observations along Kerala coast: Seasonal changes and coastal dynamics. In Eighth National Conference of Ocean Society of India, August 23-25, 2023. Hyderabad: Indian National Centre for Ocean Information Services, Ministry of Earth Sciences, Govt. of India.

2. Chandana Anil, Ratheesh Ramakrishnan, Preethi Rajput, Girish Gopinath. (2023). Shoreline retreat of sandy beaches under predicted sea level rise: A case study for Kerala coast. In Eighth National Conference of Ocean Society of India, August 23-25, 2023. Hyderabad: Indian National Centre for Ocean Information Services, Ministry of Earth Sciences, Govt. of India.

3. Rani, V., Jayachandran, P.R., Gopinath G., (2023). Navigating Climate Change Mitigation: Should We Prioritize Carbon Stock or Carbon Sequestration Rate of Mangroves?, National Conference on Reviving Wetlands conducted by CWRDM on October 11-13-2023, p.46.

4. Nair, D., Gayathri, P.V., Achu, A.L., Gopinath, G., (2023). Antibiotics usage and Its Removal in Aquaculture under Natural Sunlight using Nano ZnO, National Conference on Reviving Wetlands conducted by CWRDM on October 11-13-2023, p.56.

5. Achu, A.L., Gopinath, G., Sanju Eldhose., and Mohamed Fasil C.T., (2023). Coastal Vulnerability Assessment in a highly urbanized coast of Kerala using Bayesian Belief Network and GIS. Diamond Jubilee Annual Convention on Advances in Geosciences with Special Reference to Coastal Hazards on 22-24 November, 2023, Organised by Indian Geophysical Union (IGU) and Department of marine geology and Geophysics, Department of Marine Sciences, Cochin University of Science and Technology (CUSAT), Kochi, p.166-167.

6. Girish Gopinath., (2023). Geospatial technology in Water Resources Management. Association of Hydrologists of India (AHI) 41st Annual Convention and National Seminar on Hydrology with special reference to Hydrological Solutions for Sustainable Development on 1 - 2 December 2023 at PSG Institute of Advanced Studies, Coimbatore, India, p.87. ISBN: 978-93-95105-76-7

7. Achu, A.L., and Gopinath, G., (2023). Extreme Gradient Boosting an efficient machine-learning technique in landslide modelling: A study from Idukki district of Kerala. Association of Hydrologists of India (AHI) 41st Annual Convention and National Seminar on Hydrology with special reference to Hydrological Solutions for Sustainable Development on 1 - 2 December 2023 at PSG Institute of Advanced Studies, Coimbatore, India, p.46. ISBN: 978-93-95105-76-7

8. Anjali, N., A. L Achu., and Gopinath, G., (2023). Spatial distribution of radon concentration and its health risk assessment in the groundwater: A study from a tropical river basin, Southern Kerala, India. Association of Hydrologists of India (AHI) 41st Annual Convention and National Seminar on Hydrology with special reference to Hydrological Solutions for Sustainable Development on 1 - 2 December 2023 at PSG Institute of Advanced Studies, Coimbatore, India, p.42. ISBN: 978-93-95105-76-7

9. Divya, Nair., PadinchareVeettil Gayathri., and Gopinath, G., (2023). Zinc Oxide-Mediated Sono Photo and sonophotocatalytic Approaches for Eliminating Antibiotic-Resistant Bacteria. Association of Hydrologists of India (AHI) 41st Annual Convention and National Seminar on Hydrology with special reference to Hydrological Solutions for Sustainable Development on 1 - 2 December 2023 at PSG Institute of Advanced Studies, Coimbatore, India, p.33. ISBN: 978-93-95105-76-7

10. Sabitha A.R., and Gopinath, G., (2023). Entropy-Based Groundwater Quality Assessment of urban and peri urban water regimes of Ernakulam District, Kerala, India. Association of Hydrologists of India (AHI) 41st Annual Convention and National Seminar on Hydrology with special reference to Hydrological Solutions for Sustainable Development on 1 - 2 December 2023 at PSG Institute of Advanced Studies, Coimbatore, India, p.53. ISBN: 978-93-95105-76-7

