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DEPARTMENT OF FISHERIES

Food and Agriculture Organization of the United Nations

ICES/FAO Working Group on Fishing Technology and Fish Behaviour (WGFTFB23)

Symposium on

Innovations in Fishing Technologies for Sustainable and Resilient Fisheries

13-17 February 2023 | Taj Gateway Hotel, Kochi, India

Event Report

Organised by

BOBP

NFDB National Fisheries Development Board
Department of Fisheries
Government of India

In collaboration with

ICAR

CMFRI

ICES/FAO Working Group on Fishing Technology and Fish Behaviour (WGFTFB23)

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Event Report

Bay of Bengal Programme Inter-Governmental Organisation
91, Saint Mary's Road, Abhiramapuram
Chennai - 600 018, Tamil Nadu, India

Preparation of Symposium Report

The Symposium was funded and hosted by the Department of Fisheries, Government of India. This report has been compiled for submission to the Department of Fisheries, Government of India.

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The Symposium was held alongside the 23rd Working Group Meeting of the International Council for the Exploration of the Sea (ICES) - Food and Agricultural Organization (FAO) on Fishing Technology and Fish Behaviour (ICES-FAO WGFTFB-23), of which the Chairs were:

Dr. Daniel Stepputtis, *Scientist, Thünen Institute, Germany*
Dr. Antonello Sala, *Senior Fisheries Scientist, National Research Council, Italy*
Mr. Jon Lansley, *Fishery Industry Officer, FAO, Italy*

Compilation & Editing

Dr. P. Krishnan, *Director, BOBP-IGO, Chennai*
Dr. L. Narasimha Murthy, *Senior Executive Director, NFDB, Hyderabad*
Mr. Antony Xavier, *Fisheries Development Commissioner, DoF, GoI, New Delhi*
Mr. Rajdeep Mukherjee, *Policy Analyst, BOBP-IGO, Chennai*
Dr. M. Sri Hari, *Project Scientist, BOBP-IGO, Chennai*
Dr. A. Gopalakrishnan, *Director, ICAR-CMFRI, Kochi*

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Executive summary

The International Symposium on “Innovations in Fishing Technologies for Sustainable and Resilient Fisheries” and the 23rd meeting of the ICES-FAO Joint Working Group on Fishing Technology and Fish Behaviour (WGFTFB) were organized from 13-17 February 2023 in Kochi, India. The event was organized by the Department of Fisheries, Government of India and jointly organized by the Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO) and the National Fisheries Development Board (NFDB). It brought together scientists, researchers, officials, policymakers, diplomats, industry, entrepreneurs, and students from 32 countries both online and offline to discuss the challenges facing world fisheries, including depleted fish stocks, habitat destruction, pollution, climate change, fish loss and wastage by-catch, and ghost fishing. The symposium provided a platform for developing actionable agendas, identifying research and capacity-building needs, and forging partnerships between and among researchers, academia, industry, and policymakers for sustainable fisheries in the future.

The ICES-FAO WGFTFB aimed to incorporate fishing technology issues and specialized expertise into management advice, including the impacts of fishing on the environment, while the objectives of the International Symposium were to provide a forum for global synthesis of scientific knowledge, identify appropriate technologies for a blue transformation of small-scale fisheries, discuss and review innovations in various domains of fishing technologies, and evaluate options for optimizing energy use and reducing GHG emissions.

During the opening session, India's plans and perspectives in marine fisheries development and research were shared by Dr. J.K. Jena, DDG, Fisheries, ICAR, and Dr. J. Balaji IAS, Joint Secretary (Marine), Department of Fisheries, Government of India. The inaugural speech was given by Shri. Jathindranath Swain, IAS, Secretary, Department of Fisheries, who emphasized the government's commitment to maintaining a balance between improving fishing performance and minimizing its negative impacts. The event concluded with Dr. C. Suvarna, IFS, Chief Executive, NFDB, setting the stage for a productive and enlightening event.

The International Symposium enveloped eight thematic sessions on various topics, such as Active gears, Passive gears, Indicators, ALDFG, Behavior, Energy, Gear design, and General. A total of 137 presentations were made during these sessions leading to discussions focused on innovative fishing technologies that can help reduce bycatch, increase selectivity, and improve the efficiency and profitability of fishing operations while ensuring the sustainability of fish stocks and marine ecosystems.

The session on Active Gears, involved the use of powered vessels to actively gather or chase the target species. The session covered various aspects of trawl, including selectivity, gear modification, by-catch, and seine fisheries with presentations by experts from different countries. The salient findings emerged from the presentations include the use of fixed meshes to improve fish size selection and stabilize the selection process, LED lights to reduce bycatch in beam trawl fisheries, and specialized octopus trawl nets operated by multiday trawlers along the Southwest coast of India. The session also put forth several recommendations, including the need for research to improve size/species selection, the evaluation of the suitability of flying trawl doors in trawl nets operated in India, and the testing and popularization of acoustic deterrent devices among fishermen.

The presentations in the Passive Gears session covered various aspects related to catch efficiency, gear modifications, selectivity, and sustainability of fisheries by different passive gears such as gillnets, lines, and traps. Key findings included the use of fluorescent netting and LED in Pot/Trap fisheries yielding good catch with diverse species composition, trap fishing being used as seasonal fishing gear for catching major and minor perches along the coral reef regions, and the modified dol net cod end reducing the quantity of low-value juvenile fish and increasing the quantity of low-volume high-value fish. The presentations made recommendations such as the need for optimizing hooks for longlines, promoting trap fisheries, commercializing artificial fish baits, and conducting trials on different bycatch reduction devices for various passive gears.

The presentations on Indicators covered topics such as trawl selectivity, predicting discard survival, and addressing by-catch issues in fisheries. Salient findings from the presentations include the use of rectangular grid Bycatch Reduction Devices (BRDs) to address bycatch and practical issues in trawl fisheries, the need for a holistic approach that considers the multispecies nature of fishing gear, and the development of Fisheries Performance Indicators (FPIs) for different fishing gears. Recommendations made included the development of easily measurable and cost-effective indicators for every fishery and the use of participatory decision tools to reconcile conflicting natural resources management objectives.

The presentations on Abandoned, Lost or otherwise Discarded Fishing Gear (ALDFG), covered various aspects related to ALDFG, such as gear marking, the global and regional status of ALDFG, and gear modification to reduce ghost fishing. The salient findings from the presentations include the importance of the Voluntary Guidelines on the Marking of Fishing Gear, the need for in-depth studies on ALDFG along the Indian coast, the identification and retrieval of underwater lost and ghost fishing gears using smart acoustic solutions, and Material Flow Analysis as an environmental accounting tool. The recommendations included implementing policies and schemes for extended producer responsibility, promoting research on designing fishing gear to reduce ghost fishing and creating a regional database of ALDFG hotspots.

The Survival/Behaviour/Physiology session highlighted the importance of understanding fish behavior to modify fishing gear design and influence species composition in catches. The presentations focused on Reflex Action Mortality Predictor (RAMP) as a tool to predict escape and delay mortality during fishing, and Optomotor response and steady swimming of fish as potential indicators to increase trawl selectivity. The session recommended further research on the behavioral response of fish to assess and modify gear design.

The presentations on Energy focused on innovative solutions for energy conservation, reducing GHG emissions, and gear modification, resulting in less energy consumption. The recommendations focused on promoting alternative fuels, hybrid engines, and environmental-friendly fishing gear.

The presentations on Gear design emphasized the importance of computational simulation studies and model testing for designing and optimizing fishing gear. The recommendations focused on promoting research on alternate gear accessories and methodologies to improve the selectivity of fishing gear.

The General session had presentations and posters on various topics related to sustainable fisheries management, bycatch reduction, and technological interventions. Some key findings

included the need for a larger mesh size in cod ends to reduce juvenile bycatch, the importance of co-management systems, the need for better training to reduce post-harvest losses, and the development of sustainable harvest technologies. Recommendations included the use of Turtle Excluder Devices, the installation of artificial reefs, and the strengthening of AIS and MCS to reduce illegal fishing. Overall, the conference highlighted the need for sustainable conservation and management of shared fish stocks through regional cooperation.

The International Symposium concluded with a report on the outcomes of the WGFTFB'23 and Symposium, the report of outcomes of the side events, the award ceremony for winners under different categories, and the overall conclusions of the symposium and way forward.

It was recommended that India should focus on improving size and species selection in various fishing gears, develop and popularize artificial fish baits from fish and shellfish waste, and assess the spatio-temporal distribution patterns of bycatch species for designing spatial management measures in the future. Capacity building and development recommendations included transforming survey vessels into research cum survey vessels, establishing a Fisheries Monitoring Centre in major harbours, and creating a regional database on ALDFG to help map ALDFG hotspots and remove ghost gears. In terms of policy, it was recommended that the government implement monitoring programs like VMS and AIS, strengthen fishing gear standards, provide state-sponsored credit and subsidy schemes to fishermen to access advanced technology, and implement the Voluntary Guidelines on the Marking of Fishing Gear (VGMFG). Overall, the recommendations for India aim to promote sustainable fishing practices, reduce bycatch, and ensure responsible management of fishing resources. It is hoped that by implementing these recommendations, India can make significant strides in ensuring the long-term sustainability of its fisheries industry.

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1. Overview of the Event

World fisheries are facing various developmental and sustainability challenges. The issues in the marine fisheries sector range from depleted fish stocks, habitat destruction coupled with pollution and climate change, fish loss and wastage, and other issues such as by-catch and ghost fishing. This calls for adopting sustainable practices, including improved fishing and postharvest techniques. The choice of harvest technology is very important as it may affect the ecological outcomes but also the social and economic outcomes and human well-being, as well. The small-scale fisheries in South and Southeast Asia are mostly marginal and vulnerable. Their choice of technology or lack of it has led to the current state of fisheries.

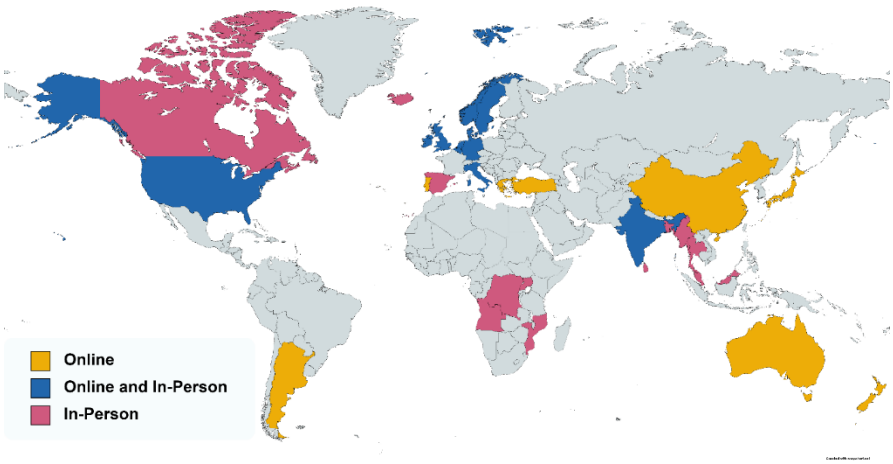
This International Symposium provided a platform for structuring actionable agenda, identifying research and capacity-building needs, and forging partnerships between and among researchers, academia, industry, and policymakers for sustainable fisheries in the future.

The 23rd meeting of the International Council for the Exploration of the Sea (ICES)-FAO Joint Working Group on Fishing Technology and Fish Behavior (ICES-FAO WGFTFB) was organized alongside the **International Symposium on Innovations in Fishing Technologies for Sustainable and Resilient Fisheries** being hosted by Department of Fisheries, Government of India.

The primary objective of the ICES-FAO WGFTFB is the incorporation of sorted fishing technology issues and specialized expertise into management advice, including, *inter alia*, the solutions to impacts of fishing on the environment (e.g., by-catch, unaccounted fishing mortality, habitat impacts, energy use, greenhouse gas emission).

The objectives of the International Symposium were to:

- *Provide a forum for global synthesis of scientific knowledge;*
- *Identify appropriate technologies for a blue transformation of the SSF;*
- *Discuss and review innovations in various domains of fishing technologies; and*
- *Evaluate the options for optimizing energy use and reducing GHG emissions.*



The participants included scientists, researchers, officials, policymakers, diplomats, industry representatives, entrepreneurs, and students. A total of 325 participants from 32 countries attended this event both Online and Offline *(Annex I).*

2. Opening Session

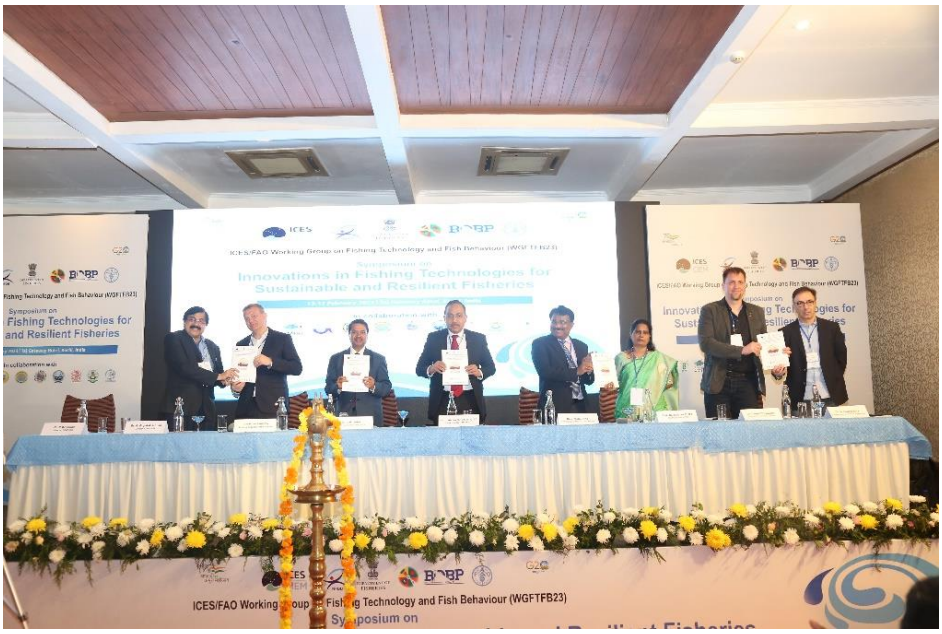
The ICES-FAO Joint Working Group on Fishing Technology and Fish Behavior (ICES-FAO WGFTFB) and International Symposium on "Innovations in Fishing Technologies for Sustainable and Resilient Fisheries" were inaugurated simultaneously on 13th February 2023, with an opening session that brought together researchers, experts, and practitioners from various parts of the world.

The opening session commenced with a welcome note from the event convener Dr. A. Gopalakrishnan (Director, ICAR-CMFRI). Dr. P. Krishnan (Director, BOBP-IGO) described the context and provided an overview of the event. Mr. Jonathan Lansley (Fishery Industry Officer, FAO) gave a detailed talk on FAO's global efforts in responsible fishing operations, followed by ICES and WGFTFB overview from Dr. Antonella sala (CNR, Italy) and Dr. Daniel Stepputtis (Thuenen, Germany).

India's plans and perspectives in marine fisheries development and research were shared by Dr.J.K. Jena (DDG (Fisheries), ICAR) and Dr. J. Balaji IAS (Joint Secretary-Marine, Department of Fisheries, Government of India)

The Inaugural speech was given by Shri. Jathindranath Swain, IAS (Secretary, Department of Fisheries) in which he said *"This event will not only ensure a way forward to better economics from the sector but also contribute to ushering ecological sustainability. The government is indeed committed to maintaining a balance between improving fishing performance and minimizing its negative impacts. Policies and legal provisions are primarily focused on low-impact fishing. The pressure on fish stocks in near-shore waters has made us think of improving the situation by exploring resources in the high seas. "The country is moving towards the Blue Economy, the approach focusing on diversifying ocean uses while conserving ecosystem health. However, technological and policy innovations, such as deep-sea fishing, mariculture, sea ranching, and deployment of artificial reefs are a must to achieve this"*

Concluding remarks were given by Dr. C. Suvarna, IFS (Chief Executive, NFDB), setting the stage for a productive and enlightening event.



Delegates during the opening session of the event

Inauguration of Wave of Arts and Stalls

Shri. Jatindranath Swain IAS, Secretary, Department of Fisheries inaugurated the Waves of Art Series - 3 event and Industry Expo. Waves of Art Series 3 – A live sketching event, with a theme on Artisanal Fisheries was conducted during the ICES-FAO International Symposium on "Innovations in Fishing Technologies for Sustainable and Resilient Fisheries" organized by BOBP-IGO and NFDB at Kochi, India, 13-17 February, 2023. Senior Artists from Chennai and Urban sketchers of Kochi actively participated and demonstrated their sketching skills on the above theme. From 13-14 Feb 2023- 2 days' live painting event, a panel of 72 paintings with various mediums was created and displayed.

Inauguration of Waves of the Art event and Industry Expo

Also, there were ten booths from various Industries and Research Institutes partners which Expo will showcase the Industrial innovations and technologies in the fish harvest sector

Interaction of Secretary, DoF, and Chief Executive NFDB at Industry Expo

3. Theme-wise reports

Symposium had plenum presentations, topic groups, and poster presentations under different themes like Active gears, Passive gears, Indicators, ALDFG, Behavior, Energy, Gear design, and General. Details of the theme-wise presentation are given in the below table.

No	Theme	Type of Presentations			Total (No.)
		Plenum (Oral)	Topic Group	Poster	
1	Active Gears	12	0	2	14
2	Passive Gear	18	4	7	29
3	Indicator	3	6	0	9
4	ALDFG	7	5	4	16
5	Behaviour	2	0	0	2
6	Energy	8	0	2	10
7	Gear Design	12	0	0	12
8	General	10	0	35	45
	Total	72	15	50	137

3.1. Active Gears

Active gears involve the use of powered vessels to actively gather or chase the target species. Active gears, where capture is achieved by moving the gear to pursue and capture organisms at the industrial scale, are highly technical, carefully engineered, and have a high economic cost. The main types of active gears are trawls and encircling nets.

Presentations covered various aspects of trawl, such as selectivity, gear modification, by-catch, and also seine fisheries.

Presenter	Title	Type
Zita Bak-Jensen *(DTU, Denmark)*	Turn and Fix – two ways to sharpen size selection	Plenum
Mattias Van Opstal *(ILVO, Belgium)*	A brighter future for the Belgian fishing fleet: an overview of 3 years of fishing trials using LED	Plenum
Rajan Kumar *(CMFRI, Kochi)*	Trawl goes selective: An insight into demand-induced innovation in trawl fishery of Gujarat	Plenum
Elsa Cuende *(AZTI, Spain)*	Does a cod-end with shortened lastridge ropes provide optimal escape opportunities for different fish species?	Plenum
Manju Lekshmi *(CIFT, Kochi)*	Beach seine fishing in India: scope for improvement for sustainability	Plenum

Thomas Noack *(Thuenen, Germany)*	A journey to new regions: Testing and improving the MiniSeine´s performance in waters off the German Baltic Sea coast	Plenum
Valentina Melli *(DTU, Denmark)*	What will it take to get fish out of the trawl? Creating a Low-Flow Zone within and outside the boundaries of a trawl to incentivize fish escape	Plenum
Das *(FSI, Vizag)*	Comparative studies of 30 mm diamond mesh and 30 mm square mesh cod-ends were conducted during the demersal fishery resources survey along the Andhra Pradesh coast	Plenum
Venkatesan *(CMFRI, Kochi)*	Emergence of specialized trawl net for the fishery of octopus along the southwest coast of India	Plenum
Ignacio Soler *(Kongsberg Maritime Spain)*	Improving energy efficiency and seabed impact in the deep-sea shrimp trawl fishery	Plenum
Pieke Molenaar *(WMR, Netherlands)*	Quick visual observation of pelagic school composition to avoid unwanted catches in commercial pelagic (trawl) fisheries.	Plenum
Mikel Basterretxea *(AZTI, Spain)*	Demonstration of pingers' potential to reduce Common Dolphin bycatch in bottom trawl gears	Plenum
Lalima *(KUFOS, India)*	The Details of trawlers (Length Overall (LOA) of Trawlers and Engine horsepower) operated in the Cochin coast	Poster
Amala Shajeeva *(TNJFU, India)*	Comparative analysis on the impact of design on the drag resistance of trawls operated from different size class vessels of Thoothukudi.	Poster

Details of the abstracts are given in Annex II

Presentation in session on Active Gears

3.1.1. Salient Findings extracted from Presentations

- ✓ Fixed meshes (Diamond or square shape) is an effective approach to improve the size selection of fish , thereby contributing to sustainable exploitation.
- ✓ LED light can be used to reduce bycatch in beam trawl fisheries and can also be used to increase the catches of Squid and Crab species.
- ✓ Different types of trawl nets are used along the Gujarat coast by changing the mesh size of the front panel for catching different species from Ribbon fish to Paste shrimp.
- ✓ Shortened Lastridge rope attached to the cod end with high opening angles increases escape opportunities for fishes. However, the escapement is primarily dependent upon the fish morphology and movement characteristics.
- ✓ Beach seines play a critical socio-economic role, especially in the management of gear operation, nutrition, and livelihood security.
- ✓ Mini seine can be an alternative for Danish seine, which has a similar catch rate and can be easily operated by one person, with appropriate deck adjustments.
- ✓ A combination of a Flow-stopping funnel, which creates a low flow zone along with the radial escape gap can increase the escapement of undersized fish.
- ✓ Square mesh cod end facilitates better quality productivity compared to diamond mesh cod by reducing bycatch.
- ✓ Specialized octopus trawl nets are operated by multiday trawlers along the Southwest coast of India.
- ✓ Gear modifications, such as reduced netting, use of the knotless net, use of Dyneema in headrope, and reducing the resistance of trawl doors (Otter boards) can increase the energy efficiency of trawls. Also, the use of flying trawl doors can minimize the impact on the seabed.
- ✓ Even though the echosounder can detect pelagic fish shoals from a 3 km distance, it cannot detect the species. Visual observation using underwater cameras before launching the pelagic trawl can reduce non-targeted catches.
- ✓ An active acoustic deterrent device like pingers in trawlers reduces dolphin entrapment.

3.1.2. Salient Recommendations

- Research should be focused on improving size/species selection by using:
    - *Fixed mesh (square or diamond meshes),* and
    - *Modification in trawl nets with shortened lastridges*

- For testing the suitability of the flying trawl doors or lightweight plastic doors for use by India's trawling fleets, extensive evaluation studies need to be carried out. If found suitable, these innovative trawl door designs can be popularized in India by the department of fisheries, which may both reduce the impact on the seabed and improve fuel efficiency.
- The use of acoustic deterrent devices to reduce bycatch of marine mammals needs to be tested and popularized among fishermen. Also, FAO guidelines to prevent and reduce the bycatch of marine mammals can be popularized (https://www.fao.org/responsible-fishing/resources/detail/en/c/1370993/).
- Need for modification in data collection procedure – Since fishermen are using a different set of trawl nets from multiday trawlers, haul-based catch, and effort data collection needs to be practiced.

3.2. Passive Gears

Passive gears, where the capture process relies on the movement of organisms into the gear, can be operated at any scale. Key examples include gillnets, lines, and traps. Gillnets are large grids of fine mesh that trap fish of a specific size by encircling them around their bodies and catching their gills.

Presentations covered various aspects regarding Catch efficiency, gear modifications, selectivity, and sustainability of fisheries by different passive gears.

Presenter	Title	Type
Jasper Van Vlasselaer *(ILVO,Belgium)*	Innovations in pot fisheries, a toolbox for a multi-use sea	Plenum
Mariappan Sangaralingam *(TNJFU, Nagapattinam)*	Analysis of the catch efficiency of fish traps operated along the coast of Thoothukudi, Southeast coast of India	Plenum
Sara Alvarez Berzosa *(Thuenen, Germany)*	Comparing entrance designs and testing of fish retention devices for Plaice (*Pleuronectes plattessa*) and Turbot (*Scophthalmus maximus*) fish pots	Plenum
Madhu (*CIFT, India)*	A simple modification in the trap entrance opening significantly improves the catch efficiency of mud crab (*Scylla serrata*) in a tropical estuarine fishery	Plenum
Chinnadurai *(CIFT, India)*	Design, development, selectivity, and underwater observations of pentagonal shape fish traps operated along the Gulf of Mannar	Plenum
Arjunan Karthy *(TNJFU, Nagapattinam)*	Invivo analysis of attracting ability of bio attractants derived from marine bivalves for evolving gelatin-based artificial fish baits suitable for longline fishing	Plenum
Genevieve Peck *(MI, Canada)*	Evaluating Whalesafe Fishing Gear in Eastern Canada	Plenum

Presenter	Title	Type
Karankumar (CIFE, India)	Improving the mean size of the harvest in dol net fishery with square mesh cod end design	Plenum
Ratheesh Kumar (CMFRI, India)	Designs and operational aspects of dolnets of North West coast of India with particular reference to its sustainability	Plenum
Madhu VR *(CIFT, India)*	Change in the colour of gillnets affects catch efficiency: results of an experimental gillnet trial in a tropical estuary in Kerala, India.	Plenum
Rithin Joseph *(CIFT, India)*	Assessment of gear damage by dolphins in small-scale gillnet fishery of the Southwest coast of India	Plenum
Santhosh Bhendekar *(CMFRI, India)*	Artisanal lobster gillnet fisheries along Maharashtra coast: A sustainability perspective	Plenum
Naganandhini *(TNJFU, India)*	Optimization of 'J' hook number on the catching efficiency of Carangids in the Gulf of Mannar, India.	Plenum
Harshavardhan Joshi (FSI, India)	Monofilament Long line: An effective fishing gear alternative to the multifilament long line	Plenum
Raju Nagpure (FSI, India)	Oceanic tuna longline survey in Lakshadweep Islands: a hotspot for large pelagics – a prerequisite to gear selectivity for mitigating shark bycatch	Plenum
Ravikumar *(TNJFU, India)*	Effect of hook size and baits on the catch efficiency of demersal longlines of Thoothukudi coast, Southeast coast of India	Plenum
Mini Sekharan *(CUSAT, India)*	Initiatives to scale up the sustainable pole and line tuna fishing in Lakshadweep	Plenum
Velmurugan *(TNJFU, India)*	Design and operational characteristics influence the catch rate in longline: Evidence from Pulicat Region, India	Plenum
Jesse F. *Senko (ASU, USA)*	Reducing megafauna bycatch by net illumination	Topic Group
Thomas Noack *(Thuenen, Germany)*	The pearlnet – Increasing the acoustic reflectivity of gillnets to reduce cetacean bycatch	Topic Group
Yann Rouxel *(Birdlife, UK)*	Review of seabird bycatch mitigation measures	Topic Group
Rob *Enever (Fishtek Marine, UK)*	Advances in bycatch reduction technology for passive gear	Topic Group
Naganandhini *(TNJFU, India)*	Influence of hook number on species composition, catch rate, and size of needlefishes in the Gulf of Mannar, India	Poster

Presenter	Title	Type
Prajith *(CIFT, India)*	Fishing around the open aquaculture cages using passive fishing gears, a novel concept for effective utilization of resources and energy	Poster
Nath Jha *(CIFT, India)*	Environmental performance of deep-sea gillnet fishing systems	Poster
Jacob *(TNJFU, India)*	Analysis of the technical status and economics of operation of deep-sea fishing vessels of the Thoothukudi and Kanyakumari districts of Tamil Nadu	Poster
Muhammed Jabir *(CIFT, India)*	Study on hook and line fishing in Agatti island, Lakshadweep with special reference to the impact of cyclone Ockhi on fishery production	Poster
Vasanth *(KUFOS, India)*	Impact of 'J' hook shapes on hooking rate, catch rate, and hooking position of carangids for the Gulf of Mannar, India	Poster
Ajay Nakhawa *(CMFRI, Inia)*	Status of mechanised gillnet fisheries of Northern Maharashtra in challenging times	Poster

Details of the abstracts are given in Annex II

Presentation in session on Passive Gears

3.2.1. Salient Findings extracted from Presentations

- ✓ Using fluorescent netting and LED in Pot/Trap fisheries yields good catch with diverse species composition
- ✓ Trap fishing can be used as seasonal fishing gear for catching major and minor perches along the coral reef regions.

- ✓ The entrance of traps should be designed based on the morphology of the fish. Also, Underwater IR cameras should be used to detect the fish behaviour in the end.
- ✓ The entrance of the trap opening facing toward the bottom of the trap increases the catch efficiency compared to the conventional ones, which have high escape rates.
- ✓ Traps made of stainless steel and HDPE bar mesh webbing are known to have better catch efficiency, low discards, and prevent loss of fishing gear due to their heavyweight compared to PVC traps.
- ✓ Artificial fish baits can be prepared from low-cost and underutilized marine bivalves with the incorporation of a gelatin-based bait matrix for longline fishing.
- ✓ The modified dol net cod end with a 35 mm square mesh cod end, reduces the quantity of low-value juvenile fish and increases the quantity of low-volume high-value fish.
- ✓ "Karli dol" is a type of dol net different from conventional stationary bags primarily operated in offshore water with a larger cod end. Based on the catch composition and net specification, the Karli dol proved to comply more with the Code of Conduct for Responsible Fisheries (CCRF) compared to other conventional dol nets.
- ✓ In experimental trials conducted in the estuary in Kerala, Green coloured gillnets have higher catching efficiency compared to transparent gillnets.
- ✓ Gillnet with pingers placed at 200-250m from the head rope incurred less damage due to interaction with the dolphin.
- ✓ Artisanal lobster gillnet fisheries can guarantee a constant seasonal income thus uplifting the livelihood of the fishing community in coastal villages of Maharashtra.
- ✓ For carangid fishery in the Gulf of Mannar region, J hood (No.8) was found to be better than other hooks No 7 and No 9 in terms of higher catch efficiency and CPUE.
- ✓ Monofilament longlines can be used as an alternative to multifilament longlines in India.
- ✓ Sharks were found to be highly vulnerable to "J" shaped tuna hooks used in multifilament long-line surveys compared to a circle hook. There is a huge potential for oceanic purple squid (*Stenotheuthis oualaniensis*) fishery in Lakshadweep which can be an alternative to tuna fishery.
- ✓ Solar-powered LED net illumination and the use of flashing light (5 Hz (10% duty cycle); 20 ms on, 180 ms off) represent promising sea turtle bycatch mitigation solutions in Gillnet fishery.
- ✓ Pearls made from acrylic glass can be attached to the gillnet, to increase the acoustic detectability of the gillnet. Spheres resonate at the echolocation frequency and have thus a strong echo for their size.

- ✓ 1/3rd of the seabird species is impacted by bycatch. Different types of mitigation measures can be employed in different gear types:
  - *Bird scaring lines – Long lines and Trawl Fisheries*;
  - *Hookpod – Long lines*;
  - *Reduced amount of netting, increased hanging ratio – Purse seine*; and
  - *Predator-shaped Kite, Looming Eyes Buoy – Gill nets.*
- ✓ Pelagic longlining for high-value tuna and billfish, mainly in sub-tropical and temperate regions, is known to have particularly high bycatch rates. Shark Guard designed by Fishtek Marine based upon the shark electroreception, helps deter sharks.
- ✓ The catch rate of needlefishes in 12 no. J hook is higher than in hook nos. 10 and 11 in longlines operated in the Gulf of Mannar.
- ✓ Fishing around the open aquaculture cages using passive fishing gears can result in better diversity of catch and also acts as an additional income for the fishermen.
- ✓ The efficiency '100 offset kirbed hook' was found to be better than the other '100 offset reversed' and 'non-offset 'J' hook' in terms of higher catch efficiency, hooking rate, CPUE, and hooking position for needle fishes.
- ✓ The benefit-cost ratio of Deep sea Gill netter *cum* longliner was found to be higher compared to Deepsea Gillnetter along the Tamil Nadu coast.

3.2.2. Salient recommendations

- Lakshadweep Tuna fishery:
  - *Full certification of MSC has to be taken forward at the earliest to kickstart the exports of the pole and line tuna from India.*
  - *A Strategic management plan has to be designed for responsible management of the Lakshadweep pole and line tuna fisheries system.*
  - *The popularisation of Oceanic squid fishery should be considered as one of the alternatives to tuna fisheries.*
- Longlines have a huge potential to harvest oceanic species, and optimisation studies of hooks should be conducted.
- Trap fisheries should be promoted with necessary subsidies and technical guidance. Further, research should be focused on improving the catch-efficiency of traps.
- Commercialization of artificial fish baits should be promoted to reduce the fishing impact on forage species.
- Fuel used by large gillnetter contributes maximum to Global Warming Potential compared to medium category. It is the need of the hour to adopt more environment-friendly implements for the harvest of seafood to reduce carbon footprint and by discouraging wasteful and unsustainable practices.