11. Vandhana T. V., and Gopinath, G., (2023). Flood Inundation Mapping and Damage Assessment on the Greater Pamba River Basin, Kerala, India. Association of Hydrologists of India (AHI) 41st Annual Convention and National Seminar on Hydrology with special reference to Hydrological Solutions for Sustainable Development on 1 - 2 December 2023 at PSG Institute of Advanced Studies, Coimbatore, India, p.43. ISBN: 978-93-95105-76-7

12. Chettiyam Thodi Muhamed Fasil., Gopinath, G., and Udayar Pillai Surendran (2023). Spectral Variation in Hyperspectral Chlorophyll Indices across Phenological Stages of Forest Species. Association of Hydrologists of India (AHI) 41st Annual Convention and National Seminar on Hydrology with special reference to Hydrological Solutions for Sustainable Development on 1 - 2 December 2023 at PSG Institute of Advanced Studies, Coimbatore, India, p.94. ISBN: 978-93-95105-76-7

13. Anjali, N., A. L Achu., T.R Reshmi., and Gopinath, G., (2023). Radon concentration (222Rn) in the groundwater of Tropical River Basin, Southern Kerala, India. In book of Abstracts of HYDRO 2023, 28th International Conference on Hydraulics, Water Resources, River and Coastal Engineering. Conducted by NIT Warangal, India on December 21-23, p.341.

14. Achu, A.L., Gopinath, G., A. R Sabitha., and M Pragath., (2023). An appraisal of Groundwater vulnerability in a Semi-Arid Coastal - inland aquifer of Southeast India. In book of Abstracts of HYDRO 2023, 28th International Conference on Hydraulics, Water Resources, River and Coastal Engineering. Conducted by NIT Warangal, India on December 21-23, p.317.

15. Aju C.D., A.L Achu., A Ashwin., M.C Raicy., and Gopinath, G., (2023). Development of Water Resources Sustainability through Strategic Identification of Suitable Sites and Artificial Groundwater Recharge Structures in the Kadalundi River Basin, South India.In book of Abstracts of HYDRO 2023, 28th International Conference on Hydraulics, Water Resources, River and Coastal Engineering. Conducted by NIT Warangal, India on December 21-23, p.312.

16. Anjali, N., A. L Achu., C.D Aju., and Gopinath, G., (2024). Assessing the Neo-Tectonic Activity in The Achankovil River Basin Through Morphotectonic Analysis. Proceedings of 36th Kerala Science Congress. Conducted by KCSTE on 8 - 11 February 2024, p.278.

17. Achu, A.L., Thomas Jobin., C.D Aju., and Gopinath, G., (2024). AI Based Decision Support System for Landslide Hazard Management in Kerala. Proceedings of 36th Kerala Science Congress. Conducted by KCSTE on 8 - 11 February 2024, p.242.

18. Vandhana, T V and Girish Gopinath., (2024). Google Earth Engine for Flood Mapping & Damage Assessment on The Greater Pamba River Basin, Kerala, India. Proceedings of 36th Kerala Science Congress. Conducted by KCSTE on 8 - 11 February 2024, p.248.

19. Divya, Nair., P.V. Gayathri., Gopinath, G., (2024). Sono photocatalytic Removal of Bacterial Pollutant from Water Using Zno as Catalyst. Proceedings of 36th Kerala Science

20. Rani, V., Gopinath, G., P.R Jayachandran., and S. Nandan Bijoy., (2024). A Novel Approach to Geomorphic-Based Carbon Stock and Sequestration Assessment of Mangroves for Climate Change Mitigation. Proceedings of 36th Kerala Science Congress. Conducted by KCSTE on 8 - 11 February 2024, p.287-288.

21. Sarathjith, M.C., Shibu Sherin., U Surendran., and Gopinath G., (2024). Assessment of Microplastic Abundance in Beach Sand Using Hyperspectral Sensing. Proceedings of 36th Kerala Science Congress. Conducted by KCSTE on 8 - 11 February 2024, p.260.

22. Lekshmi Haridas, Devika Pillai, Rejish Kumar, Rahul Krishnan, Sahul Hameed, Majeed, A., Sahoo, P.K., Mohanty, J. and Paul, A. 2023. 'Genetic epidemiology of TiLV: What we know and don't know?'. In: The 3rd International Conference on Aquatic Animal Epidemiology (AquaEpi III), November 29-December 1, 2023 in Lucknow, India.