- Trials on different bycatch reduction devices for various passive gears need to be conducted and standardized suitably for regional conditions. Government can also consider implementing FAO Guidelines to prevent and reduce bycatch of marine mammals
- Bait is an important factor that decides both the quality and the quantity of fish. Increased pressure is exerted on the forage fish, which is often used as bait in traps, pole and lines, and longlines. Hence, developing artificial fish bait using fish and shellfish waste can reduce dependence on the use of forage fish.

3.3. Indicators

Fisheries management often suffers from a wide spectrum of severe information limitations. Hence, indicators can be used to guide the decision-making process for achieving fishery management objectives. Indicators derived from observations of a fishery system can provide information about prevailing conditions and clues for mitigating them.

Presentations covered various aspects such as trawl selectivity, predicting discard survival, and addressing the by-catch issues in fisheries.

Presenter	Title	Type
Andrea Petetta (UNIBO, Italy) *Online*	A holistic approach in trawl selectivity that account for the full species community in the catches - a Mediterranean case study	Plenum
Daniel Stepputtis *(Thuenen, Germany)*	Back to the future: revisiting fishing technologies to address current by-catch problems in the North Sea shrimp fishery.	Plenum
Sven Sebastian Uhlmann *(ILVO, Belgium) Online*	Optimizing the prediction of discard survival of bottom-trawled plaice based on vitality indicators	Plenum
Håkan Eggert *(GU, Sweden)*	Assessing global fisheries using Fisheries Performance Indicators	Topic Group
Eric Gilman *(Safina Center, Hawaii)*	Criteria for evaluating alternative management strategies for fisheries bycatch of threatened species	Topic Group
Valentina Melli *(DTU, Denmark)*	A shiny app to compare the performance of different legal gears in the Nephrops-directed fishery in Kattegat	Topic Group
Naganandhini *(TNJFU, India)*	Catch efficiency of EZ baiter hook for Needlefish in the Gulf of Mannar coast	Topic Group
Tiago Veiga-Malta *(DTU, Denmark)*	Development of a catch composition indicator to assess the performance of fishing gears in relation to area closures or exemptions to discard bans	Topic Group
Chryssi Mytilineou *(HCMR, Greece)*	Is biodiversity affected by bottom trawl fishing? It's time to take decisions	Topic Group

Details of the abstracts are given in Annex II

Presentation in session on Indicators

3.3.1. Salient Findings extracted from Presentations

- ✓ Rectangular grid Bycatch Reduction Devices (BRD) can be used to address bycatch and practical issues in trawl fisheries. It also proves to be a valid solution to the clogging-related issues which reduce the selection efficiency of the gear.
- ✓ Vitality scores or aggregated indices do not always allow for accurate predictions of post-release survival. Predictions based on vitality information can be improved by knowing the kind of gear used and the temperature at the fishing depth.
- ✓ The traditional approach of assessing the selectivity and catch performance of the trawl focuses only on the commercially important or most vulnerable species. This approach does not provide a holistic picture of the ecological impact of the fishing gear. A holistic approach that considers the multispecies nature by accounting for the full species community in the catches can be used to assess the viability of a technical solution or modification from a species/community perspective.
- ✓ Fisheries Performance Indicators (FPIs) have the overall objective to provide a low-cost, easily accessible, and rapid assessment tool that measures an overall status of a particular fishery. FPIs can be used to evaluate the effectiveness of management systems in aligning ecosystem health and human well-being.
- ✓ Criteria for the development of evidence-based integrated bycatch management strategies should facilitate achieving objectives, assessing the cost to commercial viability, tradeoffs from multispecies conflicts, the likelihood of compliance, etc. Policy guided by these criteria promises to achieve the ecological and socioeconomic objectives of bycatch management strategies.
- ✓ A mobile application can provide Catch Performance Indicators like length-based selectivity of fish for each gear at different scenarios, which helps to control the length structure of the fished stock.
- ✓ The J hooks are extensively used in longlines in the Indian region to capture carnivore fishes, including needlefish. But, Modified Needlefish longline with EZ baiter hook No.8/0 gives higher catch rates compared to J hooks.

✓ Innovative modification of the trawl for the elimination of the discarded fraction, and in particular the highly vulnerable species (e.g. Elasmobranchs), is needed if biodiversity losses should be minimized.

3.3.2. Salient recommendations

- Cost-effective indicators that can be easily measured should be developed for every fishery. It should be sensitive to fishing impacts and provide rapid and reliable feedback on the efficacy of management actions
- Fisheries Performance Indicators (FPI) for different types of fishing gear need to be developed for different fishing gears. Further, fishers can use mobile applications to record the catch performance indicators.
- Participatory decision tools and processes enable stakeholders to reconcile conflicting natural resources management objectives. Evidence-based bycatch management criteria should be developed, that provide precautionary protection for endangered, threatened and protected (ETP) species.

3.4. ALDFG

ALDFG (Abandoned, Lost or otherwise Discarded Fishing Gear) is of increasing concern in all seas and oceans due to its numerous negative environmental and economic impacts, including navigational hazards and associated safety issues. The ALDFG, which involves the continued fishing with abandoned or lost gear, commonly known as "ghost fishing," has harmful consequences on fish populations, and may also pose a threat to endangered species and benthic ecosystems. Furthermore, ALDFG incurs notable economic and social expenses.

The presentations widely covered areas related to gear marking, the global and regional status of ALDFG, gear modification to curb ghost fishing, etc.

Presenter	Title	Type
Haraldur A. Einarsson, *(FAO, Rome)*	Introduction of the Global ALDFG Survey	Plenum
Amparo Perez Roda *(FAO, Rome)*	Understanding fishing gear marking systems	Plenum
Saly N Thomas *(CIFT, India)*	Knowledge base on ALDFG and ghost fishing in India	Plenum
Sandhya K.M. *(CIFT, India)*	Assessment of ALDFG from selected marine gillnet and trap fishing sectors of India	Plenum
Kelsey Richardson (FAO, Rome)	Gear modifications to reduce ghost fishing in small- scale Brazilian lobster trap, Indonesian crab pot and Kenyan gillnet fisheries	Plenum
Antonello Sala *(FAO, Rome)*	Background study on fishing gear recycling	Plenum

Presenter	Title	Type
Ulf Lundvall *(OSAC, Norway)*	PingME	Plenum
Paritosh Deshpande *(NTNU, Norway)*	Dynamic indicators to estimate gear efficiency and leakage of plastic into oceans: a case from commercial fishing in Norway	Topic Groups
Anthony Gallagher *(ERC, UK)*	Abandoned, Lost or otherwise Discarded Fishing Gear (ALDFG) in Sri Lanka - A pilot study collecting baseline data	Topic Groups
Santiphong Putsa (SEAFDEC, Thailand)	Preliminary investigation to estimate the abandon, lost, and discard gillnet and traps (pots) along the coast of Thailand	Topic Groups
Kristine Cerbule (UiT, Norway)	Ghost fishing efficiency in snow crab (*Chionoecetes opilio*) pot fishery	Topic Groups
Haraldur Einarsson / Roth	Introduction to the Manual for Marking Fishing Gear / Fishing gear marking tests in Argentina	Topic Groups
Polar Door / Others	Introduction from stakeholders for innovative solutions (about 5min each)	Topic Groups
Damaris *(CUSAT, India)*	Incidental occurrence of ALDFG in commercial trawls of Kerala, India	Poster
Divya Viswambharan *(CMFRI, India)*	Impact of derelict fishing gears on vulnerable coastal ecosystems along west coast of India	Poster
Harshavardhan *(FSI, India)*	A survey on the impact of Ghost net on Active and passive gear: Special reference to Trawl and Monofilament long line in coastal and deep sea water	Poster
Harsha *(CIFT, India)*	Lost gear retrieval exercise through scuba diving and analysis on the fate of derelict gears in Tamil Nadu, India	Poster

Details of the abstracts are given in Annex II

Presentation in session on ALDFG

3.4.1. Salient Findings extracted from Presentations

- The ALDFG global survey organized by the FAO Fishing Technology and Operations team (NFIFO) aims to collect data from fishers' knowledge of ALDFG amounts, sources, causes, and prevention measures. The survey consists of nine almost identical questionnaires designed according to the gear types.
- Implementation of The Voluntary Guidelines on the Marking of Fishing Gear (VGMFG) can prove to be a solution to prevent, reduce and eliminate ALDFG.
- The lack of in-depth studies and inadequate knowledge base is a major concern regarding ALDFG along the Indian coast. The areas with research potential are: finding out the hotspot areas and fishing sectors of origin, Management of fishing operations, and gear-based interventions including gear marking.
- Spatial pressure (gear conflicts, collision with ships/vessels) and operational pressure (bottom obstacles, bad weather/season, loss of gear components, strong currents) are the reasons for the loss of gillnets and traps.
- A combination of circular economy and Extended Producer Responsibility (EPR) principles is required for the efficient recycling of fishing gears and responsibly managing End-of-Life Fishing Gear (EOLFG) and recovered ALDFG.
- Underwater lost and ghost fishing gears can be effectively identified and retrieved using a smart acoustic solution (PingMe). PingMe is a combination of a transponder, software, and a database that can be used to control litter in the ocean effectively.
- Material Flow Analysis (MFA) is an established environmental accounting tool used to assess flows and stocks of materials in industrial and natural systems. The MFA and local stakeholder-based indicators on fishing gears provide a holistic decision support tool for industry and policy-makers in devising and exercising sustainable strategies for fishing gears-based resource management
- Oceanic and meteorological conditions, lack of education and awareness amongst fishers, and poor waste management facilities both onboard and onshore are the major drivers of ALDFG.
- The main cause of the gillnet loss is nets getting snagged due to an obstruction, while trap (pot) loss mainly results from conflicts with other fishing gear operations in the area.
- The manual for marking fishing gear can prevent and reduce negative impacts related to abandoned, lost, or otherwise discarded fishing gear (ALDFG) and ghost fishing. Marking fishing gear is necessary to ensure effective traceability to the owner and operator.
- The most common problems of ALDFG, according to trawl operators along the Kerala coast, are restricted catch, a hindrance to fishing operations, lost fishing time, and damage to fishing gear.
- Retrieved traps by scuba diving along the Tamil Nadu coast showed colonization of benthic organisms including bivalves (59.14%), echinoderms (16.13%), gastropods (10.75%), chelicerates (8.6%), crustaceans (5.38%) and uncountable smaller parts of poriferans and cnidarians which provide meagre evidence for ghost fishing in these gears.

3.4.2. Salient recommendations

- In order to effectively address ALDFG it is necessary understand the scale of the problem. It is recommended to conduct FAO ALDFG surveys for all major fishing gears. Results of the survey will guide activities/projects/resources aimed at addressing ALDFG and plastic waste.
- Government should take necessary policy decisions for the effective implementation oof the FAO Voluntary Guidelines on the Marking of Fishing Gear.
- Fishermen should be given the necessary awareness and mechanisms to report lost gear. Also, incentives can be given to remove ghost gears from the ocean. A regional database that contains ALDFG hotspots can be developed. This helps in swift clean-up and retrieval efforts by policymakers.
- Research should be promoted to design fishing gear to reduce the risk of ghost fishing when fishing gear becomes ALDFG.
- The establishment of extended producer responsibility (EPR) policies and schemes for fishing gear is one of the actionable responses to address one major vector of potential plastic pollution derived from fishing activities.
- A Material Flow Analysis model should be established involving producers, fishers, and researchers to quantify the annual stocks and flows of plastic polymers into the ocean.

3.5. Survival/Behaviour/Physiology

A detailed understanding of fish behaviour is essential to have an impact on the process of catching fish and the composition of the species caught. Further, it helps in modifying the fishing gear design to influence the species composition in catches.

Presenter	Title	Type
Vishnupriya MS *(KUFOS,India)*	RAMP scores correspond well with biochemical test indicators: results of in-situ studies	Plenum
Junita Karlsen *(DTU, Denmark)*	Optomotor response in Atlantic cod (*Gadus morhua*) – can it be elicited and manipulated by trawl netting?	Plenum

Details of the abstracts are given in Annex II

3.5.1. *Salient Findings extracted from Presentations*

- Reflex Action Mortality Predictor (RAMP) can be used for the prediction of escape and delay mortality during fishing.

- Optomotor response, and steady swimming of fishes at the same speed as the moving trawl gear can be used as a potential indicator to increase trawl selectivity.

3.5.2. Salient recommendations

- Research on the behavioral response of fish should supported, since, it is one of the highly recommended ways to assess and modify gear design.

3.6. Energy

Fishing involves the dissipation of energy to accomplish its primary activity, i.e., harvesting of fishery resources. One major impact of fisheries is generally high levels of fuel use leading to greenhouse gas emissions. Extensive efforts have therefore been made to find innovative technical solutions for saving fuel, investments in energy-efficient propellers, gears, and other equipment, replacement of engines, and the construction of new energy-efficient vessel hulls and other energy-efficient procedures for fishing activities.

Presentations broadly covered alternate technologies for energy conservation, reducing GHG emissions, and gear modification which results in less energy consumption.

Presenter	Title	Type
Thaweesak Thimkrap *(SEAFDEC, Thailand)*	Greening Trawl Fishing Operation: Optimized Energy Saving, Minimized Seabottom Contact, and Improved Safety at Sea	Plenum
Allard van Mens *(WMR, Netherlands)*	Innovation in Dutch beam trawl fisheries: rubber-ticklers-twister gear	Plenum
M P Remesan *(CIFT, India)*	Development of VFDS Otter Boards for Energy Conservation	Plenum
Mathew McHugh *(BIM, Ireland)*	Using pair trawling to reduce fuel in a demersal fishery	Plenum
Antonello Sala (FAO, Rome)	Fuel use and greenhouse gas (GHG) emissions in fisheries	Plenum
Ravichandran (CIFNET, India)	Studies on alternate fuel for outboard motor (OBM) driven fishing boats in India	Plenum
MV Bhaiju *(CIFT, India)*	Experiments with LNG as fuel for fishing vessel propulsion: Indian experience	Plenum
Morteza Eighani *(DTU,Denmark) Online*	Semi-pelagic self-adjusting otter boards: effects on the catching performance of a demersal trawl	Plenum
Arun Jenish *(TNJFU, India)*	Analyzing carbon emission level of motorized fishing sector of Pulicat region	Poster
Asokan *(KUFOS, India)*	Environmental profiling and life cycle impact assessment on Trawler operated in Thoothukudi, southeast coast of India	Poster

Details of the abstracts are given in Annex II

Presentation in session on Energy

3.6.1. *Salient Findings extracted from Presentations*

- An innovative gear called rubber-ticklers gear in the Dutch beam trawl fisheries is used parallel to the fishing direction to startle flatfish from the seafloor. It consumes only 60.5% of the fuel used by the traditional chain-beam trawl.
- Utilization of an innovative V-form double-slotted otter board (VFDS otter board) can be a potential solution for reducing the drag, fuel consumption, and GHG emission of trawlers. 2-3 litres of diesel can be saved per hour of trawling by using VFDS otter boards.
- Pair trawling can be regarded as a viable alternative to individual trawlers operating with one net in terms of reducing fuel consumption.
- LPG kit with liquid off-take technology (LOT) on Out Board Motor (OBM) is more efficient & eco-friendlier and is a viable alternative in comparison to Petrol start Kerosene run OBM.
- LNG can be used as an alternative fuel for trawling operations. LNG can be used by substituting it with HSD.
- Semi-pelagic self-adjusting otter boards can act as a significant fuel reduction option in trawl fisheries. A 14% reduction in fuel consumption can be achieved by replacing the conventional doors with Self Adjusting Otter Boards (SAO)
- Traditional fishing methods in the Pulicat Lake *(Adappu valai, Sutthu valai, Baadi valai, Kallu valai, Siru valai, Nandu valai, Konda valai, and Nandu katcha)* emit very little quantity of CO_2.

3.6.2. Salient recommendations

- V-form double-slotted otter board and Self Adjusting Otter Board may be promoted among fishermen to reduce fuel consumption.
- Hybrid engines can be developed to reduce GHG emissions from active fishing gear.
- The use of alternate fuels like LPG can be promoted in the motorized fishing sector.
- Efficient environmental-friendly fishing gear needs to be promoted to reduce GHG emissions from fisheries.

3.7. Gear Design

The choice and design of fishing gear primarily depend on the biological, behavioural, and distribution characteristics of the target species. Fishing gear has to be selected or designed based on the presence of the maximum number of attributes suitable for the particular fishing condition and resource. Model testing is increasingly used for design evaluation of the existing commercial fishing gear designs to optimize their design parameters and for the development of newer designs.

There were 12 presentations broadly covering innovations and advancements in fishing technologies.

Presenter	Title	Type
Sarath Krishnan Karumathil *(Universidade da Coruña, Spain)*	Simulation of fluid flow across fishing nets for studying the impact of trawling near the seabed	Plenum
Karsten Breddermann *(University of Rostock, Germany)*	SimuNet - Numerical modelling of fishing gear	Plenum
Finbarr G.O'Neill *(DTU, Denmark)*	Introducing RightFish – a BlueBio CoFund project to reduce environmental impact and GHG emissions in commercial fisheries	Plenum
Karen B Burgaard *(DTU, Denmark)*	Experimental and numerical investigation of hydrodynamics around towed fishing gear to develop selective fishing methods in a sea star fishery	Plenum
Shifa Jalal *(CIFT, India)*	Nano silicon dioxide incorporated epoxy polymers: Effective solution against lead pollution from fishing gear sinkers.	Plenum
Dhiju Das *(CIFT, India)*	Durability studies of ring seine (mini purse seine) gear used along the Kerala coast, India	Plenum
Daragh Browne *(BIM, Ireland)*	Side-scan sonar development of sweep modifications to facilitate the early release of unwanted catches	Plenum

Pieke Molenaar *(WMR, The Netherlands)*	Kiwi cod-end trials in the Dutch mixed demersal beam trawl fishery to improve fish quality and post-capture survival of discarded unwanted bycatch.	Plenum
Esakkimuthu *(TNJFU, India)*	Design and operational details of deep-sea pelagic longlines by fishermen of Thoothoor, South-West coast of India	Plenum
Peter Ljungberg (SLU, Sweden)	Bottom set, yet floating pontoon traps for the multispecies fishery.	Plenum
Haraldur A. Einarsson *(BIM, Ireland)*	The FishScanner	Plenum
Mette Svantemann Lyngby *(DTU, Denmark)*	Real-time detections of bycatch species in demersal trawl fisheries	Plenum

Details of the abstracts are given in Annex II

Presentation in session on Gear Design

3.7.1. Salient findings extracted from presentations

- Computational simulation of fishing nets is extremely helpful in analysing the impact of fishing gears on the seabed.
- Rightfish – a BlueBio CoFund project funded by the EU will contribute to developing methodologies to design demersal fishing gears of reduced environmental impact and carbon emissions.
- Lead is a choice material for fishing operations because of its low cost and easy availability. To avoid lead contamination in the aquatic environment, Nano Silicon dioxide-incorporated epoxy polymers can be used to reduce abrasion and corrosion of lead-based accessories.
- Polyamide webbing, which is generally used in ring seines, is less durable and requires periodic replacement. Hence, UHMWPE, and Sapphire can be used as an alternative.

- Side-scan sonar can be used to visualize gear modifications which can be used to improve the release of unwanted catches.
- To increase the post-capture survival rate and to reduce discard in Dutch mixed beam trawl fishery, Modular Harvest System (Kiwi Cod-end) was tested and resulted in a 20% reduction in total mortality.
- Thoothoor fishermen are known for their deep-sea voyages. Different types of species-specific long lines are being operated from their vessels. Improved Line haulers need to be installed in every vessel to improve the catching efficiency.
- Pontoon traps are bottom set but floating traps used for targeting perches in Sweden which show increased selectivity and also seal-safe.
- Fishscanner, a catching sensor gives a rough indication of relative catch and species in a trawl net. The information from the fish scanner can be used by fishermen to optimize towing time.
- Automatic image processing and machine learning can be used to detect the bycatch species in demersal trawls.

3.7.2. Salient Recommendations

- Computational simulation studies on the performace of fishing facilitate design of efficient fishing gears.
- Modular Harvest System can be tested on a trial basis in India to reduce discard rates, increase post capture survval rates whilst provding improved quality of catch required to access the export market.
- Deep-sea voyaging fishermen should be provided with the necessary training and provided with subsidies to install advanced machineries to improve catch efficiency.
- Automatic image processing and machine learning-oriented research to detect and avoid bycatch in trawls should be promoted

3.8. General

Apart from the theme-based presentations, there were also some general research works focused on lowering bycatch, technological inputs for sustaining the fish catch, exploitation of deep-sea resources, and the importance of VMS and AIS, and were discussed.

Presenter	Title	Type
VR Madhu *(CIFT, India)*	A review of initiatives in India to lower bycatch and discard rates in trawling	Plenum
Neha Kothari *(GBPAT, India)*	Fishing Gear Modification: A Solution To Achieve Ecosystem Objectives	Plenum
Leela Edwin *(CIFT, India)*	Technological inputs for fisheries conservation and management in Kerala, India	Plenum

Presenter	Title	Type
S Jayaraj *(BOBP-IGO, India)*	Preserving the tradition: Fishing crafts of artisanal fisher folks in the Bay of Bengal	Plenum
Drake Ssempijja *(UM, USA)*	The Fisheries of Uganda. Current and future perspectives from an African Inland Fishery.	Plenum
Júlio Zitha (MIMAIP, Mozambique)	The beach seine ban/phase out in Mozambique - tasks, opportunities, and challenges	Plenum
Piyasiri (SLFSSF, Sri Lanka)	Dissension on modern fishing technology: the bizarre saga of Blue Revolution in Sri Lanka	Plenum
Geetha Sasikumar *(CMFRI, India)*	An update on the gear characteristics of trawls operated off the Karnataka Coast, eastern Arabian Sea	Plenum
Sarasan Sabu *(CUSAT, India)*	Innovative technological interventions in harvesting methods for minimizing the impact of fishing on fish quality and post-harvest losses	Plenum
Hannah Fennell *(Heriot Watt University, UK) online*	Understanding the research needs of pelagic fisheries using a research prioritization exercise	Plenum
Mohammed Alam *(UC, Bangladesh)*	Assessment of stocks to understand trends of data-poor marine capture fisheries of Bangladesh	Poster
Mujeeb Rahiman *(CUSAT, India)*	Deep-sea Ichthyofaunal Assemblages in South-Eastern Arabian Sea (SEAS) Through a Combination of Conventional Taxonomy and eDNA Meta-barcoding	Poster
Sajeevan *(KUFOS, India)*	Exploitation status of Ochre-banded goatfish *Upeneus sundaicus* (Bleeker, 1855) fishery from Tamil Nadu, India waters using surplus production models.	Poster
Abinaya *(KUFOS, India)*	Exploitation status of marine fishery resources of Tamil Nadu, India waters using a surplus production modelling approach.	Poster
Jayasekara *(USJ, Sri Lanka)*	Does shrimp trawling contribute to the decline of Sciaenid stocks?	Poster
Eldo Varghese *(CMFRI, India)*	Indian Marine Capture Fisheries- Gear and effort-oriented stock assessment approaches	Poster
Srihari *(BOBP-IGO, India)*	Review on marine fisheries management measures in South Asian countries	Poster
Abdussamad *(CMFRI, India)*	Indian Marine Fisheries- inherently robust or intuitively buoyant?	Poster
Eldo Varghese *(CMFRI, India)*	Structural Breaks in Fishing Efforts in the Indian EEZ	Poster
Vipin *(CIFT, India)*	Need for an action plan for stock validation, fishery management, and efficient utilization of myctophid resources in India EEZ	Poster

Presenter	Title	Type
Sijo Varghese *(FSI, India)*	Mortality of sharks and other large pelagics in Indian tuna fisheries	Poster
Solly Solomon *(FSI, India)*	Prospects and potential of artificial reefs in replenishing coastal and neritic fishery resources in India	Poster
Rekha Nair *(CMFRI, India)*	Addressing issues of fisheries bycatch in the Indian Seas on a conservation angle	Poster
Babu Chelliah *(CIFNET, India)*	Studies on the distribution and abundance of yellowfin tuna, *Thunnus albacares* in the east coast of India using GIS	Poster
Rahangdale *(CMFRI, India)*	Implication of shifting spawning seasons on marine fisheries management: A case study from Gujarat	Poster
Vasanth *(KUFOS, India)*	Length-weight relationships of eight pelagic carnivore fishes by longlines of Gulf of Mannar, India	Poster
Joe Kizhakudan (CMFRI, India)	Artificial reefs in coastal systems - productivity power stations and new avenues for community-based fishery management and conservation frameworks	Poster
Claire Collins *(ZSL, UK)*	Technology and solutions to tackle illegal fishing across the Central and Western Indian Ocean regions - Poster presentation	Poster
Sreejith S Kumar *(CIFT, India)*	Abandonment of end-of-life FRP fishing boats along the beaches: a growing hazard on Kerala coast	Poster
Raghu Prakash Reghu *(CIFT, India)*	Selectivity characteristics of Rainbow Sardine Dussumieria acuta Valenciennes, 1847 with respect to diamond and square mesh cod	Poster
Lasuni Chathurima *(OU, Sri Lanka)*	Assessing the barriers to uptake of Vessel Monitoring and Automatic Identification Systems for improved fisheries management	Poster
Kumar Vase *(CMFRI, India)*	Developments in the major fishing methods along the Northwest coast of India: dynamics in fishing attributes and species composition	Poster
Abdul Azeez P *(CMFRI, India)*	Application of geostatistics in the mapping of bycatch distribution from mid-water trawlers in the north-eastern Arabian Sea: Marine Spatial Planning	Poster
Akhilesh *(CMFRI, India)*	Towards Electronic Monitoring (EM) in Indian marine fisheries: How far to go?	Poster
Abhishek *(AU, India)*	Using Vessel monitoring technologies to detect the fishing ships in Mumbai Harbor	Poster
Bijumon *(CIFNET, India)*	The operating management and maintenance strategy of an Indian Fishing vessel. The factual observance and practice of a case study	Poster
David Stanley (FEPS, UK)	Can we use low-res satellite images to study the impact of COVID on fishing activity in a small-scale fishery?	Poster

Presenter	Title	Type
Rekha Chakraborty *(CMFRI, India)*	Chronicles of deep-water shrimp fishery (2007-2020) along the southwest coast of India: trends & potential	Poster
Rajasekhar *(NIOT, India)*	An Analysis on the Management of Navigation Aids onboard Research Vessels Based on Internet of Things [IoT]	Poster
Ravikumar *(TNJFU, India)*	Investigation of the common defects and damages of the Fiberglass reinforce Plastic boats operated along the coast of Tamil Nadu	Poster
Shoba J Kizhakudan *(CMFRI, India)*	Mapping of domestic shark trade chains and utilization in India with implications for sustainable management of coastal shark fisheries.	Poster
Sureandiran *(KU, India)*	Crustacean Fishery along the North-eastern Arabian Sea Coast of India: Catch Composition, Species Monthly Wise Landing, Morphometric Relationship and Some Biological Aspects.	Poster
Amrutha R Krishnan *(KUFOS, India)*	Fish Diversity in Hooghly Matlah estuary near Sunderban, West Bengal	Poster
Amrutha R Krishnan *(KUFOS, India)*	A Comparative Study of Mechanical properties of untreated rubber wood and rubber wood treated with nano CuO added Cashew Nut Shell Liquid.	Poster
Mayur Tade *(KUFOS, India)*	Augmenting commercial lobster fisheries through sustainable capture-based mariculture in open sea cages	Poster

Details of the abstracts are given in Annex II

3.8.1. Salient findings extracted from presentations

- Even though the square mesh cod end has been adopted legally along five maritime states, the percentage of juveniles in the cod end ranges from 20-40%. Hence, a larger mesh size should be recommended. Further, TED should be mandatory along the East coast to reduce incidental entrapment of turtles.
- The co-management system should be implemented to improve fisheries conservation and management.
- Over the period, an increase in the size of the trawlers was observed on the Karnataka coast from 9.75-15.0 m LOA to 23.78 m LOA. Further, changes have been made in the mesh size to reduce drag for semi-pelagic operations.
- To reduce the impact of fishing on fish quality and post-harvest losses, fishers must be imparted with skills to handle fish hygienically according to the fishing method and apt for onboard fish preservation techniques.
- The development of deep-sea metagenomic libraries is necessary for the conservation of deep-sea ichthyofauna.

- Ochre-banded goatfish fishery resource has reached an optimally exploited status along the Tamil Nadu coast and hence, additional fishing fleet is not recommended for this fishery
- The high level of exploitation of the non-target sciaenid species by shrimp trawling appears to have an impact on this valuable fish resource in Sri Lanka. 4 dominant species of sciaenids were caught before reaching the age of sexual maturity.
- Four countries (Bangladesh, India, Maldives and Sri Lanka) have close national boundaries and the fish resources are shared between the countries. Hence, sustainable conservation and management of shared fish stocks and other living marine resources need to be ensured through regional cooperation.
- Information on the fishing effort expended by various gears over the years is very pivotal for arriving at a reasonable assessment of stocks.
- Available estimates on abundance and the new information indicate that about 16 species of myctophids occur in the Arabian Sea.If sustainably harvested with economically viable midwater trawling and judiciously utilized, it can form a significant source of fish protein and contribute to nutritional security.
- The survival rate of bycatch species (e.g., Sharks) was maximum in Pole and line fishery, followed by hook and line, whereas in the gillnet fishery, the at-haul mortality rate was high irrespective of the species being caught.
- Yellowfin Tunas are abundant in the months of October-December in the east coast of India. Further, the catch rate of YFT by longline was found to be high in December.
- A marginal shift of peak breeding season towards winter is observed in demersal predator species, whereas a shift towards post-monsoon is observed in some of the pelagic and crustacean resources along the Northwest coast of India.
- Impacts relating to aesthetics, loss of public access, reduction in space for fishing, etc., are generally associated issues with FRP boat disposal.
- Significant expansion of fishing grounds was observed recently in terms of distance by major fishing crafts along the Northwest coast of India.
- Initial results from pilot studies across the Western and Eastern provinces of Sri Lanka revealed that fishers have sufficient technical knowledge of VMS and AIS. But, a lack of trust in governing bodies acts as a barrier to the uptake and utilization of VMS and AIS.
- Key bycatch species were concentrated in the inshore area (<70 m depth) during the post-monsoon and summer seasons, but their density decreased significantly in winter in the Northeastern Arabian sea. The new knowledge of the spatial pattern and temporal distribution of key bycatch species in the fishery will support the future application of spatial management measures.
- An improved and effective Monitoring, Control, and Surveillance (MCS) system will facilitate enhanced traceability and ensure that an increasing amount of seafood is sourced from sustainable fisheries.

- Automatic Identification System (AIS) and SAR (Synthetic Aperture Radar) satellite images can be used to detect fishing vessels. In addition, participatory GIS tools can be used to improve the accuracy of fishing ship detection.

3.8.2. Salient Recommendations

- Turtle Excluder Devices should be made mandatory in trawls all along the Indian coast.
- State-sponsored credit and subsidy schemes can be provided to fishermen to gain access to advanced technology. Also, care should be taken to control the fishing pressure.
- Training courses for reducing post-harvest losses should be developed for each stage of the value chain post-capture and delivered to stakeholders.
- The development of harvest technology that is biologically sustainable and socioeconomically viable for the exploitation of non-conventional resources is the need of the hour.
- Sustainable fishery management frameworks should consider providing the include the installation of artificial reefs for habitat enhancement and resource enhancement.
- Current temporal closure and its effectiveness towards ensuring sufficient recruitment for sustaining long-term harvest from the fishery needs to be revisited.
- Efforts by the Government to to prohibit or limit fishing operations in juvenile and spawing grounds of fish will help in the reduction of by-catches.
- Guidelines are to be formulated to control FRP fishing boat abandonments in the marine and coastal environment.
- Fishing around the open sea cages can be promoted as an additional means of income for fishermen.
- Identifying the optimal hook size for different target species, may contribute to a reduction of bycatch.
- Spatio-temporal distribution patterns of bycatch species should be studied with geostatistics for designing spatial management measures in the future.
- VMS and AIS should be used to strengthen MCS efforts in India, contributing to the prevention and reduction of IUU fishing.