23. Safeena M P, Shijina. P. Nambiar, Ardhra Vijayan, Gijo Ittoop, Rahul Krishnan, Devika Pillai (2023). Concurrent occurrence of Infectious Spleen and Kidney Necrosis Virus (ISKNV) and Red Seabream Irido Virus (RSIV) in cultured Asian Seabass (*Lates calcarifer*) from Kerala: The first evidence. In: The Third International Conference on Aquatic Animal Epidemiology (2023), Lucknow. 29 November-1 December.

24. Shijina. P. Nambiar, Ardhra Vijayan, Divya Haridas, Rahul Krishnan, Safeena M. P, Gijo Ittoop, Devika Pillai (2023) First detection of Tilapia parvovirus (TiPV) associated with massive mortalities

of farmed Nile tilapia (*Oreochromis niloticus*) in Kerala. In: The Third International Conference on Aquatic Animal Epidemiology (2023), Lucknow. 29 November-1 December.

25. Poster presentation on "NSPAAD Report Fish Disease App" in International Fisheries Congress held at KUFOS. January, 2023

WORKSHOP/TRAINING/ PROGRAMMES

1. Dr. Girish Gopinath, Professor: Attended three-day International Conference on Frontiers in Marine Sciences (MARICON-2024) organized by the School of Marine Sciences, Cochin University of Sciences and Technology, Kochi-16 on 8-10 April 2024
2. Dr. Jenny Ann John, Assistant Professor: Faculty Development Program (FDP) on 'Future Foods: Cutting Edge Technologies in Food Processing at Agri-Business Incubator, College of Agriculture, Vellanikkara, from 27 th Nov.-2 nd Dec., 2024.
3. Dr. Jenny Ann John, Assistant Professor: FDP on ChatGPT and AI Tools for Educators in line with OBE, organised by St Joseph College (Autonomous), Irinjalakuda, in association with The Kerala State Higher Education Council from 19 July to 26 July 2023.
4. Dr. Jenny Ann John, Assistant Professor: One-day Seminar on IPR Awareness organized by Inter University Centre for IPR Studies (IUCIPRS), CUSAT at KUFOS, Kochi on 12 February, 2024.
5. Dr. Gijo Ittoop, Assistant Professor: Conducted classes for Shrimp farmers on the topic "Shrimp Diseases and its control and AMR" at Thevally training centre Kollam om 19/01/2023
6. Dr. Gijo Ittoop, Assistant Professor: Handled awareness session for Project Coordinators and Aquaculture promoters of Subhikshakeralam Janakeeya Matsyakrishi Project on AMR at Neyyardam Training Centre, Fisheries Department.
7. Dr. Gijo Ittoop, Assistant Professor: Attended launching of Kerala Institutional Ranking Framework organized by KSHEC on 3/5/2023 deputed by Hon. Vice Chancellor at University of Kerala Karyavattom Campus
8. Dr. Gijo Ittoop, Assistant Professor: Handled session on prospects of aquaculture at Chembu Gramapanchayath on 15/2/2023 as per order No. EXTN/VA/2017 dated 6/2/2023.
9. Dr. Phiros Shah, Assistant Professor: Jan 2024 - Participated, in MarineData4Asia 2024 Online Workshop, Organized by Copernicus, the Copernicus Marine Service, and Mercator Ocean International.
10. Dr. Phiros Shah, Assistant Professor: Jan 2024 - Participated, in the International Fisheries Congress & Expo 2024 (IFC 2024) Organized by Kerala University of Fisheries and Ocean Studies (KUFOS) and College of Fisheries Panangad Alumni Association (COFPAA) on 12 to 14 January 2024.
11. Dr. Phiros Shah, Assistant Professor: Poster Presentation: {Presented a poster on & Impact of the Long-Duration Tropical Cyclone 'Biparjoy' on the Arabian Sea: Insights into Ocean Dynamics, Air-Sea Heat Fluxes, and Biological Response.
12. Dr. Phiros Shah, Assistant Professor: Dec 2023 - Participated, in Esri Training MOOC Course, GIS for Climate Action, Online Course Earned a certificate upon completion of the Esri Training Massive Open Online Course (MOOC) on GIS for Climate Action.
13. Dr. Phiros Shah, Assistant Professor: Oct 2023 - Participated, in 24th International SST Users' Symposium and GHRSST Science Team Meeting (GHRSST24) October 2023. Attended in-person

meeting from 16 to 20 October 2023 hosted by the Indian Space Research Organisation (ISRO) and Space Application Center (SAC) in Ahmedabad, India.