4. Valedictory session

The closing session of the symposium began with the welcome address by Dr. L.N. Murthy (Senior Executive Director, NFDB), which was followed by the report of WGFTFB'23 and Symposium by Dr. Antonello Sala (Scientist, CNR, Italy). The report of side events was provided by Mr, Rajdeep Mukherjee (Policy Analyst, BOBP-IGO, India). Results for the poster presentation were announced by Dr. George Ninan (Director, ICAR-CIFT).

An overall observation of the symposium and way forward was provided by Mr. Jonathan Lansley (Fishery Industry Officer, FAO) and Dr. Daniel Stepputtis (Thuenen, Germany).

Partner organizations were felicitated by Dr. A. Gopalakrishnan (Director, ICAR-CMFRI), which was followed by Chief Guest address by Prof. K.N. Madhusoodanan (Vice-Chancellor, CUSAT).

Dr. P. Krishnan (Director, BOBP-IGO) proposed a vote of thanks and he thanked the invaluable contributions of all keynote speakers, panelists, and presenters. Also, the support extended by the partner organization in conducting this event was gratefully acknowledged. Further, he assured that the connections and collaborations established during this symposium will continue and flourish in the future.

Delegates during the valedictory session of the event

5. Action Points

5.1. *Research*

Research should be primarily focused on:

- Improving the size and species selection in various fishing gears *(E.g., Fixed square mesh panels),*
- Technological advancements to reduce the impact of active gears on the seabed *(e.g., the Use of trawl doors that do not contact the seabed, self-adjusting trawl doors and lightweight doors),*
- Identification of combining different, suitable, and cost-effective bycatch mitigation devices *(e.g., Optimising the combination of LED laser light illumination for Sea turtles, Pearl beads for marine mammals, and Looming Eyes Buoy for seabirds in Gillnet),*
- Assessment of positive and negative impacts of usage of lights during the fishing operation. *(e.g., LED lights attached to trawl headline can be used to reduce bycatch),* Advanced research on escape gaps in fishing gear *(e.g., Flow stopping funnel in Trawls),*
- Usage of visual observation by underwater cameras to reduce unwanted bycatch,
- Construction of gears with different materials to reduce fuel consumption and reduce damage and loss during fishing operations,
- Development and popularization of artificial fish baits from fish and shellfish waste,
- Developing, testing, and popularization of mobile applications which enable fishers to report ALDFG, provide catch performance indicators, etc.,
- Evidence-based bycatch management criteria to reduce interaction with vulnerable populations,
- Assessment of efficiently recycling ALDFG combination using Material Flow Analysis and Extended Producer Responsibility,
- Use of alternative fuels like LNG and engine upgrades like Hybrid engines to increase efficiency and reduce GHG emissions,
- Use of pair trawling for harvesting Deep Sea resources,
- Computational simulation of fishing nets to reduce the impact of fishing gear and also assess the behaviour of fishing gear,
- Instruments with automatic image processing and machine learning capabilities to assess the relative catch and diversity of fish caught in fishing gear in real-time, and
- Spatio-temporal distribution patterns of bycatch species for designing spatial management measures in the future.

5.2. *Capacity building and development*

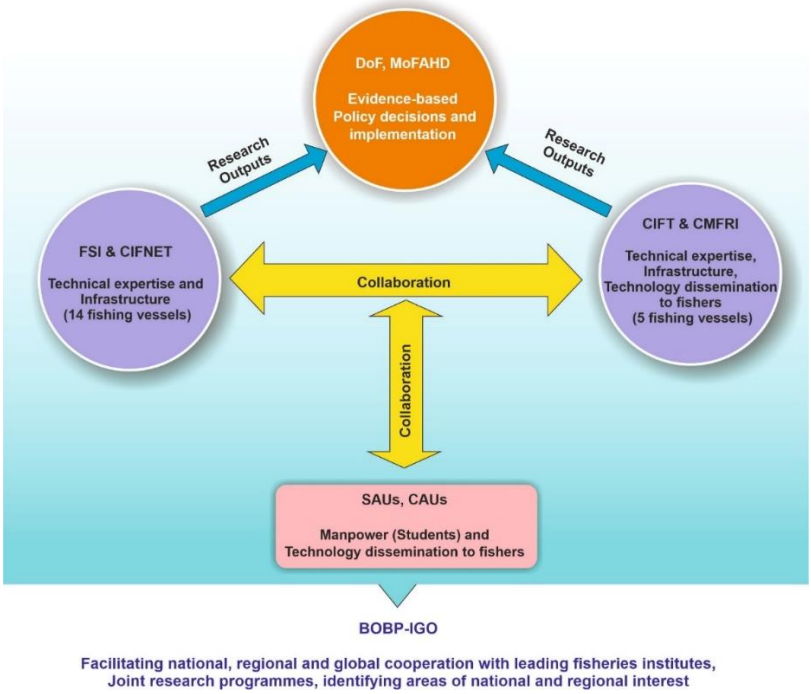
- India has 31 research vessels shared across ministries and the same should be made accessible to researchers from institutes and universities to undertake research. Survey vessels are to be transformed into research *cum* survey vessels. Fellowships are to be instituted for vessel-going researchers, i.e., students from various academic and research organizations. Further, India can assist the littoral states of the Arabian Sea and the Bay of Bengal in assisting their research on conducting trials on modified fishing gears for its suitability, fishing gear optimization, assessment of resource potential, training for fishermen,
- A Fisheries Monitoring Centre (FMC) should be established in major harbors to collect fishing vessels' data, validation, and storage, which makes the information available for analysis, either for monitoring in real-time, conducting risk assessment to determine need for inscetion of indcuviudal vessels, or for historical analyses. Adaquate training needs to be developed and delivered to FMC staff.
- Big Data Technologies can be used to sort the information, especially in case of vessel traffic intensity. Regional websites covering the Arabian Sea and the Bay of Bengal with a greater resolution by combining the data from AIS and VMS can be used to detect and curb IUU fishing in Indian waters.
- Collaborative data analyses on shared datasets improve and strengthen regional partnerships.
- A regional database on ALDFG should be created which would help map ALDFG hotspots and can be useful in removing ghost gears.
- Incorporating good practices in training, education, and advice programmes throughout the entire value chain:
    - *Raising awareness on good practices related to fishing gear can be done more easily and cost-effectively through social media to help speed the adoption of environmental innovations in fishing gear designs and operations;*
    - *Proper training should be imparted to sustainably exploit deep-sea non-conventional resources (e.g., Oceanic squids, Myctophids, etc.);* and
    - *Fishermen should be provided with the necessary skills to adopt apt fish preservation techniques to achieve a =reduction of post-harvest losses.*
- The expertise of fishing and harvest technologists in South Asia is comparatively less to rest of the world. To strengthen and establish manpower, the resource available in the member nations should be brought together. Regional working groups should be formed to work on specific aspects of national or regional concerns.

5.3. Policy

- Government should implement monitoring programs that utilise VMS and AIS. It should be followed by *ex-post* policy impact assessment *via* quantitative modelling. Any single innovative monitoring technology cannot be singled out as an effective policy instrument.

It is necessary to employ a combination of technologies, complementing and communicating with each other, inorder to provide effective results.

- Electronic Monitoring can be popularized among the fishermen, which can be used for:
    - *Gear deployment and retrieval;* and
    - *Catch validation, Sorting, and processing.*
- Selectivity is an essential component of fisheries policies to sustainably manage fish stocks. Fishing gear standards should be strengthened and should comply with internationally accepted guidelines for selectivity and ecosystem preservation.
- State-sponsored credit and subsidy schemes can be provided to fishermen to gain access to advanced technology. Also, care should be taken to control capacity and increased fishing pressure.
- Implementation of The Voluntary Guidelines on the Marking of Fishing Gear (VGMFG) contributes to the prevention, reduction and elimination of ALDFG.
- A Strategic management plan has to be designed for responsible management of the Lakshadweep pole and line tuna fisheries system and also, Certification of MSC has to be taken forward at the earliest in order to promote tuna exports from India.
- A National and Regional Plan of Action on Seabirds and Fishing capacity needs to be developed and implemented inaccorance with the IPOA for seabirds and management of fishing capacity.
- Disposal of fishing vessels (made of Steel and FRPs) after their lifetime should be brought under a regulatory framework as in the case of commercial cargo vessels *(e.g., Ship Breaking code, MoS, GoI).*



Framework for facilitating national, regional, and global cooperation

ANNEX I
LIST OF PARTICIPANTS

Number of participants from different countries (Online & Offline)

No	Country	Total Number of Participants
1.	Argentina	2
2.	Australia	1
3.	Bangladesh	4
4.	Belgium	3
5.	Canada	1
6.	China	1
7.	Denmark	13
8.	Germany	8
9.	Greece	1
10.	Iceland	1
11.	India	212
12.	Ireland	5
13.	Italy	8
14.	Japan	1
15.	Malaysia	2
16.	Maldives	3
17.	Mozambique	1
18.	Myanmar	2
19.	Netherlands	3
20.	New Zealand	1
21.	Norway	7
22.	Portugal	2
23.	Scotland	3
24.	Singapore	1
25.	Spain	4
26.	Sri Lanka	9
27.	Sweden	3
28.	Thailand	10
29.	Turkey	1
30.	Uganda	1
31.	United Kingdom	5
32.	United States of America	4

**Nationality of two participants who joined online cannot be found.*

Summary table of offline participants

No	Country	Total Number of Participants
1.	Bangladesh	4
2.	Belgium	2
3.	Canada	1
4.	Denmark	6
5.	Germany	4
6.	Iceland	1
7.	India	150
8.	Ireland	3
9.	Italy	5
10.	Malaysia	2
11.	Maldives	3
12.	Mozambique	1
13.	Myanmar	2
14.	Netherlands	2
15.	Norway	3
16.	Singapore	1
17.	Spain	4
18.	Sri Lanka	9
19.	Sweden	1
20.	Thailand	3
21.	Uganda	1
22.	United Kingdom	1
23.	United States of America	1
	Total (Offline)	**210**

Summary table of online participants

No	Country	Total Number of Participants
1.	Argentina	2
2.	Australia	1
3.	Belgium	1
4.	China	1
5.	Denmark	7
6.	Germany	4
7.	Greece	1
8.	India	62
9.	Ireland	2
10.	Italy	3
11.	Japan	1
12.	Netherland	1
13.	New Zealand	1
14.	Norway	4
15.	Portugal	2
16.	Scotland	3
17.	Sweden	2
18.	Thailand	7
19.	Turkey	1
20.	United Kingdom	4
21.	United States of America	3
	Total	**115**

**Nationality of two participants who joined online cannot be found.*

List of Offline participants

No	Name	Organization	Country	Email Id
1.	Jatindra Nath Swain, IAS	Secretary, DoF	India	secy-fisheries@gov.in
2.	J Balaji, IAS	Joint Secretary, DoF	India	jsfy@nic.in
3.	Sagar Mehra, CSS	Joint Secretary, DoF	India	sagar.mehra@nic.in
4.	A Antony Xavier	FDC, DoF	India	antonyxavier@caa.gov.in
5.	Shankar Laxman	JC, DoF	India	shankarjcfy@gmail.com
6.	Archit Sukhla	DoF	India	shuklaarchit2010@gmail.com
7.	C Suvarna, IFS	CE, NFDB	India	cenfdb@gmail.com
8.	L N Murthy	SED, NFDB	India	senior-ed@nfdb.gov.in
9.	Dipin K M	NFDB	India	dipinnfdb@gmail.com
10.	R Jeyabaskaran	DG, FSI	India	ds@fsi.eov.in
11.	Ansuman Das	FSI	India	ansuman@fsi.gov.in
12.	A Siva	FSI	India	anandhan.siva@fsi.sov. In
13.	Ashok S Kadam	FSI	India	ashoka_fsi@rediffmail.com
14.	Harshavardhan D Joshi	FSI	India	harshijoshicofsn@ gmail.com
15.	S Ramachandran	FSI	India	marine_ramc@yahoo.co. in
16.	Raju S Nagpure	FSI	India	rajusnagpure@ gmail.com
17.	Nashad M	FSI	India	nashadfsi@gmail.com
18.	Sijo P Varghese	FSI	India	varshesefsi@hotmail. com
19.	Jacob Thomas	FSI	India	jacobtjerin@vahoo.com
20.	S K Pattnayak	FSI	India	sunubeta@gmail.com
21.	Solly Solomon	FSI	India	lazarsolly@hotmail.com
22.	A Tiburtius	FSI	India	tibufsi@yahoo.co.in
23.	John Chembian	FSI	India	johnchembian@yahoo.co.in
24.	K Silambarasan	FSI	India	silambuplankton@hotmail.com
25.	Bhami Reddy	FSI	India	fsi_vizag@Yahoo.co.in
26.	GVA Prasad	FSI	India	gummadiprasad09@gmail.com
27.	Vinodkumar Mudumala	FSI	India	vmudumala@gmail.com
28.	AK Choudhury	Director, CIFNET	India	akch0507@gmail.com
29.	A Ravichandran	CIFNET	India	aravichandran1965@gmail.com
30.	Hrusikesh Bisoyi	CIFNET	India	mhabi305@gmail.com
31.	Habibullah	CIFNET	India	manjigmakwana@gmail.com
32.	MG Makwana	CIFNET	India	neelcifnet@gmail.com

No	Name	Organization	Country	Email Id
33.	M Neelakandan	CIFNET	India	bijumonkbdr@gmail.com
34.	KB Bijumon	CIFNET	India	ksvinod72@gmail.com
35.	KS Vinod	CIFNET	India	babufsi@gmail.com
36.	C Babu	CIFNET	India	achyutashaji@yahoo.com
37.	S Shaji	CIFNET	India	pradeepmarines@gmail.com
38.	Vipin PM	CIFNET	India	vipinpm83@gmail.com
39.	Pradeep K	CIFNET	India	pradeepmarines@gmail.com
40.	G Venkateswarulu	CIFNET	India	venkateshmarine@gmail.com
41.	Shine Kumar CS	NIFPHATT	India	ifpchn@nic.in
42.	J K Jena	DDG (Fy), ICAR	India	jkjena2@gmail.com
43.	A Gopalakrishnan	Director, ICAR-CMFRI	India	agopalkochi@gmail.com
44.	J Jayasankar	ICAR-CMFRI	India	jjsankar@gmail.com
45.	Eldho Varghese	ICAR-CMFRI	India	eldhoiasri@gmail.com
46.	EM Abdussamad	ICAR-CMFRI	India	emasamadg@gmail.com,
47.	R Ratheesh Kumar	ICAR-CMFRI	India	ratheeshkl4u2@gmail.com,
48.	Rajan Kumar	ICAR-CMFRI	India	rajanfrmcife@gmail.com
49.	Bhendekar Sathosh	ICAR-CMFRI	India	santucofs@gmail.com
50.	V Venkatesan	ICAR-CMFRI	India	venkatcmfri@yahoo.co.in,
51.	Geetha Sasikumar	ICAR-CMFRI	India	gs.pallath@gmail.com
52.	KV Akhilesh	ICAR-CMFRI	India	akhikv@gmail.com
53.	U Ganga	ICAR-CMFRI	India	ganga66@rediffmail.com
54.	KR Sreenath	ICAR-CMFRI	India	lecologiste@gmail.com
55.	C Ramachandran	ICAR-CMFRI	India	ramchandrancnair@gmail.com,
56.	P Shinoj	ICAR-CMFRI	India	shinoj.p@icar.gov.in
57.	Shyam Salim	ICAR-CMFRI	India	shyam.icar@gmail.com
58.	AP Dinesh Babu	ICAR-CMFRI	India	dineshbabuap@yahoo.co.in
59.	Shoba J Kizhakudan	ICAR-CMFRI	India	jkshoba@gmail.com
60.	Vinay Kumar Vase	ICAR-CMFRI	India	v.vinaykumarvs@gmail.com
61.	Abul Azeez P	ICAR-CMFRI	India	azeez.cr7@gmail.com
62.	Rekha J Nair	ICAR-CMFRI	India	rekhacmfri@gmail.com
63.	Reshma Gills	ICAR-CMFRI	India	reshma1818@gmail.com
64.	K Mohammed Koya	ICAR-CMFRI	India	koya313@gmail.com
65.	Shikha Rahangdale	ICAR-CMFRI	India	shikha.rahangdale@icar.gov.in
66.	Divya V	ICAR-CMFRI	India	divyaarinu@gmail.com
67.	Vipin Kumar	ICAR-CMFRI	India	vipincmfri@gmail.com
68.	B Jenni	ICAR-CMFRI	India	jennihsharma@yahoo.co.in

No	Name	Organization	Country	Email Id
69.	Ancy Sebastian	ICAR-CIFT	India	ancbabu@yahoo.co.in
70.	Baiju MV	ICAR-CIFT	India	Vishnubaiju@yahoo.com
71.	Chinnadurai	ICAR-CIFT	India	chinnaduraitvl@gmail.com
72.	Dhiju Das PH	ICAR-CIFT	India	dhijudas@gmail.com
73.	George Ninan	Director, ICAR-CIFT	India	george66jiji@gmail.com
74.	Leela Edwin	ICAR-CIFT	India	leelaedwin@gmail.com
75.	Madhu VR	ICAR-CIFT	India	Madhu.VR@icar.gov.in
76.	Manju Lekshmi N	ICAR-CIFT	India	manjuaem@gmail.com
77.	Muhamed Ashraf P	ICAR-CIFT	India	ashrafp2005@hotmail.com
78.	Mohammed Jabir KK	ICAR-CIFT	India	mohammedjabz44@gmail.com
79.	Paras Nath Jha	ICAR-CIFT	India	parasincof@gmail.com
80.	Prajith KK	ICAR-CIFT	India	prajithkk@gmail.com
81.	Remesan MP	ICAR-CIFT	India	mpremesan@gmail.com
82.	Rithin Joseph	ICAR-CIFT	India	josephrithin@gmail.com
83.	Renjith PK	ICAR-CIFT	India	renjith.rk05@gmail.com
84.	Saly N Thomas	ICAR-CIFT	India	alynthomas@gmail.com
85.	Sandhya KM	ICAR-CIFT	India	sandhyafrm@gmail.com
86.	Sreejith S Kumar	ICAR-CIFT	India	ssreejith1985@gmail.com
87.	Vipin V	ICAR-CIFT	India	vipinvamadevan@hotmail.com
88.	Harsha K	ICAR-CIFT	India	harshakrishna2018@gmail.com
89.	CN Ravishankar	Director / VC, ICAR-CIFE	India	ravishankar@cife.edu.in
90.	KK Ramteke	ICAR-CIFE	India	kkramteke@gmail.com
91.	Abuthagir Iburahim	ICAR-CIFE	India	iburahim@cife.edu.in
92.	Thavasi	ICAR-CIFE	India	thavasi.fecmb107@cife.edu.in
93.	Aiswarya Sali	ICAR-CIFE	India	aiswarya.fexmb101@cife.edu.in
94.	B K Das	Director, ICAR-CIFRI	India	basantakumard@gmail.com
95.	Kailasam	ICAR-CIBA	India	Kailasam.M@icar.gov.in
96.	Kumaraguru	ICAR-CIBA	India	Kumaraguru.Vasagam@icar.gov.in
97.	Suburaj	ICAR-CIBA	India	subburaj@ciba.res.in
98.	G Sugumar	VC, TNJFU	India	vc@tnfu.ac.in
99.	Arun Jenish	TNJFU	India	dajenish@gmail.com
100.	Ravikumar T	TNJFU	India	ravikumar@tnfu.ac.in
101.	Velmurugan R	TNJFU	India	rvelmurugan@tnfu.ac.in

No	Name	Organization	Country	Email Id
102.	Santhosh Kunar	TNJFU	India	s.santhoshkumar@tnfu.ac.in
103.	Durai V	TNJFU	India	duraicp2003@gmail.com
104.	Mariappan	TNJFU	India	mariappan@tnfu.ac.in
105.	Kalaiarasan	TNJFU	India	kalaiarasan@tnfu.ac.in
106.	A Karthy	TNJFU	India	karthi.fischo@gmail.com
107.	Archana	TNJFU	India	fishco.archana@gmail.com
108.	Dinesh E	TNJFU	India	edineshramukedk@gmail.com
109.	S Sabu	CUSAT	India	sabuif@cusat.ac.in
110.	Mini Sekharan	CUSAT	India	minisekharan@cusat.ac.in
111.	Mujeeb Rahiman	CUSAT	India	mujeebrkm@cusat.ac.in
112.	Hareesh N Ramanathan	CUSAT	India	hareeshramanathan@cusat.ac.in
113.	Damaris Daniel	CUSAT	India	damarisbennydaniel@gmail.com
114.	Abhirami Subash	CUSAT	India	abhiramisubash@cusat.ac.in
115.	MK Sajeevan	KUFOS	India	sajeevanfsi@gmail.com
116.	R Abinaya	KUFOS	India	abinayabfsc@gmail.com
117.	Amrutha K	KUFOS	India	amrutha.ir@gmail.com
118.	Lalima Inwati	KUFOS	India	invatilali@gmail.com
119.	Kumarakannan	KUFOS	India	kvasanthkvasanth29122@gmail.com
120.	Sunbula Kareem	KUFOS	India	sunbulakareem91@gmail.com
121.	Shivakumar Magada	COF, Mangalore	India	deanfisheries@gmail.com
122.	Kumar Naik	COF, Mangalore	India	kumarasnaik@gmail.com
123.	Jaya Naik	COF, Mangalore	India	jayanaik23@yahoo.com
124.	Mridula Rajesh	COF, Mangalore	India	mridularajesh789@yahoo.co.in
125.	Nayana P	COF, Mangalore	India	nayana.p.nayak@gmail.com
126.	Abhisek	Ashokha Univ	India	abhishek_phd22@ashoka.edu.in
127.	Divya Karnad	Ashokha Univ	India	divya.karnad@ashoka.edu.in
128.	Sebastian Mathew	ICSF	India	sebastian1957@gmail.com
129.	Venu Rajamony, IFS	Senior Advisor for SA, HD	India	rajamony@hdcentre.org
130.	Willem Punt	HD	Singapore	punt@hdcentre.org
131.	Sreejith Sugunan	HD	India	sugunan@hdcentre.org

No	Name	Organization	Country	Email Id
132.	Dayaratna Silva	PATHFINDER	Sri Lanka	ed@pathfinderfoundation.org
133.	Debesh Lahiri	NMF	India	execdir.nmf@gmail.com
134.	R K Srivatsava	NMF	India	icg1.nmf@gmail.com
135.	Ayushi Srivatsava	NMF	India	ps1.nmf@gmail.com
136.	Dharani	NIOT	India	dhara@niot.res.in
137.	Nimit Kumar	INCOIS	India	nimitkumar.j@incois.gov.in
138.	Aswathi Pacha	INCOIS	India	aswathinisha@gmail.com
139.	Nahid Rashid	Secretary, MoFL	Bangladesh	naheedkhalid72@gmail.com
140.	Kamal Haque	DG, MoFL	Bangladesh	dg@fisheries.gov.bd
141.	Yahia Mahmud	DG, BFRI	Bangladesh	dgbfri@bfri.com
142.	Md Abdul Mansur	Dean, BAU	Bangladesh	mansurft63@gmail.com
143.	M Shiham Adam	IPNLF	Maldives	msadam@mrc.gov.mv
144.	Ahmed Rizyas Jauharee	MMRI	Maldives	riyaz.jauharee@mmri.gov.mv
145.	Md Shainee	Former Minister, MoFA	Maldives	shainee2267@gmail.com
146.	Talangama Chaminda Namal	Additional Secretary, MFARD	Sri Lanka	namalthalangama@live.com.sa
147.	Ranatunga Dhammika Sanath	DG (T), MFARD	Sri Lanka	dhammikadsr@yahoo.com
148.	Sushantha Kahawatta	DG, MFARD	Sri Lanka	dg@fisheriesdept.gov.lk
149.	Wijeyarathne M J S	Chairman, NARA	Sri Lanka	chairman@nara.ac.lk
150.	Oscar Amarasinghe	Chancellor, OCU	Sri Lanka	oamarasinghe@yahoo.com
151.	NMS Jeyasekara	USJ	Sri Lanka	madhavisulochana97@gmail.com
152.	KHKL Piyasiri	NARA	Sri Lanka	kaumi.khklpiyasiri@gmail.com
153.	Lasuni Chathurima	OCU	Sri Lanka	lasunichathuri@gmail.com
154.	Salin KR	AIT	Thailand	salinkr@ait.ac.th
155.	Thaweesak Thimkrap	SEAFDEC	Thailand	thaweesakt@seafdec.org
156.	Suriyan T S	KU	Thailand	ffissrt@ku.ac.th
157.	Sitti Raehanah Binti Muhamad	UMS	Malaysia	sittirae@ums.edu.my
158.	Muta Harah Zakaria	UPM	Malaysia	muta@upm.edu.my
159.	Nyo Nyo Tun	MU	Myanmar	t.nyonyo@yahoo.com
160.	Yin Yin Htay	PU	Myanmar	seagrass772018@gmail.com
161.	E Vivekanandan	Pr. Scientist (Rtd) , ICAR-CMFRI	India	evivekanandan@hotmail.com

No	Name	Organization	Country	Email Id
162.	Dam Roy	Former Director, ICAR-CIARI	India	sibnarayan@gmail.com
163.	Latha Shenoy	Pr. Scientist (Rtd) , ICAR-CIFE	India	shenoylatha1@hotmail.com
164.	B Meenakumari	Former DDG, ICAR	India	meenakumarib@gmail.com
165.	Pravin Putra	Former ADG, ICAR	India	pravinp2005@gmail.com
166.	B Manimaran	Former VC, TNJFU	India	prof.maaran@gmail.com
167.	A.G. Ponniah	Former Director, ICAR-CIBA	India	agponniah@gmail.com
168.	Jitendra Soni	Garware	India	jsoni@garwarefibres.com
169.	Sumesh	Garware	India	jsoni@garwarefibres.com
170.	Rakhil Gopal	Garware	India	jsoni@garwarefibres.com
171.	Reyan K	Garware	India	jsoni@garwarefibres.com
172.	Xaiver L	Odaku	India	info@odaku.in
173.	M J Elmo	Odaku	India	info@odaku.in
174.	Akansha Tiwari	Captain Fresh	India	akansha13.work@gmail.com
175.	Mattias Van Opstal	ILVO	Belgium	mattias.vanopstal@ilvo.vlaanderen.be
176.	Jasper Van Vlasselaer	ILVO	Belgium	jasper.vanvlasselaer@ilvo.vlaanderen.be
177.	Paul Winger	MI	Canada	paul.winger@mi.mun.ca
178.	Valentina Melli	DTU	Denmark	vmel@aqua.dtu.dk
179.	Junita D Karlsen	DTU	Denmark	jka@aqua.dtu.dk
180.	Barry O'Neill	DTU	Denmark	barone@aqua.dtu.dk
181.	Zita Bak-Jensen	DTU	Denmark	zitba@aqua.dtu.dk
182.	Tiago Veiga Malta	DTU	Denmark	timat@aqua.dtu.dk
183.	Mette Svantemann Lyngby	DTU	Denmark	msvly@aqua.dtu.dk
184.	Thomas Noack	Thuenen	Germany	thomas.noack@thuenen.de
185.	Daniel Stepputtis	Thuenen	Germany	daniel.stepputtis@thuenen.de
186.	Karsten Bredderman	Uni Rostock	Germany	karsten.breddermann@uni-rostock.de
187.	Sara Alvarez Berzosa	Thuenen	Germany	sara.berzosa@thuenen.de
188.	Georg Haney	Hampiðjan	Iceland	georg.haney@gmail.com
189.	Haraldur A Einarsson	FAO	Italy	haraldur@mfri.is
190.	Daragh Browne	BIM	Ireland	daragh.browne@bim.ie
191.	Martin Oliver	BIM	Ireland	martin.oliver@bim.ie

No	Name	Organization	Country	Email Id
192.	Mathew McHugh	BIM	Ireland	matthew.mchugh@bim.ie
193.	Maria Amparo Pérez Roda	FAO	Italy	amparo.perezroda@fao.org
194.	Antonella Sala	FAO	Italy	antonello.sala@cnr.it
195.	Kelsey Richardson	FAO	Italy	Kelsey.Richardson@fao.org
196.	Jon Lansley	FAO	Italy	jon.lansley@fao.org
197.	Julio Antonio Zitha	NIDFA	Mozambique	jzithamoz@gmail.com
198.	Pieke Molenaar	WMR	Netherlands	pieke.molenaar@wur.nl
199.	Allard van Mens	WMR	Netherlands	allard.vanmens@wur.nl
200.	Kristine Cerbule	UIT	Norway	kristine.cerbule@uit.no
201.	Ulf Lundvall	OSAC	Norway	ulflundvall@gmail.com
202.	Paritosh Deshpande	NTNU	Norway	paritosh.deshpande@ntnu.no
203.	Elsa Cuende	AZTI	Spain	ecuende@azti.es
204.	Mikel Basterretxea	AZTI	Spain	mbasterretxea@azti.es
205.	Ignacio Soler	Kongsberg	Spain	ignacio.soler@km.kongsberg.com
206.	Sarath K Karumathil	UC	Spain	sarath.karumathil@udc.es
207.	Peter Ljunberg	SLU	Sweden	peter.ljungberg@slu.se
208.	Claire Collins	ZSL	United Kingdom	claire.collins@ioz.ac.uk
209.	Noelle Yochum	APU	United States of America	noelleyochum@gmail.com
210.	Drake Ssempijja	UMass	Uganda	drakesempijja@gmail.com

List of Online participants

No	Name	Country	Email
211.	Ricardo Roberto Roth	Argentina	rroth@inidep.edu.ar
212.	Roth Ricardo	Argentina	rroth@inidep.edu.ar
213.	Steve Eayrs	Australia	smartfishing1@hotmail.com
214.	Helen Lenoir	Belgium	heleen.lenoir@ilvo.vlaanderen.be
215.	Liming Song	China	lmsong@shou.edu.cn
216.	Esther Savina	Denmark	esav@aqua.dtu.dk
217.	Jordan Feekings	Denmark	jpfe@aqua.dtu.dk
218.	Kindt-Larsen Lotte	Denmark	lol@aqua.dtu.dk
219.	Ludvig Ahm Krag	Denmark	lak@aqua.dtu.dk
220.	Morteza Eighani	Denmark	moei@aqua.dtu.dk
221.	Rikke Petri Frandsen	Denmark	rif@aqua.dtu.dk
222.	Sven Uhlmann	Denmark	sven.uhlmann@gmx.net
223.	Hannah Schartmann	Germany	hannah.schartmann@thuenen.de
224.	Mathis Mahler	Germany	mathis.mahler@thuenen.de
225.	Theresia Eke	Germany	theresia.eke@t-online.de
226.	Thomas Noack	Germany	thomas.noack@thuenen.de
227.	Chryssi Mytilineou	Greece	chryssi@hcmr.gr
228.	Adf Mangaluru	India	dilipkumarz@gmail.com
229.	Ajay Nakhawa	India	ajaynakhawa@hotmail.com
230.	Asha Landge	India	ashalandge@cife.edu.in
231.	Baiju Malikayil Vijayan	India	vishnubaiju@yahoo.com
232.	Bejawada Naidu	India	chanikya.aykinahc2@gmail.com
233.	Bibin Xavier V F	India	bibinxavier28@gmail.com
234.	Chandrashekara Adf	India	adf2kumta@gmail.com
235.	Deputy Director Of Fisheries Malpe Fishing Harbour	India	adf1malpe@gmail.com
236.	Divakar Kharvi	India	adf2udupi2@gmail.com
237.	Dr Ranjith L	India	ranjith.l@icar.gov.in
238.	Dr. Gipson Edappazham	India	e.gipson@jainuniversity.ac.in
239.	Dr. Remya L	India	lremya9@gmail.com
240.	Dr. Shailendra Kumar Dwivedi	India	sk.dwivedi0310@fsi.gov.in
241.	Dr.Sudarsi Angeli	India	comfishap@gmail.com
242.	G J Pramoda Malli	India	gjpramodamalli@gmail.com
243.	Geetha Sasikumar	India	gs.pallath@gmail.com
244.	Gyanaranjan Dash	India	gyanranjandashcmfri@gmail.com
245.	Herald Immanuel David	India	heraldimmanuel53@gmail.com