14. Dr. Anu Gopinath, Associate Professor: Participated in "Six days short term training program on Qualitative and Quantitative Assessment of Marine Microplastics" organised by the Department of Civil Engineering, SRMIST-KTR in association with MLMP Funded Project & National Centre for Coastal Research (NCCR) Ministry of Earth Sciences, Government of India from 29/01/2024 to 03/02/2024.

15. Dr. Unnikrishnan S, Assistant Professor: International Conference cum Hands-on Workshop in Biomedical Translational Research (3rd and 4th August 2023) organized by Kerala State Higher Education Council at SCTIMST Trivandrum

16. Dr. Unnikrishnan S, Assistant Professor: Hands-on Workshop on "Mass Spectrometry-based Metabolomics" held from July 6th to July 8th, 2023 at Centre for Systems Biology and Molecular Medicine, Yenepoya Research Centre, Manglore.

17. Dr. Dinesh K, Professor: Celebrated EnvironmentalDay2023 inassociation with GHSS, Cheruthazam, onJune5th and handed over 50 saplings to SPC students in Cheruthazam.

18. Dr. Dinesh K, Professor: A painting competition was conducted on the subject of 'OCEANS' for the students of Government LP School, Payyanur, and Ocean Day was celebrated on June 8th 2023.

19. Dr. Dinesh K, Professor: On the occasion of World Mangrove Day, an environment quiz competition was conducted for the students at Aided L. P. School, Payyanur, on July 26th 2023.

20. Dr. Dinesh K, Professor: On the occasion of Ozone Day, September 16th, 2023, an essay competition was conducted for the students at Shenoy Smaraka Govt. High School.

21. Organized a one-daytrainingprogramon 'Vannamei farming' in association with the College of Fisheries and Aquaculture Development co-operative society on November 28th 2023.

22. Dr. Dinesh K, Professor: Organized a two-day training program on value-added products from Mussel (under the tribal sub-plan) with the guidance of ICAR-CIFT, Kochi, from March 21–22, 2024, at the College of Fisheries.

23. Dr. Dinesh K, Professor: Organized a one-day hands-on training program on value-added products from seafood in collaboration with the Aquaculture Development Cooperative Society(ADCOS), Payyanur, on March 27, 2024, at the College of Fisheries, Payyanur.

24. Dr. Dinesh K, Professor: Organized an online section of marketing strategies for value-added products from seafood by Dr. T. R. Ananthanarayanan (Managing Partner, Foodastha, Kochi) on April 17th 2024.

25. Dr. Dinesh K, Professor: Provided hands-on training in parasitology for the Fisheries Extension Officer and Project Coordinator from Wayand District.

26. Dr. Dinesh K, Professor: Celebrated World Environment Day with the students of B.F.Sc., College of Fisheries, Payyanur, at the Botany and Zoology Department of Payyanur College on June 5th 2024.Dr. Ratheesh Narayanan (Assistant Professor) delivered a talk on the topic 'Importance of Environment Day and Rare Species of Plants'.

27. Dr. Dinesh K, Professor: Celebrated National Fish Farmers' Day in association with the College of Fisheries, Payyanur, and the Department of Fisheries, Kannur, on July 10th 2024 at the College of Fisheries, Payyanur.

INVITED TALKS/ PANELLIST/ RADIO TALK

1. Dr. Girish Gopinath, Professor: Invited talk on "Geospatial Technology for Coastal Ecosystems" in connection with National Workshop on Rising Impacts of Climate Change and Coastal Ecosystem Responses on 6th April, 2023 at Kochi, Organised by National Insituite of Oceanography, Regional Centre, Kochi.
2. Dr. Girish Gopinath, Professor: Invited talk on "Remote sensing techniques and data sources" as a part of the one-week workshop on Landslide mitigation strategies using remotely sensed data and open-source GIS tools organized by the Department of Geology, University of Kerala, Thiruvananthapuram and funded by Indian Institute of Remote Sensing on 1st august 2023.
3. Dr. Girish Gopinath, Professor: Delivered a lecture on "Application of Remote Sensing in hydrological studies in the context of changing Climate" on 19th August, 2023 in connection with DST-SERB High End workshop Karyashala on Integrated Water Resources Management in the changing climatic Scenario: Application of advanced Geohydrological and Geophysical Techniques, Karyasala (DST-SERB) Department of Science and Technology, Govt of India organised by KSCSTE - Centre for Water Resources Development and Management Kunnamangalam P.O, Kozhikode, Kerala.
4. Dr. Girish Gopinath, Professor: Delivered a lecture on the topic "Application of Remote Sensing in Groundwater Studies" on 12th September 2023, in connection with training programme for the in-service personnel on "Sustainable Groundwater Management: Concepts and Tools" at CWRDM, Kunnamangalam, Kozhikode during 11-15, September 2023.
5. Dr. Girish Gopinath, Professor: Delivered a lecture on "Application of Geospatial Technology for Disaster Management" in connection with a Short-Term Course in Disaster Management & Climate Change on 19.09.2023 by UGC-HRDC Kannur University.
6. Dr. Girish Gopinath, Professor: Delivered a lecture on "Geospatial technology for Natural Resources Management" on 25/09/2023 in connection with the Technology Training Programme on "Ecosystem assessment, modelling & ecosystem services analysis: tool & techniques" from 21 to 25 September 2023, organized by the Department of Aquatic Environment Management, Kerala University of Fisheries and Ocean Studies, Kochi, Kerala- 682506.
7. Dr. Girish Gopinath, Professor: Delivered a talk on Geospatial Technology for Natural Resource Management in connection with Value added course organized by Department of Geology, Calicut University on 07/10/2023.
8. Dr. Girish Gopinath, Professor: Delivered a talk on "Geospatial Technology for Natural Resource Management" on 10/10/2023 in connection 11th Refresher Course in Environmental Studies by UGC – Human Resource Development Centre, University of Calicut during 06.10.2023 to 19.10.2023.
9. Dr. Girish Gopinath, Professor: Invited talk on "Geospatial technology in water resources management" in connection with 41st Association of Hydrologists of India (AHI), Annual Convention and National Seminar on Hydrology, hosted at PSG College, Coimbatore on November 30th to December 2nd, 2023.
10. Dr. Girish Gopinath, Professor: Delivered a talk on "Fundamentals of GIS and its application in Civil Engineering" on 15/01/2024 in connection with Five days faculty development program on GIS and Geo Informatics at Thrissur Government Engineering College sponsored by Directorate of Technical Education, Kerala during 15.01.2024 to 19.01.2024.

11. Dr. Girish Gopinath, Professor: Delivered a talk on "Spatial Database for Water Resources Management" on 23/01/2024 as part of the "National Workshop on Techniques of Groundwater Survey and Methods of Conservation", organized by the Department of Geography, Government Arts and Science College, Nilambur, Kerala during January 22nd - 24th, 2024.

12. Dr. Girish Gopinath, Professor: Technical Talk on "Role of Geospatial Technology for Disaster Mapping and Mitigation" on 5th February 2024 in connection with Five days training programme on "Disaster Risk Reduction under Changing Climate" Organised by TKM Engg. College, funded by Directorate of Environment and Climate Change, GoK.

13. Dr. Girish Gopinath, Professor: Technical Talk on "Recent trends in Geospatial research" on 16.02.2024 at the Department of Post-Graduate Studies and Research in Geology, Government College Kasaragod in connection with two-day National Seminar on "Recent Trends in Geosciences" during 15th and 16th February 2024. My Sincere thanks to all faculty members of the Department of Post-Graduate Studies and Research in Geology, Government College Kasaragod.

14. Dr. Girish Gopinath, Professor: Talk on "Geospatial Technology for Natural Resources Management" in connection with Value added Course, Department of Geography, Kannur University on 23rd February 2024.

15. Dr. Girish Gopinath, Professor: Lecture on "Role of Geospatial Technology for Environmental Studies" on 16th March 2024 in connection with Refresher Course on Recent advances in Environmental Science for the teachers, held online by MMTTC, Kannur University, Thavakkara.