No	Name	Country	Email
246.	Jasmin Felix	India	jasmin.f.cmfri@gmail.com
247.	Jasmin	India	jillu002@gmail.com
248.	Jayaprakash Mendon	India	jayaprakashudupi@yahoo.co.in
249.	Joint Director Of Fisheries Udupi	India	ddfudupi@gmail.com
250.	Karuppasamy K	India	karuppasamy@tnfu.ac.in
251.	Kavitha P	India	kavitaprashanth@gmail.com
252.	Komal Nandagawali	India	komalnandagawali1234@gmail.com
253.	Kumarswamy R	India	kumarswamy356@gmail.com
254.	Lalima Inwati	India	invatilali@gmail.com
255.	Loveson Edward L	India	loveson_edward@yahoo.co.in
256.	Mayur Tade	India	mayur.tade@gmail.com
257.	Mukeshkumar Bhendarkar	India	mk.bhendarkar@icar.gov.in
258.	Muktha Menon	India	muktha2007@gmail.com
259.	Nagaraj Challajjimane	India	challajjimanen@gmail.com
260.	Poonam Rani	India	poonam.ranii@gov.in
261.	Prathibha Rohit	India	prathibharohit@gmail.com
262.	Purushottama Gante Bosunaobaiah	India	puru44@gmail.com
263.	Raghu Prakash R	India	drraghuprakash@gmail.com
264.	Rajesh K M	India	rajeshmkm3@rediffmail.com
265.	Rajesh Kumar	India	rajesh.frmmb109@cife.edu.in
266.	Rajesh Kumar Pradhan	India	rajeshfrm220@gmail.com
267.	Ramana Kumar Kotha	India	ramankumarkotha@gmail.com
268.	Ravi	India	ravitalekar53@gmail.com
269.	Rekha Devi Chakraborty	India	rekhadevi7674@gmail.com
270.	Rekha M	India	rekhamuralidharan73@gmail.com
271.	Renjith R K	India	renjith.rk05@gmail.com
272.	Reshma Gills	India	reshma1818@gmail.com
273.	Revathi JA	India	revathija.adf@gmail.com
274.	Saranya Raju	India	saranyakallurumbil.sr@gmail.com
275.	Sheetal Bharda	India	sheetal.frmpb101@cife.edu.in
276.	Shivakumar G M	India	sradfudp@gmail.com
277.	Shoba Kizhakudan	India	shoba.joe@icar.gov.in
278.	Shridevi P	India	shrideviprabhu29@gmail.com
279.	Subal Roul	India	subalroul@gmail.com
280.	Sujitha Thomas	India	sujithathomascmfri@gmail.com
281.	Sukar Anjani	India	fish-diu-dd@nic.in
282.	Sumalatha .	India	adf2kundapur@gmail.com

No	Name	Country	Email
283.	Surya S	India	revandasurya@gmail.com
284.	Swatipriyanka Sen	India	swatipriyank1a@gmail.com
285.	Tejaswini Karale	India	tejaswinipk20@gmail.com
286.	Thanga Anusya S	India	anusya1507@gmail.com
287.	Vasant Hegde	India	sadftadri@gmail.com
288.	Vinod Kavungal	India	vinod_kavungal@yahoo.co.in
289.	Vinod Malayilethu	India	vinodm@wwfindia.net
290.	Elizabeth Tray	ireland	elizabeth.tray@bim.ie
291.	Geir Gudmundsson	ireland	geir@optitog.com
292.	Andrea Petetta	Italy	andrea.petetta@irbim.cnr.it
293.	Daniel Li Veli	Italy	daniel.liveli@irbim.cnr.it
294.	Nazzareno Paci	Italy	nazzarenopaci@gmail.com
295.	Chiyo Takahashi	Japan	miikosea@gmail.com
296.	Alessa Mattens	Netherland	alessa.mattens@wur.nl
297.	Melanie Underwood	New Zealand	melanie.underwood@niwa.co.nz
298.	Anja Alvestad	Norway	anja.alvestad@sintef.no
299.	Enis Kostak	Norway	enis.n.kostak@uit.no
300.	Neil Anders	Norway	neil.anders@hi.no
301.	Roger B. Larsen	Norway	roger.larsen@uit.no
302.	Aida Campos	Portugal	acampos@ipma.pt
303.	Monika Szynaka	Portugal	mjszynaka@gmail.com
304.	Alex Edridge	Scotland	alexius.edridge@gov.scot
305.	Emma Mackenzie	Scotland	emma.mackenzie@gov.scot
306.	Robert Kynoch	Scotland	robert.kynoch@gov.scot
307.	Mona Ljungberg	Sweden	monaljungberg52@gmail.com
308.	Stefan Eiler	Sweden	stefan.eiler@slu.se
309.	Kamonpan Awaiwanont	Thailand	kawaiwanont@yahoo.com
310.	Nakaret Yasuk	Thailand	ynakaret@seafdec.org
311.	Santiphong Putsa	Thailand	santiphong@seafdec.org
312.	Nopporn Manajit	Thailand	nopporn@seafdec.org
313.	Siriwan Priwan	Thailand	62330047@go.buu.ac.th
314.	Taweekiet Amornpiyakrit	Thailand	taweekiet@seafdec.org
315.	Watcharapong Chumchuen	Thailand	w.chumchuen@gmail.com
316.	Adnan Tokaç	Turkey	adnan.tokac@ege.edu.tr
317.	Robert Enever	United Kingdom	rob.enever@fishtekmarine.com
318.	Dan Watson	United Kingdom	dan@sntech.co.uk
319.	Samantha Stott	United Kingdom	samantha.stott@cefas.gov.uk
320.	Yann Rouxel	United Kingdom	yann.rouxel@rspb.org.uk

No	Name	Country	Email
321.	Jesse Senko	United States of America	jesse.senko@gmail.com
322.	Mark Lomeli	United States of America	mlomeli@psmfc.org
323.	Pingguo He	United States of America	phe@umassd.edu
324.	Joanna Haffling		joannahaffling@gmail.com
325.	Wes Stanforth		wesstanforth@gmail.com

ANNEX II
PROGRAMME AGENDA

Indian Standard Time [GMT+5.30 hrs]

Day 1: February 13, 2023 *Venue: WATER FRONT HALL*

Zoom Registration Link
https://us06web.zoom.us/meeting/register/tZUoduqsrDsrG90Q6LIDS5Jhrk2QTOkD7JuY

08.00-08.45	**Registration**	
08.45-09.00	**Assembling in the Meeting hall**	
Inaugural Session		
09.00-09.10	**Lighting of lamp**	
09.10-09.15	**Welcome and Opening remarks**	**Dr. A. Gopalakrishnan** *Director, ICAR-CMFRI*
09.15-09.20	**Program Context & Overview**	**Dr. P. Krishnan** *Director, BOBP-IGO*
09.20-09.50	**FAO Welcome and FAO's global efforts in responsible fishing operations** [ID116]	**Mr. Jonathan Lansley** *Fishery Industry Officer, FAO, Italy*
	ICES & WGFTFB Overview	**Dr. Antonello Sala** *Scientist, CNR, Italy* **Dr. Daniel Stepputtis** *Scientist, Thuenen Institute, Germany*
09.50-10.10	**India's Plans and Perspectives**	
	Marine Fisheries Development	**Dr. J.K. Jena** *DDG (FS), ICAR, DARE, India*
	Marine Fisheries Research	**Dr. J. Balaji, IAS** *Jt. Secretary (Marine), DoF, MoFAHD*
10.10-10.20	**Inaugural Address**	**Shri. Jatindra Nath Swain** *Secretary, DoF, MoFAHD*
10.20-10.30	**Concluding Remarks and Expectations from the event**	**Dr. C. Suvarna, IFS** *Chief Executive, NFDB*
10.30-11.00	**Inauguration of Industry Expo & Coffee Break**	

Plenum: ACTIVE GEARS			
Conveners	**Dr. Paul Winger** *Director, Marine Institute, Fisheries and Marine Institute of Memorial University of Newfoundland, Canada*		**Dr. B. Meenakumari** *Ex-DDG (Fisheries), ICAR, DARE, Government of India*
Time	**Presenter**	**Topic**	**ID**
11.00-11.15	Zita Bak-Jensen *(DTU, Denmark)*	Turn and Fix – two ways to sharpen size selection	12
11.15-11.30	Mattias Van Opstal *(ILVO, Belgium)*	A brighter future for the Belgian fishing fleet: an overview of 3 years of fishing trials using LED	20
11.30-11.45	Rajan Kumar *(CMFRI, Kochi)*	Trawl goes selective: An insight in to demand induced innovation in trawl fishery of Gujarat	52
11.45-12.00	Elsa Cuende *(AZTI, Spain)*	Does a cod-end with shortened lastridge ropes provide optimal escape opportunities for different fish species?	32
12.00-12.15	Manju Lekshmi *(CIFT, Kochi)*	Beach seine fishing in India: scope for improvement for sustainability	22
12.15-12.30	Thomas Noack *(Thuenen, Germany)*	A journey to new regions: Testing and improving the MiniSeine´s performance in waters off the German Baltic Sea coast	19
12.30-13.30	**Working Lunch**		
13.30-13.45	Valentina Melli *(DTU, Denmark)*	What will it take to get fish out of the trawl? Creating a Low-Flow Zone within and outside the boundaries of a trawl to incentivize fish escape	72
13.45-14.00	Das *(FSI, Vizag)*	Comparative studies of 30 MM diamond mesh and 30 MM square mesh cod-ends conducted during the demersal fishery resources survey …	81
14.00-14.15	Venkatesan *(CMFRI, Kochi)*	Emergence of specialized trawl net for the fishery of octopus along the southwest coast of India	85
14.15-14.30	Fernandez	Improving energy efficiency and seabed impact in the deep-sea shrimp trawl fishery	164
14.30-14.45	Pieke Molenaar *(WMR, Netherlands)*	Quick visual observation of pelagic school composition to avoid unwanted catches in commercial pelagic (trawl) fisheries.	95
14.45-15.00	Mikel Basterretxea *(AZTI, Spain)*	Demonstration of pingers potential to reduce Common Dolphin bycatch in bottom trawl gears	34
15.00-15.30	**Coffee Break**		
15.30-15.45	**WG Work: Presentation of National Reports (All Participants are welcome)**		
15.45-16.45	**Working Group Work** *(For the members)*		
17.00-21.00	**Kochi Backwater Cruise in NEFERTITI, Kerala State-owned ship - Dinner on Cruise hosted by Dept. of Fisheries, Govt of India.** *(By Personal Invitation)*		

Day 2: February 14, 2023 *Venue: WATER FRONT HALL*

Zoom Registration Link

https://us06web.zoom.us/meeting/register/tZUoduqsrDsrG90Q6LIDS5Jhrk2QTOkD7JuY

Plenum: Passive Gears			
Conveners	***Dr. Thomas Noack*** *Scientist, TI-OF, Germany*	***Dr. Peter Ljungberg*** *Environmental Assessment Specialist, SLU, Sweden*	***Dr. Latha Shenoy*** *Principal Scientist (Rtd), ICAR-CIFE, Mumbai*
Time	***Presenter***	***Topic***	***ID***
09.00-09.15	*Jasper Van Vlasselaer (ILVO, Belgium)*	*Innovations in pot fisheries, a toolbox for a multi-use sea*	*7*
09.15-09.30	*Mariappan Sangaralingam (TNJFU, Nagapattinam)*	*Analysis on the catch efficiency of fish traps operated along the coast of Thoothukudi, Southeast coast of India*	*115*
09.30-09.45	*Sara Alvarez Berzosa (Thuenen, Germany)*	*Comparing entrance designs and testing of fish retention devices for Plaice (Pleuronectes plattessa) and Turbot (Scophthalmus maximus) fish pots*	*90*
09.45-10.00	*Madhu et al.*	*Simple modification in the trap entrance opening significantly improves catch efficiency of mud crab (Scylla serrata) in a tropical estuarine fishery*	*56*
10.00-10.15	*Chinnadurai (CIFT, India)*	*Design, development, selectivity and underwater observations of pentagonal shape fish traps operated along the Gulf of Mannar*	*79*
10.15-10.30	*Arjunan Karthy (TNJFU, Nagapattinam)*	*Invivo analysis of attracting ability of bio attractants derived from marine bivalves for evolving gelatin-based artificial fish baits suitable for longline fishing*	*112*
10.30-11.00	***Coffee Break***		
11.00-11.15	*Genevieve Peck (MI, Canada)*	*Evaluating Whalesafe Fishing Gear in Eastern Canada*	*104*
11.15-11.30	*Karankumar (CIFE, India)*	*Improving the mean size of harvest in dol net fishery with square mesh cod end design*	*62*
11.30-11.45	*Ratheesh Kumar (CMFRI, India)*	*Designs and operational aspects of dolnets of North West coast of India with particular reference to its sustainability*	*24*
11.45-12.00	*Madhu VR (CIFT, India)*	*Change in the colour of gillnets affects catch efficiency: results of an experimental gillnet trial in a tropical estuary in Kerala, India.*	*25*
12.00-12.15	*Rithin Joseph (CIFT, India)*	*Assessment of gear damage by dolphins in small-scale gillnet fishery of Southwest coast of India*	*36*
12.15-12.30	*Santhosh Bhendekar (CMFRI, India)*	*Artisanal lobster gillnet fisheries along Maharashtra coast: A sustainability perspective*	*130*
12.30-13.30	***Working Lunch***		

Time	Presenter	Topic	ID
13.30-13.45	Naganandhini *(TNJFU, India)*	Optimization of 'J' hook number on the catching efficiency of Carangids in the Gulf of Mannar, India.	9
13.45-14.00	*Harshavardhan Joshi (FSI, India)*	Monofilament Long line: An effective fishing gear alternative to multifilament long line	96
14.00-14.15	*Raju Nagpure (FSI, India)*	Oceanic tuna longline survey in Lakshadweep Islands: a hotspot for large pelagics – prerequisite to gear selectivity for mitigating shark bycatch	132
14.15-14.30	Ravikumar *(TNJFU, India)*	Effect of hook size and baits on the catch efficiency of demersal longlines of Thoothukudi coast, Southeast coast of India	137
14.30-14.45	Velmurugan *(TNJFU, India)*	Design and operational characteristics influence the catch rate in longline: Evidence from Pulicat Region, India	100
14.45-15.00	Mini Sekharan *(CUSAT, India)*	Initiatives to scale up the sustainable pole and line tuna fishing in Lakshadweep	142
15.00-15.30	**Coffee Break**		
	Plenum: Indicator		
Conveners	**Dr. Valentina Melli** *Researcher , DTU, Denmark*	**Dr. Ravi Shankar** *Director, ICAR-CIFE, Mumbai*	
15.30-15.45 *(online)*	Andrea Petetta (UNIBO, Italy) Online	A holistic approach in trawl selectivity that account for the full species community in the catches - a Mediterranean case study	107
15.45-16.00	Daniel Stepputtis *(Thuenen, Germany)*	Back to the future: revisiting fishing technologies to address current by-catch problems in the North Sea shrimp fishery.	156
16.00-16.15	Sven Sebastian Uhlmann *(ILVO, Belgium)* Online	Optimizing the prediction of discard survival of bottom-trawled plaice based on vitality indicators	141
	Plenum: ALDFG		
Conveners	**Ms. Amparo Perez Roda** *Fishery Officer, FAO, Iatly*	**Dr. G. Sugumar** *Vice-Chancellor, TNJFU, India*	
16.15-16.30	Haraldur A. Einarsson, *(FAO, Italy)*	Introduction of the Global ALDFG Survey	117
16.30-16.45	Amparo Perez Roda *(FAO, Italy)*	Understanding fishing gear marking systems	129
16.45-17.00	Saly N Thomas *(CIFT, India)*	Knowledge Base on ALDFG and Ghost Fishing in India	80

Day 3: February 15, 2023 *Venue: WATER FRONT HALL*

Zoom Registration Link
https://us06web.zoom.us/meeting/register/tZUoduqsrDsrG90Q6LIDS5Jhrk2QTOkD7JuY

Plenum: ALDFG			
Conveners	**Ms. Amparo Perez Roda** *Fishery Officer, FAO, Iatly*	**Dr. G. Sugumar** *Vice-Chancellor, TNJFU, India*	
Time	**Presenter**	**Topic**	**ID**
09.00-09.15	Sandhya K.M. *(CIFT, India)*	Assessment of ALDFG from selected marine gillnet and trap fishing sectors of India	37
09.15-09.30	*Kelsey Richardson* *(FAO, Italy)*	Gear modifications to reduce ghost fishing in small-scale Brazilian lobster trap, Indonesian crab pot and Kenyan gillnet fisheries	153
09.30-09.45	Antonello Sala *(FAO, Italy)*	Background study on fishing gear recycling	159
09.45-10.00	Ulf Lundvall *(OSAC, Norway)*	PingME	166
Plenum: Behaviour			
Conveners	**Ms. Kristine Cerbule** *UiT, Norway*	**Dr. George Ninan** *Director, ICAR-CIFT, India*	
10.00-10.15	Vishnupriya MS *(KUFOS, India)*	RAMP scores correspond well with biochemical test indicators: results of in-situ studies	74
10.15-10.30	Junita Karlsen *(DTU, Denmark)*	Optomotor response in Atlantic cod (*Gadus morhua*) – can it be elicited and manipulated by trawl netting?	140
10.30-11.00	**Coffee Break**		

THREE Concurrent Topic Group Meetings **Passive Gear, Indicators, ALDFG**		
11.00-12.30	TG Conveners	Meeting of Topic Groups
12.30-13.30	**Working Lunch**	
13.30-15.00	TG Conveners	Meeting of Topic Groups
15.00-15.30	**Coffee Time**	
15.30-17.00	TG Conveners	Meeting of Topic Groups

Topic Group 1: Passive fishing gears

Venue: Water Front Hall

Zoom Registration Link

https://us06web.zoom.us/meeting/register/tZUoduqsrDsrG90Q6LIDS5Jhrk2QTOkD7JuY

Conveners	***Lotte Kindt-Larsen*** *Researcher, DTU, Denmark*	***Peter Ljungberg*** *Environmental Assessment Specialist, SLU, Sweden*	**Gildas Glemarec** *Researcher, DTU, Denmark*	**Thomas Noack** *Scientist, TI-OF, Germany*

Time	Presenter	Topic	ID
11.00-11.15	*TG Conveners*	Introduction	
11.15-11.45	Jesse F. *Senko (ASU, USA)*	Reducing megafauna bycatch by net illumination	167
11.45-12.15	Thomas Noack *(Thuenen, Germany)*	The pearlnet – Increasing the acoustic reflectivity of gillnets to reduce cetacean bycatch	168
12.15-12.30	*TG Conveners*	General Discussion	-
12.30-13.30		**Working Lunch**	
13.30-14.00	Yann Rouxel *(Birdlife, UK)*	Review of seabird bycatch mitigation measures	169
14.00-14.30	Rob *Enever (Fishtek Marine, UK)*	Advances in Bycatch Reduction Technology for passive gear	170
14.30-15.00	*TG Conveners*	General Discussion	-
15.00-15.30		**Coffee Break**	
15.30-16.45	*All*	Group work: "Experiences, opinions and ideas on tools for bycatch mitigation in static gears"	-
16.45-17.00	All	**Group work outcome and final remarks**	-
17.00 -		Topic Group Work - continued as required	

Topic Group 2: Indicators

Venue: Marina Hall

Zoom Registration Link

https://us06web.zoom.us/meeting/register/tZYqfu-hrjsjGdUJNOhkW717Vht5ggv-ZVHy

Conveners	Dr. Valentina Melli *Researcher, DTU, Denmark*	Dr. Jure Brčić *Assistant Professor, UNIST, Croatia*	Dr. Chryssi Mytilineou *Scientist, HCMR, Greece*	Dr. Bent Herrmann *Professor, DTU, Denmark*	Dr. Jordan Feekings *Researcher, DTU, Denmark*

Time	Presenter	Topic	ID
11.00-11.30	*TG Conveners*	Introduction	-
11.30-12.00	*All Participants*	Group discussion: what is an Indicator in the context of assessing gear performance?	-
12.00-12.30	*TG Conveners*	Mapping of the TG: where we are with the use of Indicators and where we aim to be at the end of the 3 years	-
12.30-13.30		**Working Lunch**	
13.30-13.45	Håkan Eggert *(GU, Sweden)*	Assessing global fisheries using Fisheries Performance Indicators	171
13.45-14.00	Eric Gilman *(Safina Center, Hawaii)*	Criteria for evaluating alternative management strategies for fisheries bycatch of threatened species	122
14.00-14.15	Valentina Melli *(DTU, Denmark)*	A shiny app to compare the performance of different legal gears in the Nephrops-directed fishery in Kattegat	172
14.15-14.30	Naganandhini *(TNJFU, India)*	Catch efficiency of EZ baiter hook for Needlefish in the Gulf of Mannar coast	148
14.30-14.45	Tiago Veiga-Malta *(DTU, Denmark)*	Development of a catch composition indicator to assess the performance of fishing gears in relation to area closures or exemptions to discard bans	84
14.45-15.00	Chryssi Mytilineou *(HCMR, Greece)*	Is biodiversity affected by bottom trawl fishing? It's time to take decisions	59
15.00-15.30		**Coffee Break**	
15.30-16.45	All Participants	Group work: How do we choose the best gear? Identify Indicators, existing or needed, relevant to different stakeholders (i.e. scientists, fishers, managers, public)	-
16.45-17.00	TG Conveners	Wrap up TG work. Future plan	-
17.00 -		Topic Group Work - continued as required	

Topic Group 3: ALDFG

Venue: Anchor Hall

Zoom Registration Link

https://us06web.zoom.us/meeting/register/tZcscemvrjwqE9aUQ-clefM5HIZ_L-1zfNb_

Conveners	**Ms. Amparo Perez Roda** *Fishery Officer, FAO, Italy*	**Dr. Kelsey Richardson** *Project coordinator, FAO, Italy*	**Dr. Haraldur Einarsson** *Fishing Gear Expert, FAO, Italy*

Time	Presenter	Topic	ID
11.00-11.30	*TG Conveners*	Introduction to the topic group. Review the Terms of Reference	
11.30-11.45	Paritosh Deshpande *(NTNU, Norway)*	Dynamic indicators to estimate gear efficiency and leakage of plastic into oceans: a case from commercial fishing in Norway	13
11.45-12.00	Anthony Gallagher *(ERC, UK)*	Abandoned, Lost or otherwise Discarded Fishing Gear (ALDFG) in Sri Lanka - A pilot study collecting baseline data	44
12.00-12.15	*Santiphong Putsa (SEAFDEC, Thailand)*	Preliminary Investigation to Estimate the Abandon, Lost, and Discard Gillnet and Traps (pots) along the Coast of Thailand	145
12.15-12.30	*Kristine Cerbule (UiT, Norway)*	Ghost fishing efficiency in snow crab (*Chionoecetes opilio*) pot fishery	27
12.30-13.30		**Working Lunch**	
Time	**Presenter**	**Topic**	**ID**
13.30-13.45	Haraldur Einarsson / Roth	Introduction to the Manual for Marking Fishing Gear / Fishing gear marking tests in Argentina	120/28
13.45-14.00	Polar Door / Others	Introduction from stakeholders for innovative solutions (about 5min each)	-
14.00-15.00	*TG Conveners/All*	Group Work	-
15.00-15.30		**Coffee Break**	
15.30-16.45	*TG Conveners/All*	Group Work	-
16.45-17.00	TG Conveners	Wrap up TG work. Future plan	-
17.00 -		Topic Group Work - continued as required	

Day 4: February 16, 2023 Venue: WATER FRONT HALL

Zoom Registration Link
https://us06web.zoom.us/meeting/register/tZUoduqsrDsrG90Q6LIDS5Jhrk2QTOkD7JuY

Plenum: Energy			
Conveners	**Dr. Haraldur Einarsson** *Fishing Gear Expert, FAO, Italy*	**Dr. Baskaran Manimaran** *Former Vice-Chancellor, TNJFU, India*	
Time	**Presenter**	**Topic**	**ID**
09.00-09.15	Thaweesak Thimkrap *(SEAFDEC, Thailand)*	Greening Trawl Fishing Operation: Optimized Energy Saving, Minimized Seabottom Contact, and Improved Safety at Sea	33
09.15-09.30	Allard van Mens *(WMR, Netherlands)*	Innovation in Dutch beam trawl fisheries: rubberticklers-twister gear	10
09.30-09.45	M P Remesan *(CIFT, India)*	Development of VFDS Otter Boards for Energy Conservation	29
09.45-10.00	Mathew McHugh *(BIM, Ireland)*	Using pair trawling to reduce fuel in a demersal fishery	97
10.00-10.15	*Antonello Sala (FAO, Italy)*	Fuel use and greenhouse gas (GHG) emissions in fisheries	149
10.15-10.30	*Ravichandran (CIFNET, India)*	Studies on alternate fuel for out board motor (OBM) driven fishing boats in India	121
10.30-11.00	**Coffee Break**		
Time	**Presenter**	**Topic**	**ID**
11.00-11.15	MV Bhaiju *(CIFT, India)*	Experiments with LNG as fuel for fishing vessel propulsion: Indian experience	16
11.15-11.30	Morteza Eighani *(DTU, Denmark) Online*	Semi-pelagic self-adjusting otter boards: effects on the catching performance of a demersal trawl	6
Plenum: General			
Conveners	**Dr. Noelle Yochum** *Conservation Engineer, APU, Alaska*	**Dr. Leela Edwin** *Principal Scientist, ICAR-CIFT, India*	
11.30-11.45	VR Madhu *(CIFT, India)*	A review of initiatives in India to lower bycatch and discard rates in trawling	26
11.45-12.00	Neha Kothari *(GBPAT, India)*	Fishing Gear Modification: A Solution To Achieve Ecosystem Objectives	31
12.00-12.15	Leela Edwin *(CIFT, India)*	Technological inputs for fisheries conservation and management in Kerala, India	50
12.15-12.30	S Jayaraj *(BOBP-IGO, India)*	Preserving the tradition: Fishing crafts of artisanal fisher folks in Bay of Bengal	125
12.30-13.30	**Working Lunch**		

Field trips
February 16, 2023 (2 pm – 6 pm)
Participants can select the package of their choice to visit

Option 1

ICAR-CIFT & Processing Plant

Central Institute of Fisheries technology (ICAR-CIFT) is the major national center in the country where research in all disciplines relating to fishing technology and fish processing is undertaken.

Kochi is one among the top five fish export centers in India. There are several state-of-the-art fish processing plants in Kochi. CIFT will coordinate a visit to one of the plants.

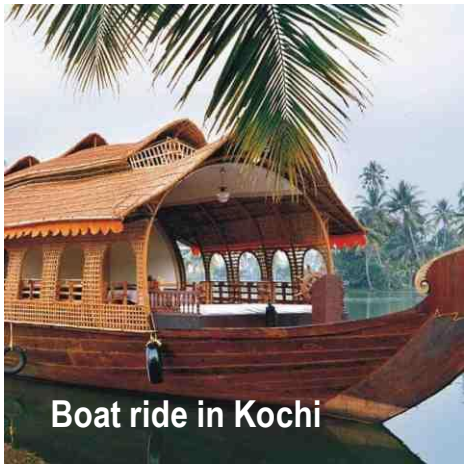
Option 2

ICAR-CMFRI & City Ride

Central Institute of Marine Fisheries Institute (ICAR-CMFRI) is the leading tropical marine fisheries research institute in the region.

The Institute's multidisciplinary approach to research in marine capture and culture fisheries has won recognition as a premier institute comparable to any well-established marine laboratory in the world.

Option 3



Kochi backwater tour will allow to enjoy unmatched beauty of nature, and enable one to get a glimpse of the busy city life.

Kochi backwaters is blessed with rich aquatic life.

The point where Arabian Sea and Vembanad Lake meets is a splendid sight.