16. Dr. Girish Gopinath, Professor: Invited Talk on "Geospatial Technology for Earth System Sciences" on 9th April 2024 in connection with International Conference on Frontiers in Marine Science, Challenges and Prospects, MARICON 2024, CUSAT, Kochi during 8th to 10th April 2024.

17. Dr. Girish Gopinath, Professor: Keynote addres on "Geospatial Technology for Mapping, Monitoring and Modelling of Landslides" in connection with Regional workshop on Landslide Disaster Management in Kerala by Geological Survey of India; Kerala & Lakshadweep on April 30th, 2024 at Trivandrum, GSI.

18. Dr. Girish Gopinath, Professor: Invited talk on "Geospatial Technology for Mapping, Monitoring and Modelling of Landslides" in connection with "Short Term Training Programme on UAV Based Geohazard Assessment: An Emerging Technology in Landslide Monitoring" under ISRO, Capacity Building in Space Based Disaster Management Support, on 14.05.2024 at School of Environmental Sciences, Mahatma Gandhi University, Kottayam, Kerala.

19. Dr. Girish Gopinath, Professor: Delivered a talk on "Geospatial Technology for Natural Resources Management with special emphasis on Hyperspectral Remote Sensing" in connection with DST-SERB sponsored high-end workshop (KARAYASHALA) on "Hyperspectral Sensing for Agriculture and Water Resources Management" on 5th June 2024 at Centre for Water Resources Development and Management (CWRDM), Kozhikode, Kerala.

20. Dr. Jenny Ann John, Assistant Professor: Invited as Speaker by Food Safety and Standards Authority (FSSAI) Cochin Branch Office on 16 th Oct., 2024, at St. Albert' College, Kochi, on the FAO theme 'Water is Life, Water if Food. Leave no one behind.'

21. Dr. Jenny Ann John, Assistant Professor: Handled (Course content and lecture videos) the NPTEL-MOOC Course on Food packaging in collaboration with IIT Chennai, Aug-Sep, 2024; 4074 students enrolled.

22. Dr. Phiros Shah, Assistant Professor: February 2024 - Attended one-day seminar on water security in Alappuzha, Kerala. The seminar was organized by the Kerala State Department of Public Education and Samagra Shiksha Kerala.

23. Dr. Unnirishnan S, Assistant Professor: Invited Talk at the Faculty Training Program (FTP) 2024 on "Development ofSustainable Packing Techniques of Fishery Food Products" under DBT Skill Vigyan State Programme Scheme held from 19th February to 6th March 2024.

24. Dr. Unnirishnan S, Assistant Professor: Expert Talk on the topic "Small Molecules as Anti-cancer and Anti-inflammatory agents" at SCIENCIA-2024 (29th Feb. 2024) at Mahatma Gandhi University Kottayam.

25. Dr. Unnirishnan S, Assistant Professor: Invited Talk at the Faculty Training Program (FTP) 2024 on Cell Culture Techniques for Biotechnology Applications – Focus on Neurobiology and Cancer under DBT Skill Vigyan State Programme Scheme held from 14 February to 27 February 2024.

26. Dr. Unnirishnan S, Assistant Professor: Invited Talk on the topic "Prospects of Marine Microbial Metabolites as Pharmaceutical Agents" at International Fisheries Congress and Expo-2024 (12-14 February 2024), Cochin, India.

27. Dr. Unnirishnan S, Assistant Professor: Co-Chaired a session in Food Enterpreneurs Conclave 2.0 (30-11-2023) organised by Association of Food Scientists and Technologists (Inida) and Department of Food Science and Technology, KUFOS.

28. Dr. Unnirishnan S, Assistant Professor: Invited Talk on the topic "From Lab Bench to Clinics; Our Era of Translational Research" at Collaborative Research Initiatives on Science and Technology-2023 (1st of July 2023 at Jubilee Centre for Medical Research, Thrissur.

29. Dr. Unnirishnan S, Assistant Professor: Chairing a scientific session in International Conference on Science and Technology of Advanced Materials (STAM-23) at Mar Athanasius College, Kothamangala on 19th April, 2023.