Day 5: February 17, 2023 *Venue: WATER FRONT HALL*

Zoom Registration Link
https://us06web.zoom.us/meeting/register/tZUoduqsrDsrG90Q6LIDS5Jhrk2QTOkD7JuY

Plenum: General			
Conveners	**Dr. Noelle Yochum** *Conservation Engineer, APU, Alaska*	**Dr. Leela Edwin** *Principal Scientist, ICAR-CIFT, India*	
Time	**Presenter**	**Topic**	**ID**
09.00-09.15	Drake Ssempijja *(UM, USA)*	The Fisheries of Uganda. Current and future perspectives from an African Inland Fishery.	2
09.15-09.30	Júlio Zitha (MIMAIP, Mozambique)	The beach seine ban / phase out in Mozambique - tasks, opportunity and challenges	161
09.30-09.45	Piyasiri (SLFSSF, Sri Lanka)	Dissension on modern fishing technology: the bizarre saga of Blue Revolution in Sri Lanka	111
09.45-10.00	Geetha Sasikumar *(CMFRI, India)*	An update on the gear characteristics of trawls operated off the Karnataka Coast, eastern Arabian Sea	131
10.00-10.15	Sarasan Sabu *(CUSAT, India)*	Innovative technological interventions in harvesting methods for minimizing the impact of fishing on fish quality and post-harvest losses	126
10.15-10.30	Hannah Fennell *(Heriot Watt University, UK) online*	Understanding the research needs of pelagic fisheries using a research prioritization exercise	160
10.30.11.00	**Coffee Break**		

Plenum: Gear Design			
Conveners	**Mr. Georg Haney** *Hampiðjan Group Iceland*	**Dr. Pravin Putra** *Former ADG (Marine Fisheries), ICAR, DARE, Govt. of India*	
Time	**Presenter**	**Topic**	**ID**
11.00-11.15	Sarath Krishnan Karumathil *(Universidade da Coruña, Spain)*	Simulation of fluid flow across fishing nets for studying the impact of trawling near the seabed	15
11.15-11.30	Karsten Breddermann *(University of Rostock, Germany)*	SimuNet - Numerical modelling of fishing gear	35
11.30-11.45	Finbarr G.O'Neill *(DTU, Denmark)*	Introducing RightFish – a BlueBio CoFund project to reduce environmental impact and GHG emissions in commercial fisheries	46

Time	Presenter	Topic	ID
11.45-12.00	Karen B Burgaard *(DTU, Denmark)*	Experimental and numerical investigation of hydrodynamics around towed fishing gear to develop selective fishing methods in a sea star fishery	113
12.00-12.15	Shifa Jalal *(CIFT, India)*	Nano silicon dioxide incorporated epoxy polymers: Effective solution against lead pollution from fishing gear sinkers.	5
12.15-12.30	Dhiju Das *(CIFT, India)*	Durability studies of ring seine (mini purse seine) gear used along the Kerala coast, India	48
12.30-13.30		**Working Lunch**	
13.30-13.45	Daragh Browne *(BIM, Ireland)*	Side-scan sonar development of sweep modifications to facilitate early release of unwanted catches	101
13.45-14.00	Pieke Molenaar *(WMR, The Netherlands)*	Kiwi cod-end trials in the Dutch mixed demersal beam trawl fishery to improve fish quality and post capture survival of discarded unwanted bycatch.	103
14.00-14.15	Esakkimuthu *(TNJFU, India)*	Design and operational details of deep sea pelagic longlines by fishermen of Thoothoor, South-West coast of India	136
14.15-14.30	Peter Ljungberg (SLU, Sweden)	Bottom set, yet floating pontoon traps for multispecies fishery.	165
14.30-14.45	Haraldur A. Einarsson *(BIM, Ireland)*	The FishScanner	110
14.45-15.00	Mette Svantemann Lyngby *(DTU, Denmark)*	Real-time detections of bycatch species in demersal trawl fisheries	157
15.30-16.00		**Coffee Break**	
15.30-16.30		Working Group Work	

16.30-17.30	**Valedictory Session**

Poster Presentations

(Venue: Besides the Waterfront Hall)

FIRST BATCH

13/2/2022 (AN) – 15/2/2022 (FN)

Category ALDFG, Passive Gears, Active Gears, Energy, General		
Presenter	**Topic**	**ID**
Naganandhini *(TNJFU, India)*	Influence of Hook number on Species Composition, Catch Rate and Size of Needlefishes in the Gulf of Mannar, India	8
Prajith *(CIFT, India)*	Fishing around the open aquaculture cages using passive fishing gears, a novel concept for effective utilization of resource and energy	11
Nath Jha *(CIFT, India)*	Environmental performance of deep-sea gillnet fishing systems	17
Claire Collins *(ZSL, UK)*	Technology and solutions to tackle illegal fishing across the Central and Western Indian Ocean regions - Poster presentation	18
Sreejith S Kumar *(CIFT, India)*	Abandonment of end-of-life FRP fishing boats along the beaches: a growing hazard on Kerala coast	21
Arun Jenish *(TNJFU, India)*	Analyzing carbon emission level of motorized fishing sector of Pulicat region	38
Raghu Prakash Reghu *(CIFT, India)*	Selectivity characteristics of Rainbow Sardine *Dussumieria acuta* Valenciennes, 1847 with respect to diamond and square mesh cod ends…	47
Lasuni Chathurima *(OU, Sri Lanka)*	Assessing the barriers to uptake of Vessel Monitoring and Automatic Identification Systems for improved fisheries management	49
Divya Viswambharan *(CMFRI, India)*	Impact of derelict fishing gears on vulnerable coastal ecosystems along west coast of India	51
Kumar Vase *(CMFRI, India)*	Developments in the major fishing methods along the Northwest coast of India: dynamics in fishing attributes and species composition	53
Mohammed Jabir *(ICAR-CIFT, India)*	Study on hook and line fishing in Agatti island, Lakshadweep with special reference to the impact of cyclone Ockhi in fishery production	63
Abdul Azeez P *(CMFRI, India)*	Application of geostatistics in the mapping of bycatch distribution from mid-water trawlers in the north-eastern Arabian Sea: Marine Spatial Planning	73
Damaris *(CUSAT, India)*	Incidental occurrence of ALDFG in commercial trawls of Kerala, India	82

Presenter	Topic	ID
Akhilesh *(CMFRI, India)*	Towards Electronic Monitoring (EM) in Indian marine fisheries: How far to go?	87
Mayur Tade *(KUFOS, India)*	Augmenting commercial lobster fisheries through sustainable capture-based mariculture in open sea cages	89
Abhishek *(AU, India)*	Using Vessel monitoring technologies to detect the fishing ships in Mumbai Harbor	91
Harshavardhan *(FSI, India)*	A survey on the impact of Ghost net on Active and passive gear: Special reference to Trawl and Monofilament long line in coastal and deep-sea water	98
Vasanth *(KUFOS, India)*	Impact of 'J' hook shapes on Hooking rate, catch rate and Hooking position of Carangids for the Gulf of Mannar, India	99
Ajay Nakhawa *(CMFRI, India)*	Status of Mechanised Gillnet fisheries of Northern Maharashtra in challenging times	102
Amala Shajeeva *(TNJFU, India)*	Comparative analysis on the impact of design on the drag resistance of trawls operated from different size class vessels of Thoothukudi.	106
Harsha *(CIFT, India)*	Lost gear retrieval exercise through scuba diving and analysis on the fate of derelict gears in Tamil Nadu, India	114
Bijumon *(CIFNET, India)*	The operating management and maintenance strategy of an Indian Fishing vessel. The factual observance and practice of a case study	123
Jacob *(TNJFU, India)*	Analysis of the Technical Status and Economics of Operation of Deep-Sea Fishing Vessels of the Thoothukudi and Kanyakumari districts …	127
Asokan *(KUFOS, India)*	Environmental profiling and life cycle impact assessment on Trawler operated in Thoothukudi, southeast coast of India	144
Lalima *(KUFOS, India)*	The Details of trawlers (Length Overall (LOA) of Trawlers and Engine horsepower) operated in the Cochin coast	154

SECOND BATCH

15/2/2023 (AN) – 17/2/2023 (FN)

Category: General		
Presenter	**Topic**	**ID**
Mohammed Alam *(UC, Bangladesh)*	Assessment of stocks to understand trends of data-poor marine capture fisheries of Bangladesh	23
Mujeeb Rahiman *(CUSAT, India)*	Deep-sea Ichthyofaunal Assemblages in South-Eastern Arabian Sea (SEAS) Through a Combination of Conventional Taxonomy and eDNA Meta-barcoding	39
Sajeevan *(KUFOS, India)*	Exploitation status of Ochre-banded goatfish *Upeneus sundaicus* (Bleeker, 1855) fishery from Tamil Nadu, India waters using surplus production models.	40
Abinaya *(KUFOS, India)*	Exploitation status of marine fishery resources of Tamil Nadu, India waters using a surplus production modelling approach.	41
Jayasekara *(USJ, Sri Lanka)*	Does shrimp trawling contribute to the decline of Sciaenid stocks?	43
Eldo Varghese *(CMFRI, India)*	Indian Marine Capture Fisheries- Gear and effort-oriented stock assessment approaches	54
SriHari *(BOBP-IGO, India)*	Review on marine fisheries management measures in South Asian countries	55
Abdussamad *(CMFRI, India)*	Indian Marine Fisheries- inherently robust or intuitively buoyant?	57
Eldo Varghese *(CMFRI, India)*	Structural Breaks in Fishing Efforts in the Indian EEZ	61
Vipin *(CIFNET, India)*	Need for an action plan for stock validation, fishery management and efficient utilization of myctophid resources in India EEZ	64
Sijo Varghese *(FSI, India)*	Mortality of sharks and other large pelagics in Indian tuna fisheries	68
Solly Solomon *(FSI, India)*	Prospects and potential of artificial reefs in replenishing coastal and neritic fishery resources in India	69
Rekha Nair *(CMFRI, India)*	Addressing issues of fisheries bycatch in the Indian Seas on a conservation angle	70
Babu Chelliah *(CIFNET, India)*	Studies on the distribution and abundance of yellowfin tuna, *Thunnus albacares* in the east coast of India using GIS	71
Rahangdale *(CMFRI, India)*	Implication of shifting spawning seasons on marine fisheries management: A case study from Gujarat	75
Vasanth *(KUFOS, India)*	Length-weight relationships of eight pelagic carnivore fishes by longlines of Gulf of Mannar, India	94

Presenter	Topic	ID
David Stanley (FEPS, UK)	Can we use low-res satellite images to study the impact of COVID on fishing activity in a small-scale fishery?	128
Rekha Chakraborty *(CMFRI, India)*	Chronicles of deep-water shrimp fishery (2007-2020) along the southwest coast of India: trends & potential	133
Rajasekhar *(NIOT, India)*	An Analysis on the Management of Navigation Aids onboard Research Vessels Based on Internet of Things [IoT]	134
Ravikumar *(TNJFU, India)*	Investigation of the common defects and damages of the Fiberglass reinforce Plastic boats operated along the coast of Tamil Nadu	138
Shoba J Kizhakudan *(CMFRI, India)*	Mapping of domestic shark trade chains and utilization in India with implications for sustainable management of coastal shark fisheries.	147
Joe Kizhakudan *(CMFRI, India)*	Artificial reefs in coastal systems - productivity power stations and new avenues for community-based fishery management and conservation	151
Sureandiran *(KU, India)*	Crustacean Fishery along the North-eastern Arabian Sea Coast of India: Catch Composition, Species Monthly Wise Landing, Morphometric Relationship and Some Biological Aspects.	152
Amrutha R Krishnan *(KUFOS, India)*	Fish Diversity in Hooghly Matlah estuary near Sunderban, West Bengal	162
Amrutha R Krishnan *(KUFOS, India)*	A Comparative study of Mechanical properties of untreated rubber wood and rubber wood treated with nano CuO added Cashew Nut Shell Liquid.	163

Annex III
ABSTRACTS

Opening Session

FAO's global efforts in responsible fishing operations

Jon Lansley[1], Amparo Perez Roda[1], Kelsey Richardson[1], Haraldur Einarsson[1], Antonello Sala[1], Pingguo He[1]

[1]*Food and Agriculture anization of the United Nations (FAO); Fisheries Division, Fishing Operations and Technology Branch, Viale delle Terme di Caracalla, 00153, Rome, Italy.*

Jon.lansley@fao.org

The FAO's Responsible Fishing Operations Team focused on the following areas related to the FTFB during the past two years. Carrying out activities to implement the FAO Voluntary Guidelines for the Marking of Fishing Gear (VGMFG) around the globe, including:

Development of guidelines for a scheme to operationalise the FAO Voluntary Guidelines on the Marking of Fishing Gear for Indian Ocean Tuna Commission (IOTC) (published 2022).
Development of a framework for conducting a risk assessment for a system on the marking of fishing gear (VGMFG Suppl. 1, published 2023)
Development of a manual for the marking of fishing gear (VGMFG Suppl. 2, published 2023)
Support to IMO sub-committees dealing with the development of an international obligation for the marking of fishing gear under Marpol Annex V

Development of a new project proposal (REBYC-III) addressing bycatch in Caribbean and North Brazilian Shelf (CLME+) trawl and non-trawl fisheries, to commence 2023. Development of factsheets to promote the "FAO Technical Guidelines to Prevent and Reduce Bycatch of Marine Mammals in Capture Fisheries" (published 2021). Developed and published FAO technical paper "Classification and illustrated definition of fishing gears" (published 2021). Co-sponsoring (with IMO) a GESAMP Working group on sea-based sources of marine litter including fishing gear, especially abandoned, lost or otherwise fishing gear (ALDFG) and other shipping-related litter (1st report published 2021). Activities addressing ALDFG and marine plastic litter through the IMO/FAO GloLitter Partnerships project including:

Producing knowledge products on "Legal aspects of ALDFG" (published 2022), "Reporting and retrieval of ALDFG" (published 2022), a "Report of good practices to prevent and reduce plastic litter from fishing activities" (published 2022) and a desk study on fishing gear recycling, Extended Producers Responsibility (EPR), and circular economy models around fishing gear (to be published in 2023)
Support for the development of National Action Plans to address ALDFG.
Incorporation of the VGMFG in national fisheries frameworks.
Fishing gear modification trials to reduce potential for ghost fishing.

Implementation of FAO surveys of ALDFG in selected regions and countries to fill data gaps. Desk study on Fuel use and greenhouse gas (GHG) emissions in fisheries (in review).

Information and resources can be found on the following Responsible Fishing Practices for Sustainable Fisheries website https://www.fao.org/responsible-fishing .

Theme: Active Gears

Turn and Fix – two ways to sharpen size selection

Zita Bak-Jensen[1]*, Bent Herrmann[1,2,3], Juan Santos[4], Valentina Melli[1], Daniel Stepputtis[4], Jordan P. Feekings[1]

[1]*DTU Aqua, Technical University of Denmark, Hirtshals, Denmark, zitba@aqua.dtu.dk*

[2]*SINTEF Ocean, Brattørkaia 17C, N-7010 Trondheim, Norway*

[3]*The Arctic University of Norway, UiT, Breivika, N-9037 Tromsø, Norway*

[4]*Thünen Institute of Baltic Sea Fisheries, Alter Hafen Süd 2, Rostock, 18069; Germany*

In demersal trawls the most used codends are made of diamond-mesh netting. However, diamond-mesh codends vary in mesh geometry during fishing which introduces variability in the size selection process. The variability in mesh geometry results in less sharp size selectivity and hence it is more challenging to find the compromise between catching small fish and catch loss using a given mesh size. This phenomenon compromises the rationality of regulating exploitation patterns in trawl fisheries based on mesh size. One technical solution often tried to achieve a sharper size selection is turning the codend netting 45 degrees (square-mesh, T45). However, there is a lack of evidence that square-mesh codends fulfill prior expectations regarding its sharper selectivity. In addition, it is a general assumption that flatfish have better escapement probability in diamond-mesh codends compared to square-mesh codends, while the opposite occurs for roundfish. To test these assumptions, we investigated the size selective properties of five codends: a standard square-mesh, a standard diamond-mesh and three rigid codends, one with mesh geometry fixed in a square shape and two fixed at different diamond opening angles (40 and 60 degrees). We collected selectivity data for cod (*Gadus morhua*) and for three flatfish species, European plaice (*Pleuronectes platessa*), common dab (*Limanda limanda*) and flounder (*Platichthys flesus*). Our results show a significant higher variability in size selection using standard diamond-mesh compared to a fixed diamond-mesh codend for both flatfish and roundfish. Moreover, we found that size selection in square-mesh codend with non-fixed meshes is not as sharp as it could be with fixed meshes, and it has significant effect on the length-dependent retention for flatfish. Thereby size selection could be improved with mesh openness kept constant as this stabilize the selection process and thereby ease achieving the desired exploitation

A brighter future for the Belgian fishing fleet: an overview of 3 years of fishing trials using LED

Van Opstal Mattias[1], Jasper Van Vlasselaer[1]

[1]*Flanders Research Institute for Agriculture, Fisheries and Food (ILVO), Jacobsenstraat 1, 8400 Oostende, Belgium, mattias.vanopstal@ilvo.vlaanderen.be*

Beam trawl fisheries targeting sole are a mixed fishery with high bycatch and discard rates. The instalment of the European Landing Obligation intensified the relevance of minimising discard rates of european plaice (*Pleuronectes platessa*), often thrown back to make space for the more valuable sole. In order to reduce the discards of plaice, research with artificial light illuminating Square Mesh Panels on board RV Belgica was performed. Without significant loss of valuable commercial fish

species, we managed to increase escape rates of the undersized plaice, which gave rise to a new project: Led there be light. It consists of two parts. In the first we tried to further improve escape rates of undersized fish in sole fisheries based on a better understanding of species-specific fish behaviour in relation to environmental conditions and by experimenting with the light itself. We trialled different wavelengths and light sources (SafetyNet Technologies "PISCES" lights, Lindgren Pitman lights and LED ropes) and developed LED separator panels, creating a visual barrier for undersized plaice. The second part of the project aimed at exploring the possibilities for LED innovations in different fishing techniques practiced by the Belgian fleet. Based on what we learned in sole fisheries, we experimented with LED to reduce bycatch of flatfish in beam trawls targeting brown shrimp (*Crangon crangon*). We did preliminary research aiming to increase the catches of squid (*Loligo spp*.) in flyshoot and otter trawl fisheries while recusing gadoid bycatch. Although currently not used in the Belgian fleet, we also looked at the potential of light to attract brown crab (*Cancer pagurus*) with pots. We will shine some light on the preliminary results that we obtained and the lessons learned from the variety of experiments we performed so far in LED there be light.

Trawl goes selective: An insight in to demand induced innovation in trawl fishery of Gujarat

Rajan Kumar[1], Dineshbabu A.P.[1], Shikha Rahangdale[1], Vinayakumar vase[1], Jayasankar J.[1]

[1]*ICAR-Central Marine Fisheries Research Institute, Kochi, Kerala, rajanfrmcife@gmail.com*

Trawl has often been criticized for being an unselective mode of fish harvest, leading to considerable ecological damage. Trawl were introduced as bottom trawl in India to harvest the lucrative prawn resources available along the continental shelves of the country. Several demonstrations in the 1980s showed that the operation of the high opening bottom trawls can efficiently harvest the demersal teleost resources, especially along the NW coast of India. This has led to the emergence of fish trawls, gradually reducing the effort spent towards bottom trawl operation. Since 2001, there are considerable changes in species preference in response to the export demand. The ribbonfishes and cephalopod emerged as the most sought for species by the fishers of the Gujarat. The changing preference of the species is reflected in the operational changes in the trawl operation, an innovation introduced by fishers of Gujarat. At present, there are basically five types of trawl nets operated by Gujarat fishers, namely perch and shrimp (bottom), ribbonfish (pelagic), cephalopod (squid), and Acetes trawl (only single day operation). Each one designed for harvesting specific resource. The major design difference was in the mesh size of the front panel. It ranges from 6000 mm in ribbonfish trawl to 600 mm (top panel) in Acetes trawl. In all the cases, the foot rope length in longer by 6-9 m. The towing speed varies from 2 to 6 knots. The 2-3 knots were used during shrimp & ribbonfish trawling. During demersal fish and Acetes trawling, the speed is around 4 knots. The towing speed used during squid trawling goes up to 6 knots. Much variation in cod end for perch, ribbonfish and cephalopod trawling is not there. The minimum mesh size for cod end was in Acetes trawl, i.e. 8 mm. A study was conducted along the NW coast during 2018-19 to partition the multi-day trawl effort in to its sub-component, namely bottom trawl, pelagic trawl and cephalopod trawl. The ribbonfish (pelagic) trawling was the most dominant component, accounting for 39.64% (27.0 to 46.97%) of the total hauls. The cephalopod trawling accounted for 20.55 to 32.15% of the total trawl hauls, with a mean of 26.99%. The bottom trawling accounted for only 33.17% (26.1 to 41.58%) of the total hauls. The monthly catch rates of the bottom trawl operation were also worked out. The catch rate of high valued fishes ranged between 22.73 to 98.52 kgs/hr. The discard rate was between 25.62 to 32.67 kgs/hr. The study advocates the shift in data collection procedure to haul based data collection from the existing boat on arrival approach to scientifically account for changing catch and catch rates from the trawl sector.

Does a codend with shortened lastridge ropes provide optimal escape opportunities for different fish species?

Elsa Cuende[1], Manu Sistiaga[2,3], Bent Herrmann[3,4,5], Mikel Basterretxea[1], Luis Arregi[1]

[1]*AZTI, Marine Research, Basque Research and Technology Alliance (BRTA). Txatxarramendi ugartea z/g, 48395 Sukarrieta, Bizkaia, Spain, ecuende@azti.es*

[2]*Institute of Marine Research, Postboks 1870 Nordnes, Bergen, 5817, Norway*

[3]*The Arctic University of Norway, UiT, Breivika, N-9037 Tromsø, Norway*

[4]*SINTEF Ocean, Fishing Gear Technology, Willemoesvej 2, 9850, Hirtshals, Denmark*

[5]*DTU Aqua, Denmark Technical University, Hirtshals, Denmark*

Diamond meshes in trawl codends have limited openness, which reduces escape chances for roundfish. Shortening the lastridge ropes (LR) attached to codend selvedges can increase the availability of open meshes resulting in higher chances of escape. However, this availability does not imply optimal mesh openness, nor does it guarantee use. We estimate the escape probability of hake, horse mackerel and blue whiting through a 20% shortened LR codend and a standard codend, and quantify the contribution of different mesh opening angles (OAs) to their size selectivity. The results confirm that high OAs increase escape opportunities for all species. However, shortened LR only improved size selectivity significantly for horse mackerel and blue whiting. This difference between species may be related to behavioural differences. The mesh openness achieved with 20% shortened LR was below that necessary to obtain optimal escape opportunities for these species. The study highlights the relevance of considering fish morphology and behaviour to optimally exploit size selectivity when designing shortened LR codends.

Beach seine fishing in India: scope for improvement for sustainability

Manju Lekshmi N.[1], Dhiju Das P.H. [1], and Leela Edwin[1]

[1]*ICAR-Central Institute of Fisheries Technology, Fishing Technology Division, Cochin, India, manjuaem@gmail.com*

The study gives an overview of designs, catch composition, problems, and solutions for beach seine operations in India. The design of beach seines in India varies in structure and size based on region and resources. In India, 2,227 numbers beach seines were reported under different names and operated along the east and west coasts of India (2015). In Kerala and Tamil Nadu, beach seines are locally known as kambavala/karamadi which have a separate bag like cod-end. Rampani/rampan is the seine operated in Maharashtra, Goa, and Karnataka which is without a specific cod-end but only has loosely hung meshes. Natural and biodegradable materials were used for the fabrication of seine nets which are now replaced with synthetic materials (nylon, polyethylene, etc) due to their wide applicability. Normally, beach seines are non-selective fishing gears with small mesh sizes (below 10 mm) and are operated during the post-monsoon season due to the easy availability of coastal pelagics like sardines, mackerel, herrings, ribbon fishes, anchovies, etc. Fishing practices are governed by a well-defined set of traditional rules enforced by the fishing community to share the catch/revenue/wages. The majority of beach seines in India were operated as a community (group of fishers), and few have been owner-operated where each group takes a turn (rotation) for fishing from a specific location. Even though beach seine is one of the traditional fishing gear, management practices followed by the fishers in many of the states in India

are remarkable. Studies conducted by ICAR-Central Institute of Fisheries Technology (CIFT) found that the number of beach seines has been declining in India during the last two decades. Despite its declining contribution to national income, beach seines have an important socio-economic role, especially the management in gear operation, in providing livelihoods, nutrition, and food security. ICAR-CIFT has developed technical guidelines for the operation of beach seines along the Indian coast for the reduction of juvenile incidence by increasing the existing codend mesh size and recommends square mesh at the cod-end. Suggestions are made to avoid ecologically sensitive areas for beach seine operations. This study concludes that technical improvements and the introduction of measures for the reduction of juvenile catches will lead to the sustainability of the beach seine fishery in India which is a source of livelihood for the of aged traditional fisherfolk.

A journey to new regions: Testing and improving the MiniSeine´s performance in waters off the German Baltic Sea coast

Thomas Noack[1], Daniel Stepputtis[1]

[1]*Thünen Institute of Baltic Sea Fisheries, Alter Hafen Süd 2, 18069 Rostock, Germany, thomas.noack@thuenen.de*

The MiniSeine is a small demersal seine that might be considered an alternative gear for small passive fisheries suffering from interactions with raiding seals. Such seals can damage or remove fish from for instance gillnets or cause damage to the fishing gear itself. By reducing seine rope length, seine rope diameter as well as seine net size of a conventional demersal seine system, the MiniSeine system can fit and be operated from rather small vessels as gillnetters usually are. As previous studies by Danish and Swedish colleagues have shown, the Danish prototype of the MiniSeine system is able to catch fish, but offers a number of issues, like low hauling speed. Current trials, conducted in summer 2022 off the German Baltic coast, aimed at i) testing the gear with another vessel in another region and ii) improving the gear´s performance (e.g. catch efficiency). The results of these trials will be presented by showing and discussing catch composition as well as other relevant information like gear handling and fuel efficiency. Although several pitfalls of the gear could be identified, the results indicate that the MiniSeine has the potential to become part of the list “efficient fishing gears with reduced seal interactions”.

What will it take to get fish out of the trawl? Creating a Low-Flow Zone within and outside the boundaries of a trawl to incentivize fish escape

Valentina Melli[1]*, Finbarr G. O'Neill[1]*, Karsten Breddermann[2], Jens Peter Kofoed[3], Junita D. Karlsen[1]

[1]*DTU Aqua, National Institute of Aquatic Resources, North Sea Science Park, Hirtshals, Denmark, vmel@aqua.dtu.dk ; barone@aqua.dtu.dk*

[2]*University of Rostock, Justus-von-Liebig-Weg 2, D-18059, Rostock, Germany*

[3]*SINTEF Ocean, North Sea Science Park, Hirtshals, Denmark*

A promising, yet under-utilized approach to bycatch reduction in trawl fisheries is one that exploits and manipulate the swimming orientation and flow refuging behaviour of bycatch species to encourage their escape from inside a trawl. We investigated whether a low flow zone area, expanding both within and outside the extension section of a demersal trawl, can be used to increase fish escape. A 360° radial escape opportunity, in the form of a gap in the trawl between the extension and codend, was offered to the fish in the low flow area. The catch was guided into the codend by

an impermeable tarpaulin funnel, which generated a low flow area in the wake region behind it, where the gap was located. In principle, only individuals that exploit the low flow area can swim forward and escape through the gap. To prevent fish with strong flow refuging behaviour to hold stationary in the low flow zone, without exiting the gap, a deflector flange also made of an impermeable tarpaulin was mounted outside the entrance of the funnel to expand the low flow area in the open water surrounding the extension piece. This concept was designed using flume tank trials and computational fluid dynamic modelling and tested during experimental trials at sea. Substantial escape rates were found for all three roundfish species considered: cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*) and whiting (*Merlangius merlangus*). Moreover, based on the fluid dynamic models, we tested two different gap sizes, with the smaller gap (1 m) moving the codend entrance into the recirculation area created by the low flow zone. We found a significant difference in the escape of undersized haddock and whiting, but not cod, which suggest complex and possibly species-dependent interactions between hydrodynamic flow and fish behaviour.

Comparative studies of 30 mm diamond mesh and 30 mm square mesh codends conducted during the demersal fishery resources survey along the Andhra Pradesh Coast

P.Das[1], G.V.A.Prasad[1], A.B.Kar[1], D.B.Reddy[1], K.Silambarasan[2], A.Siva[3], S.R.Panda[1], R. Jeyabaskaran[3]

[1]*Fishery Survey of India, Beach Road, Visakhapatnam, Andhra Pradesh-530 001,* fsi_vizag@yahoo.co.in

[2]*Fishery Survey of India, Royapuram, Chennai, Tamil Nadu- 600013*

[3]*Headquarters, Fishery Survey of India, Sassoon Dock, Colaba, Mumbai 400 005*

Indian Marine Fisheries is a multi-gear and multispecies fishery. However, trawl fishery contributes substantially to the marine fish landings in India. The trawl catch comprises of commercial varieties and also the by-catch. Among the by-catch some are trash fishes which are not economically beneficial hence discarded. The trawl discards have biological and ecological impacts. In Indian waters there are many by-catch reduction mechanism available for the reduction of trash and escapement of juveniles. The most effective one is the square mesh codend as it remains open during the net tow in comparison to the traditional diamond mesh codend. To establish the efficiency of the square mesh codend than the diamond mesh a comparative study was undertaken by Fishery Survey of India, Visakhapatnam along the Andhra Pradesh coast. The study was undertaken onboard the departmental survey vessel MFV Matsya Dashini (OAL: 36.5m, GRT: 268.8T, BHP:1160) during the bottom trawl operations by deploying the 45.6 M expo model bottom trawl with the 30 MM diamond mesh and 30 MM square mesh (2.5mm Φ HDPE) codends. A total of 44hauls (fishing effort of 66 hrs) each using diamond and square mesh codend were made. The collected data was analysed for the average CPUE, spatial variation, species diversity, variation in size etc. The result indicates that in square mesh codend a better CPUE of 55.9 kg/hr was obtained than the diamond mesh codend (CPUE of 50.5 kg/hr). Species composition indicated more trash fishes in the diamond mesh codend. The study also indicated larger size species in the square mesh codend. The square mesh cod end shows better productivity, reduction in by-catch/ trash fishes and escapement of the juveniles in the Andhra Pradesh coast. The same study needs to be carried out in other part of the EEZ also so that effectiveness of the square mesh codend can be established and can be promoted in Indian trawl fisheries.

Key words: Trawl fisheries, by-catch, juveniles, square mesh codend, CPUE, Matsya Darshini

Emergence of specialized trawl net for the fishery of octopus along the southwest coast of India

V. Venkatesan[1], KK. Sajikumar[1], VR Madhu[2], Geetha Sasikumar[1]

[1]*ICAR-Central Marine Fisheries Research Institute, Kochi-682018 Kerala, India,* venkatcmfri@yahoo.co.in

[2]*ICAR-Central Institute of Fisheries Technology, Kochi-682018 Kerala, India*

Cephalopods including octopuses are commercially exploited all along the Indian coast. Octopuses were once thrown overboard as discards but the demand from export trade in the mid-seventies induced the fishers to catch these resources. The cephalopods contribute to about 4% of total marine landings. Among the cephalopods, octopuses formed 10-12 % in total catch. The production of octopuses increased all along the Indian coast However, the increase was more along the west coast than in the east coast. Octopuses are caught as by-catch of trawl nets along the Indian coast except along the certain area where there is a targeted fishery for these resources. Specialized octopus trawl nets are operated from multiday trawlers in the southwest coast. Peak fishing season starts September onwards. Octopus fishing grounds were off Alappuzha or Kollam in the depth ranging from 30- 108 m. it is operated as per the fishing ground either along the bottom or just above the bottom. Peak fishing season are 5 months from August to December. Octopus fishing ground lie between Kanyakumari to Munambam. During the operation of octopus trawl net, the average towing speed of vessel is 2.5 knots.

Improving energy efficiency and seabed impact in deep-sea shrimp trawl fishery

Agustín Mayans Fernández[1], Ignacio J. Martínez Soler[1], A.V. Martínez Sanz[2], Vicente Colomer Romero[2]

[1]*Kongsberg Maritime Spain S.L.U, Polígono Atalayes, 20, 03570 Villajoyosa (Alicante), Spain,* agustin.mayans@simrad.com

[2]*Institute of Design and Manufacturing (IDF) Universitat Politècnica de València. Ciudad Politécnica de la Innovación (CPI), Camino de Vera s/n, Building 8G, 46022 Valencia, Spain,* anmarsan@mcm.upv.es

The objective of this work is to show the benefits of a new eco-systemic fishing gear installed in three bottom trawlers after one year using it. The study has been based on fuel consumption reduction for the three vessels and the catch in two of them.

The new system minimizes the impact of the fishing gear on the seabed, with a reduction on the tow resistance. This generates significant fuel savings that improves the economical result of the fishery, helping the ship owners in the return of investment first, then in the future viability of the operation.

Apart of the evident savings due to the fuel consumption reduction, in the long term, the ship owner will notice also savings on maintenance, both because the winches are towing with less tension (longer life for warps, brakes and hydraulic system) and the engine is running at low rpm's (longer life of the engine and between breakdowns).

The new fishing gear doesn't requires any modification on the way that the fisherman are working, only replacing and/or modify some parts or components of the fishing gear. The implementation is easy and the adjustments required could be done in a couple of days.

Keywords: Mediterranean trawlers, fishing gear, flying bottom trawl doors, energy efficiency, electronics systems

Quick visual observation of pelagic school composition to avoid unwanted catches in commercial pelagic (trawl) fisheries.

Pieke Molenaar[1]

[1]*Wageningen Marine Research, Haringkade 1, 1967 AB IJmuiden, The Netherlands, pieke.molenaar@wur.nl*

Commercial pelagic fisheries locate pelagic schooling fish with sophisticated echo sounding techniques. Those may locate fish school in a range up to 3 kilometer around the vessel. However, when a school is detected in some cases it cannot be determined what species are present. The skipper of a pelagic trawler may decide to perform an experimental short haul to assess species and composition, leading to substantial unwanted catches is case it appeared to be the wrong species. We developed a cost-efficient quick tool that can be deployed and towed through pelagic schools up to 200 meters depth. Within several minutes the skipper knows the species and is able to avoid unwanted catches. The tool has been successfully implemented on trawlers resulting in reduced unwanted catches with some by-catch of interesting underwater recordings.

Demonstration of pingers potential to reduce Common Dolphin bycatch in bottom trawl gears

Esteban Puente[1], Leire Citores[1], Elsa Cuende[1], Iñigo Krug[1], Mikel Basterretxea[1]

[1]*AZTI, Marine Research, Basque Research and Technology Alliance (BRTA). Txatxarramendi ugartea z/g, 48395 Sukarrieta, Bizkaia, Spain, basterretxea@azti.es*

Bycatch of common dolphin (*Delphinus delphis*) in commercial bottom trawl fisheries in the Bay of Biscay (NE Atlantic) is of particular concern and its mitigation has become a priority. Active acoustic deterrent devices (pingers) attached to the fishing gears seem to be promising for bycatch mitigation. However, the high number of days at sea needed to monitor common dolphin bycatch due to the low frequency of those events in the fishery challenges demonstrating pingers' effectiveness. The use of remote electronic monitoring (REM) systems in fisheries allows to significantly increase onboard observation and thus, the access to large and robust databases to comprehensively address bycatch mitigation studies. In this study, the effectiveness of pingers to reduce the bycatch of common dolphin was evaluated in a demersal pair trawler in FAO Division 27.8.c. During 195 fishing days, one of the vessels in the pair operated with a set of pingers, while the other one operated without them. In total, 660 fishing hauls were alternatively carried out by the trawls with and without pingers, and the bycatch of common dolphin was monitored through REM system. The results showed that the common dolphin bycatch frequency and the number of individuals bycaught per haul were significantly lower when pingers were deployed. Specifically, the pinger tested reduced the common dolphin bycatch by more than 90%. The results also showed that the bycatch of common dolphin is related to factors such as the type of net used, the fishing zone (north and south of Capbreton Canyon) and the depth, whereas the time of day was not found to significantly affect the bycatch of this species.

The Details of trawlers (Length Overall (LOA) of Trawlers and Engine horsepower) operated in the Cochin coast

Lalima inwati[1], Remesan M P[2], Dhiju das P.H[2], Manoj kumar B[1], Somashekara S.R.[3], Talib Mohammad[4]

[1]*Deparment of Fish Engineering and Technology, Kerala university of fisheries and ocean studies, Panangad, Kochi 682506, Kerala India, invatilali@gmail.com*

[2]*ICAR- Central institute of Fisheries Technology, Willingdon Island, Kochi, Kerala*

[3]*College of Fisheries, Mangaluru, Karnataka Veterinary, Animal and Fisheries Sciences University, (KVAFSU Bidar, Karnataka-585401*

[4]*ICAR-Central Institute of Fisheries Education*

Trawl fisheries is an important component in marine capture fisheries of the major contributing state of India like Kerala. Considering the importance of the trawlers operated, the present study attempted to study the composition of trawlers, operational details of single-day and multi-day fishing and changing trends of trawl fisheries along the Cochin coast. The study was conducted from 2021 to 2022 at the major 4 landing centers of the Cochin coast i.e., Thoppumpady fishing harbour (Cochin harbour), Kalamukku Fishing harbour, Murikkumpadam Fishing harbour, and Munambam fishing harbours, with a sample size of 128 vessel (32 from each harbour), Trawlers in the length-class of 16.1-24.0 were dominant at Thoppumpady fishing harbour with a contribution of 27.03%. The length of fishing vessels varied from 14.3 – 24 m. Length classes of 23-24 m were dominant at Kalamukku fishing harbour with a contribution of 20.59%. The length class of 17-19 m were dominant at Murikkumpadam fishing harbour with a contribution of 13.51% m, Length class of 22-23 was dominant at Munambam fishing harbour with a contribution of 25 %. Trawlers in the length range of 30-41 m were also constructed at Munambam and they may be engaged in trawling from Kerala waters or in the neighbouring state. The dominant installed engine horsepower at Thoppumpady, Kalamukku, Murikkumpadam, and Munambam was of 250 to 300 hp (37.5 %), 400-450 hp (21.88%), 400 to 450 hp (34.38%), The dominant installed engine horsepower at Munambam was between 400 to 591 hp (62.5%). The relationship between the length overall (LOA) of trawlers and engine horsepower showed that the value of installed engine power was not according to LOA. and indicates that the trawlers at Thoppumpady, Kalamukku, Murikkumpadam, and Munambam were installed with high-powered engines regardless of the size of vessels (LOA). The study suggested the need for restriction on the installed engine horsepower, the number of trawlers operated, for optimized utilization of resources.

Keywords – Trawler, Length Overall (LOA), Engine horsepower (hp)

Comparative analysis on the impact of design on the drag resistance of trawls operated from different size class vessels of Thoothukudi, Southeast coast of India

J.Amala Shajeeva[1], N.Neethiselvan[1], S.Archana[1], T.Ravikumar[1]

[1]*DFT&FE, FC&RI, Thoothukudi, India, jeeva.julin@gmail.com*

A study was conducted to analyse the design features and drag resistance of trawl nets operated from three types of trawlers being operated from Thoothukudi fishing harbour, (8º47'N &78º9.5'E) viz Type 1 trawler (45' OAL), Type 2 trawler (55' OAL) and Type 3 trawler (65' OAL). The drag resistance was estimated based on the twin surface area of the net and trawling speed. The study

revealed that all the trawl designs of Thoothukudi have been evolved with excess twine surface area. Among the three types of trawlers, Type 3 trawler was found operated relatively with higher Head Rope Length (HRL). The HRL was found to be about 25.2 % longer than the optimal length recommended by Koyama (1970). The total stretched length of trawls operated from different size class vessels were found to be 1.48 to 1.77 times longer than the recommended length. Further, the stretched length of overhang of trawls operated from all the three size classes of trawlers were about 2 to 3 times higher than the recommended stretched overhang length. All the trawl designs were also found to have very low horizontal hanging co – efficient ranging from 0.05 to 0.25, leading to excess accumulation of webbing at the mounting region which lead to excess surface area of the net in trawls of all the three types of vessels. This error could be inferred as the excess drag resistance of 52%, 87% and 91% in Type 1, Type 2 and Type 3 trawlers during trawling. The study implied that the trawl nets of Thoothukudi have been designed with the objective of increasing the mouth opening so as to sweep a larger area and collect more fishes. However, excess mounting of webbing in the head rope has lead to the increased drag resistance and eventually resulted in excess drag and thereby found increased the fuel consumption.

Keywords: Trawler, HRL, twine surface area, drag resistance, stretched overhang length, stretched length of net, increased fuel consumption

Theme: Passive Gears

Innovations in pot fisheries, a toolbox for a multi-use sea

Jasper Van Vlasselaer[1], Mattias Van Opstal[1]

[1] *Flanders Research Institute for Agriculture, Fisheries and Food, Jacobsenstraat 1, 8400 Oostende, Belgium, jasper.vanvlasselaer@ilvo.vlaanderen.be*

Our oceans and seas, though vast as they might seem, are heavily crowded. This is certainly true for the North Sea where many countries lie closely together around a small portion of water. In each of their EEZ's, a plethora of sectors vie for space. Alongside shipping lanes and dredging sites, marine reserves and offshore oil platforms, fishing grounds have a historical claim of presence in our seas. Under the pressure of climate change, an energy crisis and incentives such as the green deal, development of offshore windfarms has taken flight. All along the European coasts, turbines sprout like saplings after a fire, competing for space with other stakeholders, and most importantly fisheries. In their wake, aquaculture at sea or mariculture, follows as there is not only a demand for green (or blue) energy, but also for sustainable food. Besides conflict, the development of these mari- and windfarms offers opportunity. A space for a new type of fishing, that is more like farming.

Due to safety and technical measures implied in offshore development, not any type of fishing is appropriate to take on this role of fisher/farmer, nor does it fall within a sustainable way of food sourcing. Thus, at ILVO, we are developing a toolbox for a pot fisher to take on board, of which the content can vary depending on the location, season, and presence of species. This toolbox consists of innovations that will increase catches in a more sedentary type of fishing. We have tried and tested a variety of innovations related to light, sound and odour focusing on some key species. These were *Sepia officinalis, Cancer pagurus, Trisopturus luscus, Solea solea, Pleuronectes platessa, Necora puber and Palaemon serratus*. Using fluorescent netting, we increased Sepia catches by tenfold. We used LED's to lure crabs, but the effect was not as effective. For humpback prawns on the other hand we saw significant catch increases. Other tests using underwater speakers for the attraction of roundfish or using the odours of bananas to attract flatfish showed potential and will be further trialled.

Analysis on the catch efficiency of fish traps operated along the coast of Thoothukudi, Southeast coast of India

Mariappan Sangaralingam[1], Neethiselvan Neethirajan[1], Ravikumar Thangaraji[1], Sudan Chandran[2]

[1]*Department of Fishing Technology and Fisheries Engineering, TNJFU-FCRI, Thoothukudi-08, Tamil Nadu, India., mariappan@tnfu.ac.in*

[2]*Department of Fisheries Biology and Resource Management, TNJFU-FCRI, Thoothukudi-08, Tamil Nadu, India.,*

Trap fishing with arrow head shaped traps having the dimension of 90cm L X 76cm B X 40cm H is one of the commercial fishing activities being practiced along the coast of Thoothukudi. The fishermen operate 25 to 30 traps from modified traditional craft of Thoothukudi region namely FRP Vallam of 8.25 m OAL. The traps were soaked for 24 hours per fishing trip. The mean fishing effort per month was estimated as 575 boat days. Shrimp head waste were used as baits (1kg/trap). Twelve species of finfishes were recorded in traps viz *Scarus ghobban, Epinephalus coioides, Siganus canaliculatus, Lethrinus nebulosus, Acanthurus nigricauda, Lutjanus rivulatus, Parupenus indicus,*

Epinephalus areolatus, Plectorhincus schotaf, Plectorhincus albovittatus, Lethrinus microdon, Lutjanus indicus. The mean catch rate of trap was estimated as 0.8 kg hr-1. With regard to species wise catch rate *Scarus ghobban* was recorded the highest catch rate of 0.26 kg hr-1. Regarding month wise catch rate in terms of number the highest and the least rate were recorded during the month of March (S= 12, N=382) and January (S= 12, N=261) respectively. In terms of weight, the catch rate was found to be highest during March (0.17 kg hr-1) and the lowest during April (0.11 kg hr-1). The common fishes recorded in the trap was *Scarus ghobban* (28.17%), *Lethrinus nebulosus* (21.14%) and *Parupenus indicus* (15.77%). The least fishes caught in terms of species composition are *Lethrinus microdon* (0.05%), *Plectorhincus albovittatus* (0.16%) and *Lutjanus indicus* (0.32%).

Comparing entrance designs and testing of fish retention devices for Plaice (*Pleuronectes plattesa*) and Turbot (*Scophthalmus maximus*) fish pots

Sara Berzosa[1], Daniel Stepputtis[1], Thomas Noack[1], Uwe Lichtenstein[1], Juan Santos[1], Hannah Schartmann[1]

[1] *Thuenen Institute of Baltic Sea Fisheries, Alter Hafen Süd 2, 18069 Rostock, Germany,* *sara.berzosa@thuenen.de*

Gillnets have many benefits for fishing. Nevertheless, they are also problematic from a nature conservation perspective due to unwanted catches of marine mammals and seabirds. One potential solution to reduce bycatch is to reduce the fishing effort with gillnets by a switch to alternative fishing gear such as fish pots and traps. However, previous studies showed that their catch efficiency is lower compared with gillnets.

To improve the catch efficiency of fish pots, the present study investigates different entrance designs for flatfish and tests the efficiency of a fish retention device. The behaviour and interaction with the fishing gear of two flatfish species, Plaice (*Pleuronectes plattesa*) and Turbot (*Scophthalmus maximus*), were evaluated by observing entry and exit rates. Observations were conducted in an enclose net pen using an infrared (IR) lamp and camera system to avoid influencing the behaviour of the flatfish during the night. The results could help to improve the gear design and development of pots for multiple species.

Simple modification in the trap entrance opening significantly improves catch efficiency of mud crab (*Scylla serrata*) in a tropical estuarine fishery

Madhu, V.R.[1], Sreelakshmi B. Anand[1], Kristine Cerbule[2,3], Bent Herrmann[2,3,4]

[1]*ICAR-Central Institute of Fisheries Technology, Matsyapuri, W. Island, Cochin – 682029,* *madhucift@gmail.com*

[2]*UiT The Arctic University of Norway, Tromsø, Norway*

[3]*SINTEF Ocean, Fishing Gear Technology, Trondheim, Norway*

[4]*DTU Aqua, Technical University of Denmark, Hirtshals, Denmark*

Traps are widely used fishing gear in Vembanad lake, Kerala, for targeting mud crab (*Scylla serrata*), which has high commercial value. Traps, with dimensions of 820 mm x 400 mm x 400 mm, made of galvanized iron frames are commonly used. The entrance opening of the trap is rectangular in shape (150x150 mm) and made of nylon mesh with a mesh size of 18 mm wrapped around the trap. The catch rates of traps with this design are generally low for the target species. It is speculated that the low catch rates are due to the escape process through the pot entrances.

Furthermore, it is observed that a significant quantity of bycatch, mostly fishes, are captured in such traps. Therefore, this study was carried out to find if a simple modification in the entrance opening of the traditional traps, can improve the catch efficiency of mud crab. An extension of the trap entrance (150 mm x 100 mm), with the opening facing towards the bottom of the trap, was the only modification made in the experimental trap, with other parameters remaining the same as in the standard design. A total of 34 simultaneous deployments during June to October 2022 were conducted. Each deployment contained two replications of each trap design, which were separated at a distance of 50 m. The soak time was kept to 24 hours. The results of this experiment showed that the catch efficiency of mud crab was significantly improved for all sizes of mud crab when using modified traps. Specifically, it was estimated that the catch efficiency would be more than six times higher with the modified compared to the traditional design (622% (CI: 344-1867%)). However, the capture of mud crab under length at first sexual maturity (95 mm), would imply that significant quantities of juvenile crabs are caught in modified trap, which although would be welcomed by the fishers, is not acceptable ecologically. The results of the findings, implications, and further directions are discussed.

Design, development, selectivity and underwater observations of pentagonal shape fish traps operated along the Gulf of Mannar

Shunmugavel Chinnadurai[1], V R Madhu[1]

[1]*Fishing Technology Division, IACR-Central Institute of Fisheries Technology, Kochi-29, Kerala,* *Chinnadurai.S@icar.gov.in*

The Gulf of Mannar (GoM) archipelago is bestowed with 21 uninhabited coral islands that occur between Rameswaram and Tuticorin is known for coral reefs and associated biodiversity. Nearly 100,000 fishermen live in hundreds of fishing villages and hamlets along the coast of GoM, and they mainly depend on the reef-associated fishery for their livelihood. There exists an organized trap fishing along the Gulf of Mannar using traditional traps. Trap fishing is one of the oldest indigenous fishing methods in the Gulf of Mannar. The traditional traps are made out of split branches of *Acacia planifrons* or out of thin bamboo creepers and midribs of palmyra leaves. These traps are heavy, have short life spans and occupy more space in the traditional fishing craft that are operated with severe space constraints. In recent years, however, the fishermen shifted to traps made of PVC polymesh which is light-weight and easy to handle. But, due to light-weight these traps are prone to lose from the site during rough sea conditions. A recent underwater study in GoM reported that fish traps are the second most dominant marine debris in the studied area. The derelict traps may lead to ghost fishing and adversely affect the coral reefs. To overcome this issue, ICAR-CIFT designed a pentagonal shape fish trap which is made of 10 mm dia. stainless steel for corrosion resistance and covered with HDPE webbing of different mesh sizes. The dimensions of the trap were 0.6 m in length, 1.0 m in width and 0.4 m in height. There is one oval shape entrance at the front side of the trap.

The newly designed pentagonal shape fish traps (PSFT) were field tested along the Gulf of Mannar group of Islands during January to April, 2021 in the depth range of 5-8m. Five PSFTs and five conventional traps were used for experimental fishing with a soaking time of 24 hours. For the selectivity study, we used 5 different mesh sizes for covering the traps starting from 17.5, 20-, 25-, 30- and 40-mm bar mesh. A total of 244 trap deployments were successfully completed during the study, with each experiment involving ~30 replicate deployments of the treatments and the control. An underwater camera was fitted inside the trap to understand the behavioral response of the fish to the trap. Better catch efficiency was recorded in 20, 25 and 30 mm bar mesh traps. On the whole, the 20 mm bar showed better catch efficiency in terms of weight. The major species that formed

the catch were *Lutjanus fulvus, L. Lutjanus, Lethrinus lentjan, L. nebulosus, L. microdon, Scarus spp., Pristipomoides typus, Parupeneus indicus, Epinephelus bleekeri, E. coioides, and E. malabaricus*. The length of the fishes were compared with the minimum legal size (MLS) and nearly 95% of the species caught had lengths above the MLS. The catch efficiency of the PSFTs (20 mm mesh bar) and the control trap was 2.75 kg/trap/day and 1.59 kg/trap/day in terms of weight. Notably, the PSFTs produced very few discards when compared to the conventional traps.

Invivo analysis of attracting ability of bio attractants derived from marine bivalves for evolving gelatin-based artificial fish baits suitable for longline fishing

Arjunan Karthy[1]*, Neethirajan Neethiselvan[1], Thangaraji Ravikumar[1], Robinson Jeya shakila[2], Karunanithi Masilan[3], Chellapa Kalidas[4], Thavasiyandi Umamaheswari[5], Balasubramanian Sivaraman[6]

[1]*Department of Fishing Technology and Fisheries Engineering, FC&RI, Thoothukudi-628 008, Tamil Nadu, India,* karthi.fischo@gmail.com , neethiselvan@tnjfu.ac.in , ravikumar@tnjfu.ac.in

[2]*Dean, Dr.MGR. Fisheries college and Research Institute, Ponneri,* jeyashakila@tnjfu.ac.in

[3]*Department of Fish Processing Technology, Dr.MGR. FC&RI, Ponneri,* masilan@tnjfu.ac.in

[4]*Mariculture Division, Tuticorin Regional Station of CMFRI, Thoothukudi,* das@cife.ac.in

[5]*Dept. of Fisheries Economics, Extension and Statistics, FC&RI, Thoothukudi,* umamaheswari@tnjfu.ac.in

[6]*Department of Fish Processing Technology, FC&RI, Thoothukudi,* sivaraman@tnjfu.ac.in

The commonly used forage fishes as baits in Indian longline fishing industry include squids, sardines, anchovies, mackerels and trigger fishes. These forage fishes also have food value as they have direct human consumption. The present study aimed at deriving potential bait attractants from low-cost and underutilized marine bivalves, incorporation in gelatin-based bait matrix to prepare artificial fish bait suitable for longline fishing. Nine different attractants were prepared from three marine bivalves such as oyster (*Crassostrea madrasensis*), mussel (*Mytella strigata*) and clam (*Gafrarium pectinatum*) at three different levels such as 1% (w/w), 3% (w/w) and 5% (w/w) in laboratory glass tank study. Traditional baits such as Sardines and Squids were taken as control baits. All the attractants tested triggered feeding responses of Lutjanus fulvus, individually indicating that they have potential while incorporating at 3% level attractants for developing artificial baits. The study indicated that both free amino acids and other unidentified compounds are responsible for the baiting responses by the snapper (L. fulvus). However, the attractants from oyster, mussel and clam, showed relatively less bait stimulant in relation to the natural baits such as sardines and squids. Thus, the study emphasized the requirement of additional attractants to improve the performance of the artificial baits of the present study.

Keywords: Invivo analysis, bio attractants, artificial fish baits, feeding response and longline fishing

Evaluating Whalesafe Fishing Gear in Eastern Canada

Genevieve Peck[1], Paul Winger[1]

[1]*Fisheries and Marine Institute, P.O. Box 4920, St. John's, NL, CANADA,* *Paul.Winger@mi.mun.ca*

Entanglement in fishing gear is one of the main factors inhibiting the recovery of critically endangered North Atlantic Right Whales (NARWs). In Newfoundland and Labrador (NL), whale encounters with fishing gear are expected to increase over the next several years due to warming waters and northward movement of the species. This study focuses on the testing and evaluation of "whalesafe" fishing technology in the snow crab fishery. Whalesafe gear incorporates weak components that allows it to cut or break away in the event of an entanglement. This presentation describes several ongoing experiments monitoring the deployment and hauling of snow crab traps in varying real-life conditions using in-line load cells to measure and log tension exerted on ropes. This research will collect valuable data supporting the implementation and adoption of gear modifications across the industry with the goal of reducing death and injuries in the vulnerable NARW population.

Improving the mean size of harvest in dol net fishery with square mesh cod end design

Karankumar K. Ramteke[1], Zaheer Abass[1], Abuthagir Iburahim[1], B. B. Nayak[1], Asha T. Landge[1]

[1]*ICAR- Central Institute of Fisheries Education, Panch Marg, Off. Yari Road, Versova, Andheri (west), Mumbai 400 061 (India),* *arankumar@cife.edu.in*

Dol net is an indigenous bag net operated in the mouth of the estauries along the northwest coast of India. Coastal zones also represent nursery sites for numerous fishes. The operation of the dol net depends majorly on the tidal currents, Lunar cycle and the depth of the coastal areas. During Full moon and New moon days, the soaking time of dolnet fishing operation remains 4 to 5 hours. The mesh size of the codend of the traditional dolnets varies and it measures less than 10 mm in most cases for targeting seasonal Acetes fishery. The reduced mesh size indiscriminately catches juvenile bycatch which leads to economic inefficiency and is visible in the reduction in quantity and quality of fishes caught in the net. The choice of the fishing site makes it a destructive passive fishing gear. Fishes cannot withstand strong current get caught irrespective of type of the species. Given the presence of a significant number of juveniles of economically valuable fishes, it appears necessary to control the mean size of dol net catches. These problems call for additional improvements to increase the mean size of the catch and provide opportunity for the fish to grow and breed. In this study, a design was developed and tested to improve mean size selection of fish in the dol net. The modified dol net cod end with 35 mm tested onboard a commercial dol netter and compared to the conventional dol net design. The new design was inclusion of a square mesh panel of 35 mm mesh in the cod end in place of the conventional less than 10 mm existing cod end. This panel reduces the quantity of low value juvenile fishes and increases the quantity of low volume high value fishes.

This codend showed a reduction proportion of fish below the size at first maturity in the catches. The average catch per haul for conventional and modified dol net fishing operations was 20 kg/haul and 12 kg/haul, respectively. A total of 48 species belonging to 25 families were recorded from both conventional and modified experimental gear during experimental fishing. The fishery comprised 31 species of finfishes, 15 Species of Crustaceans, and two species of Molluscan. Major catch composition of dol nets recorded during the study from both the net included *Coilia dussumieri, Acetes indicus, Trichiurus lepturus, and Harpadon nehereus*. Square mesh codend

designs tested in this study could benefit aimed sustainability of fishery resources, albeit at the expense juveniles of some commercially important species.

Designs and operational aspects of dolnets of North West coast of India with particular reference to its sustainability

Ratheesh Kumar R[1]; Ajay Nakhawa[1], Manju Lekshmi N[2], Dinesh Babu

[1]*ICAR - Central Marine Fisheries Research Institute, Kochi, rkcmfri@gmail.com*

[2]*ICAR - Central Institute of Fisheries Technology, Kochi*

Dolnets are traditional fixed bag nets operated in areas of strong tidal currents along the Northwest coast of India, targeting mainly bombay duck and non-penaeid prawns. According to the National Marine Census, Maharashtra has the maximum number of stationary bag nets and the majority are operated in Palghar, Thane, Greater Mumbai, and Raigad districts. The stationary bag net accounts for around 47% of the mechanized vessels owned by fishers and supports the livelihood of a larger fisher population. Mechanization of fishing vessels leads the fishers to operate dolnets up to depths of 40-70 m compared to an operation maximum of 20-25 meters. The study aimed to document the operational aspects, catch composition and design of dolnets of Maharashtra with particular reference to its sustainability. The stationary bag net has technologically evolved in net design and operation to target high-value finfishes. Specially modified dolnets called "Karli dol" which are different from conventional stationary bag nets such as Machardhanis, Ghani dol, Bokshi nets, and Perkawala net in the net design and operational area. The Karli dol is primarily operated in the offshore water, while others are operated near shore or creek areas. The Karli dol net used by fishermen was of two seams; 50-60 m length, 20-25 m in breadth, and 5-6 m in height. The net is tapered from the mouth to the cod end. Usually, 200 to 60 mm mesh size. The other conventional dolnets of two seams with 25-45 m length, 13-25 m breadth, and 5-6 m height. The net is tapered from mouth to codend. Usually, 180 to 10 mm mesh sizes. The bycatch and juveniles of targeted species are comparatively higher in conventional dol nets than in Karli dol due to the large mesh cod end. Based on the catch composition and net specification, the Karli dol proved to comply more with the Code of Conduct for Responsible Fisheries (CCRF) than other conventional dol nets. Although bag net fishing is the most widespread among the traditional fisheries in the northwest of India, providing a living for many fishermen, there is no formal policy to manage, develop, and assure the sustainability of bag net fish resources.

Change in the colour of gillnets affects catch efficiency: results of an experimental gillnet trial in a tropical estuary in Kerala, India.

Madhu, V.R.[1]*, Kristine Cerbule[2,3], Salini Mohanan[1,4], and Bent Herrmann[2,3,5]

[1]*ICAR-Central Institute of Fisheries Technology, Matsyapuri, W. Island, Cochin – 682029, madhucift@gmail.com*

[2]*SINTEF Ocean, Fishing Gear Technology, Willemoesvej 2, 9850, Hirtshals, Denmark*

[3]*University of Tromsø, Breivika, N-9037, Tromsø, Norway*

[4]*Kerala University of Fisheries and Ocean Sciences, Panangad, Cochin- 682506*

[5]*DTU Aqua, Technical University of Denmark, Hirtshals, Denmark*

Gillnets are widely used fishing gears in marine and inland waters and are often made of different coloured webbing. For most fisheries, it is unknown how gillnet colour affects catch efficiency.

Therefore, the effect of gillnet colour on the catch efficiency was investigated during trials for Pearlspot (*Etroplus suratensis*) fishery in Vembanad lake, Kerala, India. Green, blue and transparent gillnets were tested during the trials. Compared to other colours, using green gillnets in this fishery increased catches. On average, green gillnets were 74% (CI: 30.91-126.29%) more effective than transparent gillnets. When comparing the catch efficiency of the green gillnets to that of the blue netting, the catch efficiency increased by 81.25%. (CI: 45.77-127.67). These results demonstrate that in the specific fishery, gillnet colour has a significant impact on the catch efficiency and the results are discussed in the manuscript.

Assessment of gear damage by dolphin in small scale gillnet fishery of Southwest coast of India

Rithin Joseph[1], Dhiju Das P.H[1], Leela Edwin[1]

[1]*ICAR-Central Institute of Fisheries Technology, CIFT Road Matsyapuri, Willingdon Island, Kochi, Kerala, India 682029, josephrithin@gmail.com*

Cetacean interaction with fishing gear has been reported widely around the world. Depredation caused by interaction and damage caused to the gear results in financial loss to the fishers. In India, interaction by Indo-pacific humpback dolphin (*Sousa chinensis*), spinner dolphin (*Stenella longirostris*), long beaked common dolphin (*Delphinus capensis*) and Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) has been reported. An experiment was conducted for a period of one year to assess the loss/ damage and effectiveness of acoustic pingers in warding off dolphins. Four commercial gillnets of 700 – 900 m length with the mesh size of 30-50 mm made of nylon monofilament were selected for the study and one of these was equipped with acoustic pingers. The pingers were placed at a distance of 200 – 250 m approximately on the head rope of the selected gillnet. The damage to the gears were assessed on the basis of the number of tears/ holes caused during dolphin attack. When the gear was roughly apportioned to three horizontal sections, it is observed that 41% of the total tears/ holes were identified on lower portion of the nets followed by 37% in middle portion and 22% in upper portion. The average quantity of net discarded was 50 kg for non-pinger gear and 10 kg for pinger assisted gear respectively. During the initial stages of the experiment pingers showed absolute deterrence of cetaceans, but after three months the same units started reporting attack of dolphins. In the present study it is evidenced that the pingers are effective in reducing dolphin gear interaction but long-term exposure to pingers can possibly result in habituation of dolphins to pinger signals. No dolphin entanglement in gears is observed during the entire period of study.

Artisanal lobster gillnet fisheries along Maharashtra coast: A sustainability perspective

Santosh N Bhendekar[1]*, Anulekshmi C.[1], Ajay D Nakhawa[1], Akhilesh K. V[1], Ratheesh Kumar R[1], Sunil Ail[1], Vaibhav Mhatre1, Thakurdas[1], and P Laxmilatha[1]

[1]*ICAR-Central Marine Fisheries Research Institute, Ernakulam North, P.O., Kochi-682 018, Kerala, India, santucofs@gmail.com*

Lobsters are one of the highly priced and important export commodity in India. India is one among the top five lobster exporting countries of world with destinations to USA, China, Hong Kong, UAE. Lobster fishery of India still remains as a small scale sector where the estimated annual landing in 2021 was 1215 tonnes. Maharashtra coast particularly northern coast is rich in lobster

resources and is a major contributor in lobster landing of India (~12%). Artisanal fishing with monofilament polyamide bottom set gillnets (locally named "Shevandi jal") in rocky area to capture the mud spiny lobster *Panulirus polyphagus* is a common in coastal region of Maharashtra. It supports artisanal small scale fishers. The study aims to understand the extent of lobster fishing grounds along coastal region, mapping of habitual lobster fishing ground on GIS platform, gill net landing assessment of *Panulirus polyphagus* and organized market chain in lobster fisheries. The targeted mud spiny lobster fishery is carried out in rocky area near coastal fishing villages. Most of the fishing grounds were located at distance of 8-12 km from fishing villages at depths 6-10 m. The single cylinder boats of OAL 8-12 feet carry 20-25 gill net pieces and soak it for 20 to 24 hours. The mesh size varies from 40-50 mm. The nets last for 10-12 operations as gill net shot in rocky and rough seabed areas. The fishing season for mud spiny lobster start during mid October-November and last up to May. The lobster market and supply chain in coastal villages of Maharashtra is in unique nature. The price is decided on weight of lobster with four weight grade and will not change with glut and lean landing across the season. The bigger individual (>200 g) get higher prices which prevent overexploitation juveniles/small sized individual. The use of larger mesh sized gill nets can help the fishers to stick to the minimum legal size (MLS) of the resources which supports the fishery. The fishers are also reluctant to catch small size lobster as it will not fetch high price in market.

Artisanal lobster fisheries can guarantee a constant seasonal income thus uplifting livelihood of fishing community in coastal villages of Maharashtra. The trends towards the fishing gear diversification, inter-sectoral conflicts, coastal developmental activities, etc. are challenges in near future. The level of sustainability of artisanal lobster fisheries with bottom set gill net is still quite good, but it needs to be regulated by restrictions on fishing efforts during peak breeding season of mud spiny lobster, implementing minimum legal size and market-based incentive scheme to reduce the market demand for juvenile/ small size lobsters.

Keywords: Mud spiny lobster, Gill net, Sustainability, GIS, Livelihood, Maharashtra.

Optimization of 'J' hook number on the catching efficiency of Carangids in the Gulf of Mannar, India.

Vinayagamoorthy Naganandhini[1], Kalaiarasan Muthupandi[2]*, Kathavarayan Vasanth[3], Neethirajan Neethiselvan[4], Pandurangan Padmavathy[5], Kalidoss Radhakrishnan[6]

[1]*Department of Fishing Technology and Fisheries Engineering, TNJFU-Fisheries College and Research Institute, Thoothukudi – 628 008, Tamil Nadu, India, naganandhiniv31@gmail.com*

[2]*Directorate of Incubation and Vocational Training for Fisheries, Ramanathapuram, Tamil Nadu, India, kalaiarasan@tnfu.ac.in*

[3]*Department of Fishing Technology, Kerala University of Fisheries and Ocean Studies, Kochi – 682 506, Kerala, India. kvasanthkvasanth29122@gmail.com*

[4]*Department of Fishing Technology and Fisheries Engineering, TNJFU-Fisheries College and Research Institute, Thoothukudi – 628 008, Tamil Nadu, India, neethiselvan@tnfu.ac.in*

[5]*Department of Aquatic Environment and Management, TNJFU-Fisheries College and Research Institute, Thoothukudi – 628 008, Tamil Nadu, India, padmavathy@tnfu.ac.in*

[6]*Department of Fisheries Extension, Economics and Statistics, ICAR-Central Institute of Fisheries Education, Mumbai – 400 061, Maharashtra, India, theradhakrishnank@gmail.com*

The efficiency of different 'J' hooks No 7, 8, and 9 in carangid longline fishing gears were studied from January to August 2022. As revealed through the hooking rate, the highest percentage of contribution in terms of number was observed for *Alectis indicus* (35.6%), *Caranx ignobilis* (23.3%), *C. hippos* (17.0%), *Scomberoides commersonnianus* (13.8%) and *Megalaspis cordyla* (10.3%). However, an increased percentage contribution when the catch composition was expressed as basis of weight instead number for *Caranx ignobilis* (35.2%) was dominated followed by *Alectis indicus* (33.7%), *C. hippos* (11.5 %), *Scomberoides commersonnianus* (10.9%) and *Megalaspis cordyla* (8.8%) The result appeared that, using hook 8, the highest percentage compositions of the carangids was 40.9% followed by hook No 9 and hook No 7 were 33.5% and 25.6% in terms of number basis. Further, in terms of weight basis, hook No 8 ranked first (43.5%) among the three hook numbers. Considering catch rates, the overall CPUE (individual/1000 hooks) of hook No 8 was 4.31 higher than that of hooks 7 and 9. Among the three hook number, the overall performance of 'hook No 8' was found to be better than other hook No 7 and hook No 9 in terms of higher catch efficiency and CPUE for carangids.