RECOGNITIONS/AWARDS

1. Dr. Radhika Rajasree S R, Professor: Spanish Ministry of Agriculture- International Centre for Advanced Agronomic Mediterranean Studies (CIHEAM)International Training Fellowship Spain (2023)
2. Dr. Radhika Rajasree S R, Professor: Best poster Award 2024 International Fisheries Congress and Expo-2024
3. Dr. Rejish Kumar V J, Assistant Professor: Greeshma James, Sajeevan T P and Rejish Kumar V J (2024). Exploring the antimicrobial, antioxidant and quorum quenching activities of actinobacterial isolates associated withmangroves in Ernakulam district. International conference on frontiers in marine science (Maricon 2024) organized by School of marine science, cochin university of science andtechnology (India), 8-10 April 2024, held at CUSAT, Kochi (Best poster Award)
4. Dr. Phiros Shah, Assistant Professor: Poster Presentation: Presented a poster on Impact of the Long-Duration Tropical Cyclone'Biparjoy' on the Arabian Sea: Insights into Ocean Dynamics, Air-Sea Heat Fluxes, and Biological Response. Awarded 2nd Best Poster on the presented theme at the conference.
5. Dr. Anu Gopinath, Associate Professor: Kirthiga S S and Dhinesh R has been the first prize winners of Quiz competition conducted in the training programme, "Six days short term training program

on Qualitative and Quantitative Assessment of Marine Microplastics" organised by the Department of Civil Engineering, SRMIST-KTR in association with MLMP Funded Project & National Centre for Coastal Research (NCCR) Ministry of Earth Sciences, Government of India from 29/01/2024 to 03/02/2024.

KIRTHIGA S S has also been awarded with the "Overall Performer" award and "Best Speaker Award" in the same training programme mentioned above.

6. Dr. Anu Gopinath, Associate Professor: KIRTHIGA S S has been conferred with 'Best Paper Award' for the paper entitled "Study on Accumulation of Pesticides and Microplastics in the Sediments of Kongsfjorden - Krossfjorden Systems of Arctic" presented in World Ocean Science Congress conducted during Feb 27-29, 2024.
7. Dr. Anu Gopinath, Associate Professor: Honorary fellowship of Indian Society of Analytical Scientists 2024.
8. Dr. Unnikrishnan S, Assistant Professor: Awarded with Young Investigator Program in Biotechnology-2023 by KeralaBiotechnology Commission.
9. Arjun Arulvel and Radhika Rajasree (2023) BEST ORAL presentation: Extraction and characterization of gelatin based biodegradable polymers, National Technical Workshop, Indian

   Perspective on Food safety, security and standards, ICAR-CIFT,7-8 th June, 2023.
10. Roopa Rajan and Radhika Rajasree (2023) BEST POSTER presentation: Extraction of Seaweed pasta and noodles, National Technical Workshop, Indian Perspective on Food safety, security and standards, ICAR-CIFT,7-8 th June, 2023.

ACTIVITIES AT KUFOS

1. Dr. Girish Gopinath, Professor: Organised ISRO sponsored 10 days Training Program on Geospatial Insights for landslides mapping and mitigation at KUFOS, Puduveypu campus (Dept. of Climate Variability and Aquatic ecosystems) on January,2024.
2. Dr. Girish Gopinath, Professor: Organised DoECC sponsored 5 days Training Program on Geospatial Technology for Natural Resources Management at KUFOS, Puduveypu campus (Dept. of Climate Variability and Aquatic ecosystems) on February ,2024.
3. Dr. Girish Gopinath, Professor: Conducted Mapathon training workshop jointly by Nansen Environmental Research Centre, India and KUFOS, Puduveypu campus (Dept. of Climate Variability and Aquatic ecosystems) March 11 ,2024.
4. Dr. Gijo Ittoop, Assistant Professor: Organized International Fisheries Congress and Expo 2024 (Three days 12/1/24 to 14/1/24) as Organizing Secretary.
5. Dr. Gijo Ittoop, Assistant Professor: Taken oneday Awareness class on the topic "Fish Diseases and Preventive Measures" on 22/06/2023 held at Pathanamthitta organized by National Surveillance Program for Aquatic Animal Diseases (NSPAAD) project, KUFOS and Department of Fisheries, Pathanamthitta.
6. Dr. Radhika Rajasree S R, Professor: KADAL state level workshop Convenor, Sub theme: Fish value addition and waste valorization 30 th September, 2023.