Monofilament Long line: An effective fishing gear alternative to multifilament long line

Harshavardhan D. Joshi[1], Ashok S. Kadam[1]

[1]*Mumbai base of Fishery Survey of India, Sassoon Dock, Colaba, Mumbai-400005,* harshjoshicofsn@gmail.com

Fishing gear is a special device or structure which is mainly prepared to catch the special type of fish in special habitat. Long line, it is mainly used to catch oceanic fishes mainly high in weight and having migration behaviour. Long line is a special passive gear which is having main line (may be more than 30 Km in commercial fishing) and various branch line (length of branch line depends upon thermocline temperature). Fishery Survey of India having four long line survey and research vessels in which two vessels namely Matsya Vrushti and Matsya Drushti are monofilament longliner and Blue Marline and Yellow Fin are multifilament long liner. In this study, critical issues on long line of the world are re-assessed with specific reference to the long line fishing industry. The adaptability, selectivity and seasonality of both monofilament and multifilament long line fishing gears to deep sea, fish species and stretch of the year are re-scrutinized. Furthermore, new innovations in Multifilament and Monofilament are required to improve the effectiveness of gears and thus the long line fishery is expressed in the light of speedy socioeconomic variations within the fishery industry.

Oceanic tuna longline survey in Lakshadweep Islands: a hotspot for large pelagics – prerequisite to gear selectivity for mitigating shark bycatch

Raju S Nagpure[1], Nashad M[1], Ramachandran S[1]*, Pradeep H. D[1], Unnikrishnan N[1], Jeyabaskaran R[2]

[1]*Fishery Survey of India, Mormugao Zonal Base, Opp. Microwave station, Bogda road, Mormugao, Goa, India*

[2]*Fishery Survey of India (Headquarters), 2nd Floor, Plot No.2A, Unit No.12, New Fishing Harbour, Sassoon Dock, Colaba, Mumbai, Maharashtra*

**Corresponding author: marineramc1974@gmail.com*

Fishery Survey of India undertook Oceanic Fishery Resources survey in Lakshadweep waters during the period from 2015-2021 using conventional long line gear which were analysed and

presented in this paper. Lakshadweep Islands are depending on the skipjack tuna resources for its economy as well as the dwellers lively hood which were exploited by traditional ecofriendly pole and line fishing methods. The annual landings of skipjack resources have been highly fluctuating over the years, which start from 12,516t in 2015 and to 19,444t in 2019; it reached all-time high of 24,923t during 2018. However, the other economically important fishery resources such as large pelagic, mesopelagic fishes and oceanic squids are still exists untapped in the Lakshadweep waters. The survey results of multifilament long line gear operated by the survey vessel MFV Yellow Fin during 2015-2022 revealed that Lakshadweep waters are comparatively higher potential area (1.0-1.7 % hooking rate) in the west coast of India for oceanic fishery resources such as sword fish (*Xiphias gladius*), Yellowfin tuna (*Thunnus albacares*), Indo- pacific sail fin (*Istiophorus platypterus*), Pelagic thresher shark (*Alopias pelagicus)*, Bigeye thresher shark (*Alopias supersiliosus*), Silky shark (*Carcharhinus falciformis)*, Oceanic whitetip shark (*Carcharhinus longimanus*), Scalloped hammerhead shark (*Sphyrna lewini*), Common dolphin fish (*Coryphaena hippurus*) and other species of marlins.

The oceanic survey vessel MFV Yellow Fin, a multi filament long liner attached to Mormugao Base of Fishery Survey of India has carried out exploratory fishery survey during the period 2015-2021 along Lat. 08ºN to 13ºN (Lakshadweep waters) above the depth of 1000m to study the Oceanic resources like tunas, swordfishes, sailfishes, marlins, sharks etc. by experimenting diversified fishing method called multifilament tuna long line using "J" hook of 3.6sun in order to back up the livelihood of Island fishermen as an alternative to pole and line fishing. Average aggregate hooking rate during the study varied between 0.15% – 0.56%. Sharks were the major bycatch recorded during the study; they were predominant during the pre-monsoon period like April 2019 (68% of the total large pelagic caught) and March 2019 (66.6%) respectively. Present study revealed that sharks are highly vulnerable to "J" shaped tuna hook used in multifilament long line survey, while comparing with the data on circle hook experimented in sister vessel attached to Fishery survey of India in the same coast. Further studies using various hooks are in essential to understand the mitigation measures to be adopted to reduce the shark bycatch from this niche will be discussed. In addition, FSI has mapped fishing ground for Oceanic purple squid, *Stenotheuthis oualaniensis* in and around Lakshadweep group of Islands which are also an alternative to tuna fishery. Mapping and dissemination of these new fishery resources will encourage the fishers of Lakshadweep to diversify their fishing practices, which minimize fishing pressure on skipjack tuna and leads to sustainable fishery in Islands.

Keywords: Lakshadweep Islands, Tuna longline, MFV Yellow Fin, Mapping, J hook, Oceanic purple squid, bycatch

Effect of hook size and baits on the catch efficiency of demersal longlines of Thoothukudi coast, Southeast coast of India

Thangaraji Ravikumar[1], Neethirajan Neethiselvan[1], Sangaralingam Mariappan[1], Arjunan Karthy[1]

[1]*Tamil Nadu Dr.J.Jayalalithaa Fisheries University, FC&RI, Thoothukudi, ravikumar@tnfu.ac.in*

A survey was undertaken to analyze the effect of two different hook sizes of 'J' hook such as Hook No 13 and Hook No 14 with two different bait viz., Sardines and Squids in the commercial longline fishery of Thoothukudi. The group wise percentage composition revealed that Lethrinids contributed highest to the catch irrespective of the hook sizes. Regarding species wise contribution, the fishery was found constituted by 37 species under 10 fish groups. Further, the study revealed significant difference in catch per unit effort (CPUE) both with respect to hook sizes and baits($p<0.05$). The CPUE found to be higher for longlining with squid bait than that with sardines

as baits. Out of the two baits studied, squid bait (12.02%) showed better performance over sardine bait (10.02%) in terms of hooking rate. The estimated hooking rate of longline lines baited with squids and sardines in hook No 14 were 12.62% and 10.65% respectively and in the case of hook No 13, the respective hooking rates were 11.41% and 9.39%. A overall hooking rate of 11.64% was observed for hook No 14 while it was 10.40% for hook No.13 indicating higher hooking rate for smaller hook. However, a reverse phenomenon was observed with respect to CPUE. The overall CPUE in terms of weight for hook No.14 was 3.68kg/100 hooks/soaking whereas for hook No.13 was 4.18 kg/100 hooks/soaking. It could be observed that as the hook size increased the CPUE increased indicating the fact that larger hook (Hook No.13) captured fishes of higher weight than smaller hook (Hook No.14).

Design and operational characteristics influence the catch rate in longline: Evidence from Pulicat Region, India

R. Velmurugan[1], M.Kalaiarasan[2], D.Arun Jenish[1], V. Durai Varatharajan[3]

[1]*Dr. MGR Fisheries College and Research Institute, Ponneri, Tamil Nadu 601204,* rvelmurugan@tnfu.ac.in

[2]*Directorate of Incubation and Vocational Training in Fisheries, Ramanathapuram, 623 519*

[3]*Dr.M.G.R. Fisheries College and Research Institute, Thalainayar, Tamil Nadu 614712*

Pulicat Coast is in Tamil Nadu, which is a species-rich aquatic habitat and provides livelihood to fishers. Fast-moving high-value fish have been reaped in particular longlines. Therefore, the present study aimed to document the design and operational details with respective catch data in Pulicat Coast, from January to December 2020. The results of the study manifested that there were three types of longlines namely seer fish, snapper, and tuna operated that were classified based on the depth of operation. We also noticed that there were considerable differences in the mainline, branch line, depth of operation, and number of branches. The catch rate was greater in yellowfin tuna than in the other two species. Interestingly, snapper longline catch was 10-fold higher (100 kg operation-1) compared to seer fish longline (10 kg operation-1). The weight, number of fish caught, and market price did not differ statistically ($P>0.05$) among the studied areas of longline whereas a significant ($P<0.05$) difference was observed for the monthly catch rate. No significant differences were observed in weight, the number of fish caught, and market price between the gillnet and longline. Data from the present study suggest that longline design and operational details are significantly influenced the catch rate in the Pulicat Coast.

Initiatives to scale up the sustainable pole and line tuna fishing in Lakshadweep

Mini Sekharan.N[1]

[1]*School of Industrial Fisheries, Cochin University of Science and Technology, Kochi, Kerala, India,* minisekharan@cusat.ac.in

In India, sustainable pole and line fishing for the capture of skipjack tuna (Katsuwonus pelamis) is practised only in Lakshadweep Island (FAO 51) in alignment with SDG. This selective tuna harvesting method target skipjack tuna specifically and has no by catch and low impact on environment. Pole and line harvested tuna is of high quality and safety and have a good demand in global markets and fetch a premium price. Customers demand information on transparency of seafood from ocean to plate for ensuring standard safety and quality. Therefore, traceability has to

be set right from the primary link in tuna supply chain i.e. the pole and line fishing to the end consumer. The paper tries to analyse the initiatives needed to scale up the pole and line fishing sector in Lakshadweep through an exploratory survey of tuna fishers and focus group interviews with the stakeholders in Lakshadweep. Tuna fishing in Lakshadweep is characterized by the small vessels <15 m operating live bait-pole and line with limited facilities for fish storage and multiday fishing. Well-equipped mechanized live bait pole-and-line vessels are needed to capture tuna in good quality. Vessels must be equipped with on- board chilling facilities using RSW (Refrigerated seawater) or CSW (Chilled Sea Water) and other onboard preservation equipment. Possibility to commission larger vessels for multiday fish collection motherships/factory vessels or freezer vessels with on board pre-processing and storage and preservation facilities need to be analysed. The sector needs enhancing of infrastructure facilities and organising of the fragmented value chain to cater highest grade tuna to the national and international markets. Sustainability certifications are gaining importance in international marketing and aim at sustainability of a fishery and therefore Lakshadweep pole and line skipjack tuna fishery completed the pre-assessment for sustainability and FIP (Fishery improvement projects) for obtaining sustainability certification of Marine Stewardship Council Certification (MSC). Full certification of MSC has to be taken forward at the earliest to kick-start the exports of pole and live tuna from India. Some implications for fisheries management and sustainability certifications in Lakshadweep are ecological issues behind the removal of lower trophic level baitfish species, Fish Aggregation Devices (FAD) and implementation of harvest control strategies for the tuna stock. A Strategic management plan has to be designed for responsible management of Lakshadweep pole and line tuna fisheries system which integrate technologies for tuna harvest, post harvest, utilisation and processing, supply chain coordination, livelihood empowerment, capacity building of fishers and value chain players on best management practises for sustainable fisheries management and marketing, communication and digitalisation.

Developing solar-powered net illumination to reduce marine megafauna bycatch

Jesse F. Senko[1]

[1]*School for the Future of Innovation in Society, Arizona State University, Tempe, AZ, USA,* *jesse.senko@asu.edu*

Gillnet fisheries are globally ubiquitous and vital for food security, nutrition, and livelihoods in coastal areas throughout the world's oceans. However, these fisheries incur high bycatch of marine megafauna that can lead to costly fisheries restrictions that result in important revenue losses in coastal communities with scarce economic alternatives. Over the past decade, net illumination – via battery-powered light emitting diode (LED) lights or chemical lightsticks – has emerged as a potential solution to reduce bycatch of sea turtles, seabirds, sharks, and marine mammals in coastal gillnet fisheries while maintaining target fish catch. However, batteries in most existing LEDs need to be changed bi-weekly to monthly to maintain their effectiveness and chemical lightsticks last for only 24 h, creating recurring costs for coastal fishers and concerns over battery disposal and marine pollution. In partnership with coastal fishers, we developed solar-powered net illumination by creating a buoy that houses a flexible solar cell, rechargeable lithium-polymer battery, and two green LED light-strips. The lighted buoy is constructed of a polycarbonate housing which allows for the integration of electronics for charging and discharging. The lighted buoy can self-charge in sunlight and be programmed to automatically emit static or flashing light, while remaining illuminated for up to a week with approximately 60 minutes of direct sunlight. In contrast to existing LEDs which require a complex locking mechanism to replace batteries, our design is sealed and can run for years without opening. Using controlled experiments, we tested the solar-powered lighted buoys with flashing green light (5 Hz (10% duty cycle); 20 ms on, 180 ms off) on sea turtle bycatch and target fish catch in the Gulf of California, Mexico. We found that the solar-powered lights significantly reduced sea turtle bycatch while maintaining target fish catch and

value. Our results suggest that solar-powered net illumination and the use of flashing light represents a promising sea turtle bycatch mitigation solution with global applicability.

Beating bycatch by beads – Increasing the acoustic reflectivity of gillnets to reduce cetacean bycatch using the *PearlNet*

Hannah Schartmann[1], Thomas Noack*[1], Uwe Lichtenstein[1], Sara Berzosa[1], Daniel Stepputtis[1]

[1]*Thünen Institute of Baltic Sea Fisheries, Rostock, Germany, thomas.noack@thuenen.de*

**presenting author*

The incidental catch in fishing gear, especially in gillnets, is one of the main threats to marine mammals around the world, including harbour porpoises. Since porpoises use echolocation for orientation, one way to reduce their bycatch might be to increase the acoustic detectability of the gillnets. This can be achieved by the so-called PearlNet – a gillnet equipped with small acrylic glass beads to it as those "pearls" were found to give a strong echo. Besides giving a brief overview of the history of the PearlNet development process, the first outcomes of the latest PearlNet experiments – a catch comparison study – will be presented. Within that study could be verified that catch efficiency of target fish species is similar for PearlNets and standard gillnets. Those positive results show that a large-scale bycatch trial is worth to be conducted as next step in the project. In order to reduce the effort required to plan and conduct such trial, two aspects need to be considered and shall be discussed: i) finding a suitable fishing location with high bycatch chances of porpoises (or other odontocetes); ii) automatized production of PearlNets for providing large amounts of them.

Review of seabird bycatch mitigation measures

Yann Rouxel[1]

[1]*BirdLife International Marine Programme, The Royal Society for the Protection of Birds Scotland, Glasgow, UK, Yann.Rouxel@rspb.org.uk*

Bycatch of seabirds in fisheries is a global conservation threat for many species. Fishers, scientists, conservationists and engineers have been collaborating over the years to develop technical solutions to this threat. In this presentation, we will explore the array of technologies that have been developed and their relative success, particularly in regard to static fishing gears. We will also discuss limits and alternatives to strictly technical solutions in tackling seabird bycatch from commercial fisheries.

Advances in Bycatch Reduction Technology for passive gear

Rob Enever[1]

[1]*Fishtek Marine, Dartington, Devon, UK, rob.enever@fishtekmarine.com*

Whilst Fishtek Marine provide engineering support to bycatch mitigation projects across the globe, the team also undertake their own primary research and are developing solutions to some of fisheries biggest challenges. This talk focuses on two new innovations that are being developed. 1) An electric pulsed device called "SharkGuard" that is designed to deter sharks in pelagic longline fisheries and 2) A novel, low-impact method for catching scallops "Scallop Potting" – a discovery unearthed through a lucky accident!

Influence of Hook number on Species Composition, Catch Rate and Size of Needlefishes in the Gulf of Mannar, India

Vinayagamoorthy Naganandhini[1], Kalaiarasan Muthupandi[2], Kathavarayan Vasanth[3], Neethirajan Neethiselvan[4], Pandurangan Padmavathy[5], Kalidoss Radhakrishnan[6]

[1]*Department of Fishing Technology and Fisheries Engineering, TNJFU-Fisheries College and Research Institute, Thoothukudi – 628 008, Tamil Nadu, India, naganandhiniv31@gmail.com*

[2]*Directorate of Incubation and Vocational Training for Fisheries, Ramanathapuram, Tamil Nadu, India, kalaiarasan@tnfu.ac.in*

[3]*Department of Fishing Technology, Kerala University of Fisheries and Ocean Studies, Kochi – 682 506, Kerala, India. kvasanthkvasanth29122@gmail.com*

[4]*Department of Fishing Technology and Fisheries Engineering, TNJFU-Fisheries College and Research Institute, Thoothukudi – 628 008, Tamil Nadu, India, neethiselvan@tnfu.ac.in*

[5]*Department of Aquatic Environment and Management, TNJFU-Fisheries College and Research Institute, Thoothukudi – 628 008, Tamil Nadu, India, padmavathy@tnfu.ac.in*

[6]*Department of Fisheries Extension, Economics and Statistics, ICAR-Central Institute of Fisheries Education, Mumbai – 400 061, Maharashtra, India, theradhakrishnank@gmail.com*

The contribution of needlefishes from the Gulf of Mannar coast has been remarkable and is presently exploited by pelagic longlines. The J hook is extensively used in longlines in the Indian region to capture carnivore fishes, including needlefish. The catch rate significantly differed between the hook numbers. In this context, three hook numbers of 10 "J", 11 "J", and 12 "J" were studied from January to May 2022. Results showed that the *Ablennes hians* was the dominant fish caught (47.9 %) followed by *Tylosurus crocodiles* (22.2 %), *T. choram* (16.6 %) and *Strongylura strongylura* (13.3 %) in terms of number basis whereas, weight basis T. crocodiles (39.7 %) was higher dominant followed by *A. hians* (35.9 %), *T. choram* (13.8 %) and *S. strongylura* (10.6 %). The two-way ANOVA results revealed that there was a significant ($P < 0.05$) difference between the hook size and the number of species caught. The highest number of fish caught in hook size 12 (3,769) followed by hook size 11 (2,745) and hook size 10 (1,445). However, the highest weight of 2749.74 kg was recorded in hook size 11 and the lowest of 1602.65 kg in hook size 10 ($P < 0.05$) and is related to a lesser number of fish caught in hook size 10 and, heavy fishing pressure on sub-adult (<50 cm) due to the use of hook No12. Considering the maximum total length and weight, the optimum hook number for the commercial exploitation of needlefishes was arrived as hook No 11. The CPUE was disproportionately increased with increasing the hook number; which the significantly higher contribution of 48.25 individuals/1,000 hooks was from hook No 12 whilst hook No 11 and hook No 10 were 35.13 individuals/1,000 hooks and 18.51 individuals/1,000 hooks respectively.

Analysis of the Technical Status and Economics of Operation of Deep-Sea Fishing Vessels of the Thoothukudi and Kanyakumari districts of Tamil Nadu

Jobin Jacobi[1], N. Neethiselvan[1], T. Ravikumar[1], S. Archana[1]

[1]*Fisheries College and Research Institute, Thoothukudi, India, neethiselvan@tnfu.ac.in , fishco.archana@gmail.com*

A study undertaken to analyse the technical status of Deep-Sea Tuna Gillnets operated from two different fishing harbours of Tamil Nadu Viz Tharuvaikulam (78.89° N 8.17° E) and Thengapattinam (77.16° N 8.23° E) revealed similarity in gear designs, however notable variations in the locations of fishing grounds could be observed. The fishing crafts included two sectors namely, Gill Netter cum

Longliners (GNCL) of Thengapattinam and Gill Netters (GN) of Tharuvaikulam. Though GN belong to Tharuvaikulam, which is located in the South East coast of India, they were found operated in the South West coast in the deep-sea fishing grounds located relatively nearer to the coast (100-700 Nm). The GNCL of Thengapattinam were found involved in gill netting in the fishing grounds far off from the South West coast of India in fishing grounds (1500 Nm) off the coast. The GNCL of Thengapattinam in the South East coast were found operated in a depth ranging from 12m to 16m whereas, the GN of Tharuvaikulam in the South East coast were operated in a depth ranging from 10m to 14m. Among the 800 deep-sea tuna fishing vessels found operated from Thengapattinam, 500 boats were of GNCL, and the remaining 300 boats were found to be Exclusively Long Liners. In the case of Tharuvaikulam, all 220 fishing vessels of GN were found operated. There existed significant differences with respect to the CPUE of GNCL and GN. The total catch from GNCL of Thengapattinam and GN of Tharuvaikulam were estimated as 20,368.065 tonnes and 16, 760.95 tonnes respectively. During the year 2020, the CPUE for GNCL of Thengapattinam and GN of Tharuvaikulam were estimated as 769.40 kg/day and 590.963 kg/day, respectively. The economics of the operation of deep-sea gill nets operated from GNCL and GN worked out for a period of five months and the Benefit-Cost Ratio was estimated as 1.32 for the GNCL and 1.19 for the GN.

Keywords: Gill Netters (GN), Gill Netter cum Longliners (GNCL), Exclusively Longliners (EL), CPUE, Benefit-Cost Ratio

Study on hook and line fishing in Agatti island, Lakshadweep with special reference to the impact of cyclone Ockhi in fishery production

Mohammed Jabir K.K.[1], Salim G[1]

[1]*ICAR-CIFT, Kochi, mohammedjabz44@gmail.com*

Natural disasters can cause significant changes in fish community structure. Cyclone Ockhi reached closer to the Lakshadweep islands on 1st December 2017, as strong winds struck the southernmost islands of Minicoy and Kalpeni. The fish catches from the hook and line fishery during pre-Ockhi and post-Ockhi cyclone period was assessed to understand the impact of the cyclone and a database on hook and line fishing gears and crafts used in the Agatti island, Lakshadweep was developed to understand the impact of the cyclone, which could help later on in fisheries management. The traditional fishing and land rights of the people of Agatti extend as far as Perumal Par reef and includes the small island of kalpitti in the south of Agatti Island. The five-month survey was undertaken regarding the landings of hook and line fishing gears from Agatti island during November 2017 to March 2018. Average monthly production from hand line during the month of November 2017 (Pre- Ockhi period) was 22,416 kg, which reduced to 6,448 kg during the post Ockhi period. During the month of January 2018, the average production was 12,520 kg and in February it was 18,372 kg. The average monthly production of March 2018 was 23,350 kg, which showed that the catches increased to the pre Ockhi period. The outcome of the study and the impact of natural disasters in the island groups is discussed

Impact of 'J' hook shapes on Hooking rate, Catch rate and Hooking position of Carangids for the Gulf of Mannar, India

Kathavarayan Vasanth[1], Kalaiarasan Muthupandi[1], Vinayagamoorthy Naganandhini[1], Manoj Kumar[1], Amrutha Krishnan[1], Harsha[1], Kalidoss Radhakrishnan[1]

[1]*Kerala University of Fisheries and Ocean Science, kvasanthkvasanth29122@gmail.com*

A total of 15 fishing trips were conducted to analyze the efficiency of different 'J' hook shapes along the coastal waters of the Gulf of Mannar from February to August 2022. The percentage compositions

of the carangids using kirbed hooks appeared to be 43.75%, 30.68% for reversed hooks, and 25.56% for straight hook, the overall hooking rate of carangids was higher for the kirbed hook (16.74%) than for the straight hook (7.76%). Considering CPUE (individual per 150 hooks) of the kirbed hook was (6.4 versus 3.75) higher than that of the non-offset 'J' hook, the percentage of hooking position in the jaw was higher in the kirbed hook than that of the straight hook (55.84% versus 37.76%), and it was found lower in the gut system (14.29% versus 24.07%). Among the three hook shapes of hook number 8 tested, the overall performance of 'offset kirbed hook' was found to be better than other offset reversed and non-offset 'J' hooks in terms of higher catch efficiency, hooking rate, CPUE, and hooking position for carangids.

Status of Mechanised Gillnet fisheries of Northern Maharashtra in challenging times

Ajay D Nakhawa[1], Anulekshmi C.[1], Akhilesh K. V[1], Santosh N Bhendekar[1], Ratheesh Kumar R[1], Thakurdas[1], Prathibha Rohit[1], Abdussamad E.M.[1]

[1]*ICAR-Central Marine Fisheries Research Institute, Ernakulam North, P.O., Kochi-682 018, Kerala, India, ajaynakhawa@hotmail.com*

Maharashtra, having a coastline of 720 kilometers, is one of India's major contributors to marine fish production. The Satpati fishing village in northern Maharashtra is an important commercial center for the marine fishery, targeting high-value fishes such as pomfret, large pelagic, elasmobranch, and Hilsa shad by mechanized multiday gillnetters. Satpati gillnet fishers' fishing location is off northern Maharashtra and off southern Gujarat, where trawling operation is less intense due to the geographical patterns and intense use of fixed gears in the region. As the region is known for high-value fishes, the fishers from Northern Maharashtra mainly operate stationary bag nets and various types of gill nets to exploit these economically important fishes. The Satpati village and fishers adjacent to Satpati village have adopted gill net fishing since the 1960s as the major fishing practice, which led to the region's economic development. The Satpati Fisheries Cooperative Society is recognized as a model cooperative in the marketing of fish through the tender system, where a minimum price is assured for high-value fish. Self-imposed conservation measures adopted by the Satpati gillnet fishers, such as extended closed fishing season and the use of large mesh nets throughout the year to avoid juvenile bycatch and ensure the conservation approach to marine fauna. Fisheries Cooperative Society also engages in the welfare of the fisher's community through various social programs. Technological changes in craft and gear and its operations have taken since the introduction of the gill nets, which improved the community's socio-economic status. In recent years, extreme events, catch fluctuation, labor shortage, increased input cost, and sectoral conflicts over fishing-space affected fishery's profitability. The study presents the coping mechanism of mechanized gill netter fishery in the impact of dwindling catch, inflation in operation cost, and other sectoral issues affecting the cooperative sector while promoting sustainable fishing practices.

Keywords: Gill netter, fisheries, livelihood, Sustainability, cooperative, Arabian Sea

Theme: Indicators

A holistic approach in trawl selectivity that account for the full species community in the catches - a Mediterranean case study

Andrea Petetta[1,2*]; Bent Herrmann[3,4,5]; Daniel Li Veli[2]; Massimo Virgili[2]; Rocco De Marco[2], Alessandro Lucchetti[2]

[1]*Department of Biological, Geological and Environmental Sciences (BIGEA), University of Bologna (UNIBO), Piazza di Porta San Donato 1, 40126, Bologna, Italy, andrea.petetta@irbim.cnr.it*

[2]*Institute for Biological Resources and Marine Biotechnologies (IRBIM), National Research Council (CNR), Largo Fiera della Pesca 1, 60125, Ancona, Italy, andrea.petetta@irbim.cnr.it*

[3]*The Arctic University of Norway UIT, Hansine Hansens veg 18, 9019, Tromsø, Norway*

[4]*SINTEF Ocean, Fishing Gear Technology, Trondheim, Norway*

[5]*Technical University of Denmark, National Institute of Aquatic Resources, Hirtshals, Denmark*

Bottom trawl fisheries target species that often inhabit areas occupied by a wide range of other species (multi-species fisheries). However, most studies addressing selectivity and catch performance of a specific trawl usually focus on a few commercially important or most vulnerable species requiring management measures. This traditional approach leads to neglecting large fractions of the catch when evaluating the ecological impact of the specific fishing gear. By contrast, the present study considers the multispecies nature of Mediterranean bottom trawl fisheries by accounting, through a holistic approach, for the full species community in the catches. In particular, we evaluated and compared the catch performance of the two legal codends for this fishery, made of 40 mm square (SM40) and 50 mm diamond (DM50) meshes. We included in the analysis all the animals being caught intentionally or unintentionally and being both landed or discarded, and determined if there were changes in the catch profiles, in terms of species composition and dominance, when shifting from one codend to another. Regardless of the codend used, results showed that 50 and 80% of the catch in weight and in count numbers, respectively, consisted of species without commercial value, highlighting the high impact exerted by this fishing gear on the benthic community and demonstrating that large proportions of the catch are not considered when using the existing approaches to evaluate its ecological impact. Significant differences in catch profiles between the two codends were observed, especially for two commercial flatfish species, *Arnoglossus laterna* and *Citharus linguatula*, which had a larger dominance in the SM40 catches. Further, the SM40 codend had a significantly higher retention, compared to DM50 codend, for specific sizes of *Merluccius merluccius* and *Mullus barbatus*. Both legal codends were insufficiently size selective for *M. merluccius.* The methodology here described can contribute to assess the viability of a technical solution or modification, by evaluating more in-depth its overall impact and comparing the catches obtained with it to those obtained with traditional gears from a species community perspective.

Back to the future: revisiting fishing technologies to address current by-catch problems in the North Sea shrimp fishery.

Juan Santos[1], Daniel Stepputtis[1]*, Uwe Lichtenstein[1], Frederik Furkert[1], Mathis Mahler[1], Thomas Noack[1]

[1]*Thünen Institute of Baltic Sea Fisheries, Alter Hafen Süd 2, Rostock, 18069; Germany, juan.santos@thuenen.de, daniel.stepputtis@thuenen.de*

The brown shrimp (*Crangon crangon*) beam-trawl fishery is one of the most important North-Sea coastal fisheries, supporting an international fleet of more than 500 vessels. One recurrent issue in the fishery is the bycatch of unwanted fish species, as consequence of the small-mesh codends that are used to efficiently capture the targeted shrimp. This bycatch issue has been extensively addressed in the past by the development of bycatch reduction devices (BRD) aiming at providing escape possibilities to fish species before entering the codend. As a result of those efforts, fishers are obliged to mount either sieve-nets or sorting grids in their nets. However, while sieve nets and sorting grids can effectively reduce the bycatch of medium and large fish, none of them deliver an optimal species separation. Moreover, the performance of these devices can be largely affected by spatio-temporal variations of fishing grounds conditions, e.g. benthos material entering the trawl and clogging their selection surface. The latter is an issue of increasing concern in the German fishery, especially during the summer season, when the presence of high densities of suspended sea-grass in estuarine fishing grounds are encountered by the trawls. Therefore, there is a need to develop effective Bycatch-reduction technologies to address today's fisheries challenges. This study tested the catch efficiency of the mandatory sieve-net and housed-elliptic sorting grid devices, and two device concepts as alternatives i) a simplified, rectangular grid design developed in the English fishery, and the letterbox device developed in the Dutch fishery. Results obtained from a paired-gear experiment conducted in German fishing grounds revealed that ~95% of the marketable shrimps (total length ≥ 50 mm) available for the trawl ended in the codend when the sieve net was used. Fishing with the traditional housed-elliptic sorting grid was impractical due to clogging problems, leading to a catch efficiency for the target shrimp of less than ~50%. In contrast, the simplified rectangular grid and the letterbox did not suffer clogging-related issues, delivering a catch efficiency for marketable shrimp of ~75%. Altogether, the rectangular grid delivered the best bycatch-reduction performance with catch efficiency below 50% for the quoted species plaice and whiting. The study reveals the potential of alternative BRD to address today's bycatch and practical issues in the fishery and paths for further development of the tested devices.

Optimizing the prediction of discard survival of bottom-trawled plaice based on vitality indicators

Sven Sebastian Uhlmann[1,2,3,4], Bart Ampe[1], Junita Karlsen[4], Esther Savina[4]

[1]*Fisheries and Aquatic Production, Animal Sciences Unit, Institute of Agricultural and Fisheries Research (ILVO), Ankerstraat 1, 8400 Oostende, Belgium, bart.ampe@ilvo.vlaanderen.be*

[2]*Marine Institute, Rinville, Co., Galway H91 R673, Ireland*

[3]*Vrije Universiteit Brussel (VUB), Brussels, Belgium, sven.sebastian.uhlmann@vub.be*

[4]*Technical University of Denmark, National Institute of Aquatic Resources, North Sea Science Park, PO Box 101, DK-9850 Hirtshals, Denmark, juka@aqua.dtu.dk , esav@aqua.dtu.dk*

Routine, at-sea observations of an organism's vitality (responsiveness, vigor, and visible condition) are needed to address management policies related to post-release fate (i.e., discard survival), as well as growing welfare concerns. An animal's involuntary motor responses to external stimuli (i.e., reflexes), external physical condition (i.e., injury) and vigor of movements (i.e., activity) upon capture can be

rapidly collected after immediate capture impact. This has been a common approach to integrate the effects of multiple stressors a fish experiences during fishing. Using vitality scores or aggregated indices (e.g., a simple proportion: mean score of impaired reflexes and present injury or sum of impaired reflex and present injury scores divided by the total number of tested reflexes and injury types, R&I index) does not always allow for accurate predictions of post-release survival. One reason could be that due to collapsing individual reflex and injury scores into a single index, any differential contributions (or loadings) of individual reflexes/injuries to observed mortality events are not accounted for. To test whether some reflexes and injuries may be more relevant over others in contributing to survival, in this study, the performance of suitable optimization functions was evaluated to optimize the loadings of individual reflex and injury attributes (either at individual or aggregated at trip level), and compared with conventional vitality proxy indicators (i.e., the original R&I index; number of absent reflexes; number of present injuries; number of absent reflexes and present injuries; categorical vitality index; reflexes and injuries as individual covariates ; and only the environmental variables). The proposed method was tested by using two datasets of bottom-trawl-caught plaice collected following a harmonized protocol in Belgium and Denmark. From 14 and 3 commercial fishing trips, and 51 and 18 gear deployments of Belgian beam- and Danish otter trawlers, respectively, in total, 736 and 386 undersized plaice (~ 23 cm TL) were assessed for vitality and delayed survival from the monitored trips in Belgium and Denmark, respectively. Alive individuals were sampled and monitored for their post-capture fate by being held in captivity until fishing-capture related mortality events were not observed for at least three days. It was difficult to predict either the average (per trip) survival probability of a group of fish (i.e., those discarded per trip) or that of individual fish without ancillary information about capture (environmental) conditions. Knowing what kind of gear was used and the temperature at the fishing depth was needed to improve predictions based on vitality information, and much more so than optimizing the loadings of individual reflex/injury attributes. Hemorrhages around the head region constituted the single most relevant predictor, whereas point bleeding injury assessments were redundant to score. A categorical vitality index provided a viable alternative to the more labour-intensive, scoring method of reflex responsiveness.

Keywords: Catch welfare; Landing Obligation; Reflex Action Mortality Predictor (RAMP); Indicator optimization

The use of indicators to measure and compare performance in fisheries management

Håkan Eggert[1]

University of Gothemburg, Gothemburg, Sweden, hakan.eggert@economics.gu.se

Fisheries Performance Indicators (FPIs) have the overall objective to provide a low cost, easily accessible and rapid assessment tool that measures an overall status of a particular fishery anywhere in the world where all three sustainability pillars; ecology, community, and economics are considered.

Assessing global fisheries' performance along ecological, economic, and community dimensions is essential to understanding the current state of our resources and the progress brought about by reform. The FPIs are designed for evaluating and comparing the world's fisheries management systems. The FPIs were developed in recognition of the fact that an effective management system is one that is ecologically sustainable, socially acceptable, and generates profitable stable firms and employment directly in the fisheries as well as in service and processing industries. Hence, FPIs can be used to evaluate the effectiveness of management systems at aligning ecosystem health and human well-being. The FPIs have been used in various other contexts; for example, in assessing specific species groups like tunas and in measuring the impacts of investment projects.

The FPIs metrics fall into two categories. The first category is of indicators of outputs that identify and measure whether the fishery is delivering economically viable and socio-ecologically sustainable

results. The 68-output metrics may also be aggregated into 11 different dimensions. The second category is of input metrics or enabling conditions that contribute to the process of incentivizing socio-ecologically sustainable use of fish resources.

Criteria for evaluating alternative management strategies for fisheries bycatch of threatened species

Eric Gilman[1], Milani Chaloupka[2]

[1]*The Safina Center, 3661 Loulu Street, Honolulu, Hawaii USA, EricLGilman@icloud.com*

[2]*Ecological Modelling Services Pty and Marine Spatial Ecology Lab, University of Queensland, Brisbane, Australia*

Fisheries targeting highly productive species can have profound impacts on co-occurring species also susceptible to capture that have long generation lengths, low fecundity and other life history traits that make them vulnerable to anthropogenic mortality. There has been increasing concern over the sustainability of bycatch mortality of marine megafauna given their vulnerability to exploitation, ecosystem-level cascading effects from declines in abundance and reduced population fitness from fisheries-induced evolution. There has also been increasing attention to risks from bycatch to food, nutrition and livelihood security. The presentation identifies key criteria for the development of evidence-informed, integrated bycatch management strategies. We introduce the following criteria that can be applied to determine which alternative bycatch management measures best meet fishery-specific ecological and socioeconomic objectives:

- Contribution to achieving objectives: The predicted contribution towards meeting ecological and socioeconomic objectives defined for a fishery at various spatial scales. This includes the predicted relative size of reduced catch and mortality risk responses to the measure.
- Relative strength of evidence of a reduced catch or fishing mortality response.
- Costs to commercial viability: Some bycatch management measures may cause costs to economic viability, practicality and fisher safety.
- Tradeoffs from multispecies conflicts: Some measures can benefit one threatened bycatch species but exacerbate the catch or mortality risk of others. Bycatch management strategy evaluation can account for these conflicts so that tradeoffs are planned and acceptable.
- Tier in a sequential bycatch mitigation hierarchy: Interventions that avoid capture are considered before those that minimize catch risk. These are then followed by remediation interventions that reduce fishing mortality and sublethal impacts. Finally, either direct, compensatory banking or in lieu fee-based offsets of residual impacts that were not possible to avoid, minimize and remediate can be implemented as a last resort.
- Likelihood of compliance: The probability that a prescribed bycatch management measure will be implemented, determined by the fishery-specific enabling environment.

Policy guided by these criteria promises to achieve ecological and socioeconomic objectives of bycatch management strategies.

A shiny app to compare the performance of different legal gears in the *Nephrops*-directed fishery in Kattegat

Valentina Melli[1], Tiago Veiga-Malta[1]

[1]*DTU Aqua, National Institute of Aquatic Resources, North Sea Science Park, Hirtshals, Denmark, vmel@aqua.dtu.dk*

Scientific advice plays a key role during both the setting of annual Total Allowable Catches (TACs) and the introduction of national technical regulations regarding fishing gears. However, while the stock assessment process has been highly standardized over the decades, with organization such as ICES

processing the data and providing short notes to fisheries managers and stakeholders, this is not the case for gear-related advice. When it comes to setting which gear design can be legally used in a fishery, fisheries scientists are typically requested by their local fisheries managers to provide a summary of the scientific knowledge available to aid the stakeholders' discussion around the choice. Faced with the challenge of synthesizing and communicating complex scientific information to stakeholders, we as scientists have increasingly relied on Catch Performance Indicators. Such indicators express the percentage of undersized and commercial sized individuals caught for a given species by a gear with known length-based selectivity. They can, therefore, convey the consequences on TACs of adopting a gear design in a specific fishery, and have shown great potential to support stakeholders' decision-making processes. However, they can also easily lead to misinterpretations as they provide only a temporary picture of the gear performance, under a given catch scenario. To facilitate a safe and optimal use of the Catch Performance Indicators when providing advice to stakeholders, we developed a set of interactive Shiny Apps, one for each of the major trawl fisheries in Denmark. As an example, we will demonstrate the app for the Nephrops (*Nephrops norvegicus*) directed fishery in Kattegat. The app has been pre-loaded with the known length-based selectivity for each of the legal gear options currently available to the industry, while alternative options can be manually added for comparative purposes. All gears are then compared using single-species Catch Performance Indicators, as if they were fishing simultaneously on the same population. A dynamic tool allows to control the length structure of the fished population, enabling a more thorough comparison of the gears, at different scenarios, and highlighting which gears could be more susceptible to a change in the structure of the population encountered. The apps are currently being developed to include the main species of relevance for each fishery, thus crossing the bridge from single- to multi-species assessment of performance. The apps will be made open access and their format can be applied to whatever fishery of interest, granted that knowledge of the length-based gears selectivity is available.

Catch efficiency of EZ baiter hook for Needlefish in the Gulf of Mannar coast, India

Vinayagamoorthy Naganandhini[1], Kalaiarasan Muthupandi[2]*, Kathavarayan Vasanth[3], Neethirajan Neethiselvan[4], Pandurangan Padmavathy[5]

[1]*Department of Fishing Technology and Fisheries Engineering, TNJFU-Fisheries College and Research Institute, Thoothukudi – 628 008, Tamil Nadu, India, naganandhiniv31@gmail.com*

[2]*Directorate of Incubation and Vocational Training for Fisheries, Ramanathapuram, Tamil Nadu, India, kalaiarasan@tnfu.ac.in*

[3]*Department of Fishing Technology, Kerala University of Fisheries and Ocean Studies, Kochi – 682 506, Kerala, India, kvasanthkvasanth29122@gmail.com*

[4]*Department of Fishing Technology and Fisheries Engineering, TNJFU-Fisheries College and Research Institute, Thoothukudi – 628 008, Tamil Nadu, India, neethiselvan@tnfu.ac.in*

[5]*Department of Aquatic Environment and Management, TNJFU-Fisheries College and Research Institute, Thoothukudi – 628 008, Tamil Nadu, India, padmavathy@tnfu.ac.in*

The J hooks are extensively used in longlines in the Indian region to capture carnivore fishes, including needlefish. In this context the standard J hook No 11 was compared with the modified needlefish longline (MNL) with EZ baiter hook No. 8/0. The MNL were operated in locations along the Gulf of Mannar coast from April to October 2022. Throughout the study, 14 trials with 5,600 hooks were carried out which yielded a total catch of 276 fishes. The highest contribution of *Ablennes hians* (42.8%) followed by *Tylosurus crocodiles* (25.8%), *Strongylura strongylura* (17.3 %) and *T. choram* (10.5 %) in terms of number whereas, *T. crocodiles* (39.8 %) was dominant followed by *A. hians* (36.5 %), *S. strongylura* (12.1%) and *T. choram* (7.2%) in terms of weight. The result showed that EZ baiter hook contributed 169 fishes (62.3%) and the J hook contributed 97 fishes which accounted for 37.7%.

Considering catch rates, the CPUE of EZ baiter hook was 12.2 individual/200 hooks and the J hooks was 7.6 individual/200 hooks. Further, the percentage of hooking position in jaw (desirable hooking position) was higher in EZ baiter hook than that of straight hook (80.9% versus 43.3%).

Development of a catch composition indicator to assess the performance of fishing gears in relation to area closures or exemptions to discard bans

Tiago Veiga-Malta[1], Juan Santos[2], Daniel Stepputtis[2], Jordan Feekings[1], Valentina Melli[1]

[1]*Technical University of Denmark, DTU Aqua, Niels Juelsvej 30, 9850, Hirtshals, Denmark, timat@aqua.dtu.dk*

[2]*Thuenen Institute of Baltic Sea Fisheries, Alter Hafen Süd 2, 18069 Rostock, Germany*

Traditional catch performance indicators, such as single-species discard ratios and percentage of individuals retained, are an effective way to summarize the performance of a given fishing gear. However, in a management system that is turning more and more towards multi-species fisheries management, single species indicators cannot answer questions such as "what gear provides the best ratio of bycatch to target catch, with regards to current regulations/quota compositions?". Therefore, additional indicators need to be developed for a more comprehensive assessment of the performance of gear designs. Here, we present a new indicator that combines population structures from fishery-independent surveys with the length-based absolute selectivity rates, to simulate realistic multi-species catch compositions for different gear designs. By running the simulation 10000 times, we are able to quantify and compare across gears the risk of exceeding bycatch limits that would trigger area closures or revoke discard exemptions. To demonstrate the new indicator, we use a case-study the demersal trawl fishery in the Baltic Sea, which is a relatively simple multi-species fishery with three species of interest: plaice (*Pleuronectes platessa*) and flounder (*Platichthys flesus*) as target species, and cod (*Gadus morhua*) as unwanted bycatch. In this fishery, a discard exemption is in place stating that catches of cod should not exceed 10% of the commercial catch of plaice and flounder combined. Eight gear designs were compared, including the two currently legislated codends (T90 120 mm and BACOMA 120 mm) and alternative designs developed by the Thünen Institute in Germany (e.g. ROOFLESS). Multiple fishing areas and years were considered in terms of population structures to better understand the effect variability in population structures on the fishing performance of the different gears. The results show that for some areas and years, maintaining cod bycatch below the 10% threshold would be almost impossible when fishing with the legislated gears. On the other hand, the use of ROOFLESS in conjunction with a T90 120 mm codend and shortened lastridge ropes showed a consistently better catch composition. Thus, the use of this type of multi-species catch indicator can be a valuable tool for fishers and managers when deciding for which gears to use/enforce.

Is biodiversity affected by bottom trawl fishing? It's time to take decisions?

Ch. Mytilineou[1,2]*, B. Herrmann[3,4,5], C.J. Smith[1], D. Mantopoulou-Palouka[1], A. Anastasopoulou [1], A. Siapatis[1], A. Sala[6], P. Megalofonou[2], K. Papadopoulou[1], V. Vassilopoulou[1], C. Stamouli[1], S. Kavadas[1], E. Lefkaditou[1], A. Nicolaidou[2]

[1]*Institute of Marine Biological Resources & Inland Waters (IMBRIW), Hellenic Centre for Marine Research (HCMR), Anavyssos, Attica, Greece, chryssi@hcmr.gr*

[2]*Faculty of Biology, Department of Zoology-Marine Biology, National and Kapodistrian University of Athens (NKUA), Athens, Greece*

[3]*SINTEF Ocean, Fishery Technology, Foundation for Scientific and Industrial Research, Hirtshals, Denmark*

[4]*The Norwegian College of Fishery Science, UiT The Arctic University of Norway, Tromsø, Norway*

[5]*National Institute of Aquatic Resources (DTU Aqua), Technical University of Denmark, Hirtshals, Denmark*

[6]*Italian National Research Council (CNR), Institute of Marine Biological Resources and Biotechnologies (IRBIM), Ancona, Italy*

The severe impacts of fisheries on marine biodiversity are quite well known. Biodiversity is a key element in ecosystem functioning and its maintenance is also very important, with positive relationships for commercial fish stocks and consequently, fisheries. In the present work, the abundance, species richness, diversity indices, species composition, trophic level and vulnerability index were investigated for the first-time to detect differences in five units related to trawl fishing: the total fish assemblage entering the trawl codend, and the escaping, retained, discarded and landed fractions, derived by gear and fisher selection processes. The case study was conducted in the Mediterranean Sea. Three different meshes (40 mm - 40D and 50 mm - 50D diamond meshes, and 40 mm - 40S square meshes) were used in the trawl codend and the cover-codend method. Results showed that trawl fishing produced an escaping fraction that was always lower in abundance, richness, and vulnerability index, similar in diversity indices and trophic level, and different in species composition compared to the total fish assemblage entering the codend. Fishers selected a landings fraction which had the lowest diversity indices, but highest trophic level; they discarded a fraction with the highest diversity and vulnerability. The 40S codend showed better values for some of the indicators studied. It was suggested that an innovative modification of the trawl for the elimination of the discarded fraction, and in particular the highly vulnerable species (e.g. Elasmobranchs), is needed if biodiversity losses should be minimized. Moreover, emphasis on species-selectivity and discarded species behaviour should be given to our future studies to achieve this goal.

Theme: ALDFG

Introduction of the Global ALDFG Survey

Haraldur A. Einarsson[1], Eric Gilman[1], Kelsey Richardson[1], and Amparo Perez Roda[1]

[1]*Food and Agriculture Organization of the United Nations (FAO); Fisheries Division, Fishing technology and operations team (NFIFO), http://www.fao.org/responsible-fishing/ , Viale delle Terme di Caracalla, 00153, Rome, Italy. haraldur.einarsson@fao.org*

Abandoned, lost or otherwise discarded fishing gear (ALDFG) is of increasing concern due to its numerous adverse environmental and economic impacts, including navigational hazards and associated safety issues. Some approaches to estimating total marine debris from world fisheries are published but often focus on a few regions or limited data collection without synchronisation between studies. The Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) Working Group 43 report on Sea-based sources of marine plastic litter advises updating global ALDFG estimates and identifying data gaps. The FAO Fishing Technology and Operations team (NFIFO) have organised a global survey to collect data from fishers' knowledge and experiences within their fisheries around ALDFG amounts, sources, causes and prevention measures. The ALDFG global survey comprises nine almost identical questionnaires adapted to unique characteristics of different gear types; surrounding nets, seine nets, trawls, dredges, lift nets, falling gear, gillnets, traps, and hooks and lines. While the target group for these surveys are the world's fishers, the surveys focus on oceanic fisheries (i.e., aquaculture or inland fisheries are currently excluded). Survey sample sizes are adapted to achieve the lowest possible uncertainty levels, with confidence levels at or near 90%. These sample sizes are typically achieved by surveying around 120 fishers per gear type for fisheries with more than 500 vessels operating using the given gear type. After the surveyor has entered all respondents' answers for a provided questionnaire into the FAO global ALDFG database, the FAO team generates a summary report from the survey responses to validate the data, followed by a country report with the main results and possible recommendations. These reports are only available for the cooperating parties, and FAO will not publish single-country outcomes. This presentation will summarise the ALDFG Global survey structure and identify how collaborators will benefit from joining these project efforts and collecting this data within their fisheries. The presentation also presents some questions to the audience and provides a summary of approaches to interpreting the outcomes of these questions.

Understanding fishing gear marking systems

Amparo Perez Roda[1], Jon Lansley[1]

[1] *Food and Agriculture Organization of the United Nations (FAO); Fisheries Division, Fishing Operations and Technology Branch, Viale delle Terme di Caracalla, 00153, Rome, Italy. amparo.perezroda@fao.org*

The Voluntary Guidelines on the Marking of Fishing Gear (VGMFG) are a tool to contribute to sustainable fisheries, to improve the state of the marine environment, and to enhance safety at sea by combatting, minimizing and eliminating abandoned, lost or otherwise discarded fishing gear (ALDFG) and facilitating the identification and recovery of such gear. The Guidelines assist fisheries management and can be used as a tool in the identification of illegal, unreported and unregulated (IUU) fishing activities. The Guidelines address the implementation of a gear marking system and its associated components, including reporting, recovery and disposal of ALDFG or unwanted fishing gear and commercial traceability of fishing gear. The VGMFG were designed to assist States in meeting their

obligations under international law, including relevant international agreements and related governance frameworks and the specific requirements for gear marking contained in FAO's Code of Conduct for Responsible Fisheries.

The proposed presentation will provide the audience with an overview of the elements needed to develop and implement effective fishing gear marking system as the main mechanism to prevent, reduce and eliminate ALDFG. The presentation will also inform of the knowledge products and tools produced by FAO to support its implementation: guide on how to legislate fishing gear marking systems, the gear marking manual, a risk assessment framework, a guideline document on "Operationalization of FAO Voluntary Guidelines for the Marking of Fishing Gear in the IOTC Area of Competence",etc.

Knowledge Base on ALDFG and Ghost Fishing in India

Saly N Thomas[1]

[1] *ICAR-Central Institute of Fisheries Technology, Cochin, India, salynthomas@gmail.com*

Abandoned, lost or otherwise discarded fishing gear (ALDFG) constitute a key component of the marine plastic pollution today. While quantity wise, it contributes around 10% of marine plastic debris, the negative impacts are wider. There is wide knowledge gap on ALDFG related aspects from different geographic areas especially from Africa, Asia, South America and Antarctica.

The intensity of the problem is greater for India, having a long coastline of 7516 kms, harbours/fish landing sites numbering around1500, and a total of 251969 fishing vessels in operation as of 2022. The key contributors to ALDFG, the wide spread use of nylon monofilament netting and lines of a short life, apart from the intensity of the gear deployed and the multiplicity of gears operated across jurisdictional boundaries. Lack of regulatory measures across the country is a matter of concern, besides lack of in-depth studies and inadequate knowledge base. Under beach litter surveys conducted by different organizations since 2007, fisheries have been identified as a primary source of litter on the Indian coast. The first quantitative assessment on contribution of fishing related debris (FRD) was made during 2017-18, by systematically analysing the beach litter across 25 beaches of Kerala over a year. This study indicated FRD contribution to the total debris at 36% while that to the plastic debris at 48%.

The first systematic study on ALDFG undertaken in 2017 by ICAR-CIFT confining to gillnet and trammel net sectors covering four States, exposed the severity of the problem. This study based on fishers' perception estimated ALDFG contributing to 29% of the total gear used per vessel annually in selected gillnet sectors. The magnitude of the problem gets exacerbated against the intensity of vessels and gears in the country. Operational pressures and spatial pressures along with lack of proper collection facilities at the harbours/landing sites magnify the problem. Underwater investigations by CIFT during 2018-2020, through scuba diving, retrieved about 33 kg lost gears settled on trap fishing ground at Enayam, Tamil Nadu by scanning 700 m2 of sea bottom.

The pioneering study by ICAR-CIFT in 2018, assessed the ghost fishing capacity of lost gears. Ghost fishing efficiency of purposefully lost shrimp gillnets in the backwaters indicated that in calm weather, the ghost nets continue to have the fishing capacity upto 53 days while in turbulent weather, it was upto 14 days only and the catch rate reduced to 3.6 - 4.2% of the initial catch rate. Trials (obstructed by COVID 19 pandemic) on mitigation of ghost fishing by derelict fish traps through timed release mechanism (TRM) incorporated with natural fibres and metal wires showed that TRM based on jute fibre became effective after 45 days exposure in sea while that based on aluminium wire after 53 days.

Retrieval and removal of lost nets, is a method to address ALDFG and ghost fishing. NGOs and Coastal community voluntary organisations such as Friends of the Sea, Temple Adventures etc have been conducting ghost net removal/ Marine Debris Clean-up programmes with support from different

Organizations and Volunteers. Under Suchitva Sagaram ("clean ocean") project in Kerala, trawl operators collect plastic during trawling operations and is recycled. Govt of India conducted a 75-day long cleanliness campaign named Swachch Sagar, Surakshit Sagar ("Clean coast safe sea") in July 2022, through which 75 beaches all across the country's coastline were cleaned.

ALDFG related research is yet to take off in India. The areas with research potential are, finding out the hotspot areas and fishing sectors of origin. Management of fishing operations and gear-based interventions including gear marking are researchable problems. Regulatory policies also need close examination and analysis.

Assessment of ALDFG from selected marine gillnet and trap fishing sectors of India

Saly N Thomas[1], Sandhya K M[1]

[1] *ICAR-Central Institute of Fisheries Technology, Cochin, India, sandhyafrm@gmail.com*

Abandoned, lost or otherwise discarded fishing gears (ALDFG) is a growing issue of global concern due to its deleterious impacts on target and non-target species in marine systems. ALDFG causes "ghost fishing", as lost fishing gears continue to function even after they are left in water leading to death of marine mammals, seabirds, turtles and fishes through entanglement, ingestion etc. Knowledge concerning ALDFG is scanty from Indian waters. Few scattered reports on lost nets washed on seashores and retrieved are available from India. Over the years, Indian marine fisheries sector has shown significant growth with regard to size of the gear. For example, the gillnet sector during the last one decade has switched over from small- scale to large- scale, by increasing the length of net from 2500 m to more than 15000 meter and height from 7 to 18 meters. Deployment of very long nets and widespread use of polyamide (nylon) monofilament which lasts for less than a year create greater chances of gear loss and consequent ghost fishing in Indian waters. Hence, a study has been undertaken to estimate the fishing gear loss rate in the small-scale gillnet sector in Chellanam, Puthuvypu and Arthunkal areas in Kerala and in the trap fishing sites in Enayam coast of Tamil Nadu. The evidences for occurrence of ALDFG also were assessed. Average gillnet loss varied from 4-10 kg/year/vessel and trap loss was 10- 12 traps/year/vessel. The main reasons identified from fishers for gillnet loss were operational pressure (bottom obstacles, bad weather/season, loss of gear components, strong currents) followed by spatial pressure (gear conflicts, collision with ships/ vessel). The reasons identified for trap loss were operational pressure mainly bad weather/season, current/ tides and spatial pressure mainly vandalism/ theft and gear conflicts. About six types of lost fishing gears/gear parts were retrieved from the trap fishing ground at Enayam by scanning an area of 700m2 of seabottom by scuba diving. The retrieved gears included nylon monofilament netting panels, traps, pieces of trawl codends, pieces of monofilament lines, ropes and squid jigs. Nylon monofilament gillnet panels (47.3%) were the predominant gear types. This baseline information generated from the present study, the first kind of it in India, is a pointer to the scale and distribution of ALDFG in Indian seas and to the need for identification of the hotspot areas of gear losses.

Gear modifications to reduce ghost fishing in small-scale Brazilian lobster trap, Indonesian crab pot and Kenyan gillnet fisheries

Kelsey Richardson[1], Amparo Perez Roda[1], Eric Okuku[2], Mochammad Riyanto[3], Vanildo Souza de Oliveira[4]

[1]*Food and Agriculture Organization of the United Nations (FAO), Viale delle Terme di Caracalla, 00153, Rome, Italy. Kelsey.Richardson@fao.org*

[2]*Kenya Marine and Fisheries Research Institute*

[3]*Bogor Agricultural University*

[4]*Universidade Federal Rural de Pernambuco*

The GloLitter Partnerships project aims to prevent, reduce and mitigate impacts from sea-based sources of marine plastic litter (SBMPL) from the shipping and fisheries sectors in developing countries around the world. As part of this project, the Food and Agriculture Organization of the United Nations (FAO) is supporting pilot studies in Brazilian lobster trap, Indonesian crab pot and Kenyan gillnet fisheries that modify small-scale artisanal gears to reduce ghostfishing impacts when these gears are lost, discarded or abandoned to the marine environment. Each pilot study is led by researchers at local and national Universities and research institutions who collaborate directly with artisanal fishers and relevant fisheries authorities to trial the gears and communicate results. This presentation will highlight key findings from these gear modification trials including a comparison of costs and benefits of employing the modified gears and trade-offs with the traditional gears. The presentation will also discuss how community uptake of the modified gears is achieved both from the fishers themselves as well as support engaged from local and national fishery managers.

Background study on fishing gear recycling

Antonello Sala[1], Kelsey Richardson[1]

[1] *Food and Agriculture Organization of the United Nations (FAO); Fisheries Division, Fishing technology and operations team (NFIFO), http://www.fao.org/responsible-fishing/ , Viale delle Terme di Caracalla, 00153, Rome, Italy.* *antonello.sala@fao.org*

The Food and Agriculture Organization of the United Nations (FAO) through its collaborative GloLitter Partnerships project supported the development of a Background study on fishing gear recycling to examine recycling options as possible effective interventions to prevent and reduce marine plastic litter from the fishing sector. This study provides an overview of the technical feasibility of current fishing gear recycling practices and mechanisms, with a special emphasis on end-of-life fishing gear (EOLFG) and retrieved abandoned, lost or otherwise discarded fishing gear (ALDFG). Technologies summarized include primary (reuse), secondary (mechanical), tertiary (thermochemical), and quaternary (energy recovery) recycling processes. The background study highlights the need for a combination of circular economy and Extended Producer Responsibility (EPR) principles to be applied to the full suite of primary to quaternary recycling processes to responsibly manage EOLFG and recovered ALDFG. These interventions should be aimed at all levels of the fisheries sector and tailored to the requirements and capacities of each country. Although recycling is essential, it is not a viable stand-alone solution to the global marine litter crisis. Product circularity must be considered while designing more effective fishing gear management systems, materials, and products. Additionally, socioeconomic incentives are required to promote the selection of renewable alternative materials (i.e., more recyclable or non-plastic materials) in the design, manufacture and assembly of fishing gears, as well as to promote fishing gear reuse and repair options. The report's collected information of best practices and case studies of fishing gear recycling provide illustrative practical examples to be more widely applied. In some cases, the good practices highlighted by the report are enforceable by legislation, in other situations, the case studies presented may be adopted by the public or private sector to improve waste management and reduce the flow of marine plastic litter to the marine environment.

Smart acoustic solution for tagging fishing gears and objects underwater (PingMe)

Ulf Lundvall[1]

[1] *Ocean Space Acoustics, Trondheim, Norway, ulflundvall@gmail.com , ulf@osac.no*

Three hundred kilometres of ghost-fishing gillnets were retrieved by the authorities from the Barents Sea last year. With PingMe, a lot more of the gear would have been located and identified by the fisherman himself, and removed much earlier. PingMe is patented and consists of three units:

1) PingMe transponder: A smart, small device attached to gear / objects you want identified and located underwater.

2) PingMe Software: A software module integrated in the boat's existing sonar system or as a stand-alone system. The software allows communication with the transponder to determine location and ID.

3) PingMe Service in the cloud: A management tool for the authorities. Information of lost, detected and retrieved gear is reported to the cloud, some of it automatically. This enables the authorities to keep better control of litter in the ocean, which might come in conflicts with other boats or fisheries.

The transponder is passive and reflects the sound waves originating from the sonar. The reflected signal is encoded with a unique identity so that the sonar with PingMe software integrated can identify the transponder and calculate its position. This information might be encrypted if the information is to be transferred to the cloud. With PingMe's scheduled online service, you can:

- Register your own lost gear with associated ID, or
- Report findings of other lost tools

In the long term, such a service can be integrated into the Authorities Public Service (in Norway: The Directorate of Fisheries). PingMe can also be used for better control during active fishing, by attaching transponders at regular intervals to the gear (long-line). Better control of where the gear is located can make fishing more efficient and profitable.

Dynamic indicators to estimate gear efficiency and leakage of plastic into oceans: a case from commerical fishing in Norway

Paritosh Deshpande[1]

[1]*NTNU Norwegian University of Science and Technology, Alfred Getz vei 3, 7491 Trondheim, Norway, paritosh.deshpande@ntnu.no*

Abandoned, Lost, or Discarded Fishing Gears (ALDFG) continue to trap marine life for years upon release, causing ghost fishing. However, the lack of scientific data on the loss of fishing gear (FG) and associated reasoning hinders the management of FG across the globe. The problem of ghost fishing is especially threatening in the Nordic context as commercial fishing in Norway alone contributes to around 35% of that total catch from the EU-EEA region, implying the country's heavy reliance on the blue economy.

Material Flow Analysis (MFA) is an established environmental accounting tool used to assess flows and stocks of materials in industrial and natural systems. Accordingly, we present a system life cycle of typical FGs used by commercial fishers in Norway and model the flows of plastics polymers (PP, PE, and Nylon) used as building blocks of advanced FGs. Based on extensive data collection spanning six years (2016-2021), we present the static and dynamic indicators to track the mass of plastic entering the ocean through commercial fishing in Norway.

Critical indicators are developed and measured using the survey of local fishers' to capture their knowledge of FGs. These indicators include the typical life span of FGs (in years), rate of gear repair, frequency of gear purchase, disposals, and rate of gear loss upon deployment. Additionally, the gear effectiveness was quantified to determine the typical rate of macro plastic loss in the oceans per ton of biological catch by the six commercial FGs deployed in Norway, namely, trawls, seines (Danish and Purse), longlines, gillnets, and traps.

The analysis shows that commercial fishing in Norway contributed to an estimated 130 to 480 t/yr of plastics as ALDFG in the ocean annually from 2016-2022. Gillnets, longlines, and traps are the main contributors to ALDFG in the ocean, as these gear types are more susceptible to getting lost due to gear design, practice, and ground deployment.

Studying the indicator 'gear efficiency', we conclude that an estimated 0.2 kg of plastic is lost in the ocean per ton of biomass caught by the commercial fishers of Norway. The FGs such as crab pots (3.3 kg/ton), Danish Seine (1.1 kg/ton), and longline (0.5 kg/ton) provide the worst gear efficiency.

The MFA and local stakeholder-based indicators on FGs provide a holistic decision support tool for industry and policy-makers in devising and exercising sustainable strategies for FG resource management. The case and learnings from Norwegian fishing practices can be transferred to other fisheries with necessary local adaptations.

Abandoned, Lost or otherwise Discarded Fishing Gear (ALDFG) in Sri Lanka - A pilot study collecting baseline data

Anthony Gallagher[1], Peter Randall[2], David Sivyer[2], Umberto Binetti[2], Gayathri Lokuge[3], Mohamed Munas[3]

[1]*Evolved Research and Consulting Ltd, Heatherlands, Jordan's Lane, Sway, Lymington, SO41 6AR, United Kingdom, anthony.gallagher@evolvedresearch.co.uk*

[2]*Cefas, Pakefield Road, Lowestoft, Suffolk NR33 0HT, United Kingdom*

[3]*Centre for Poverty Analysis, 16, Jawatta Road, Colombo 05, Sri Lanka*

Despite increasing attention globally, there has been only limited data collected on the extent of abandoned, lost and otherwise discarded fishing gear (ALDFG) globally. This pilot study was conducted using a fisherfolk survey to quantify the scale of the problem and identify contributory factors in Sri Lanka. Funded through the Ocean Country Partnership Programme (OCPP), and delivered under the Blue Planet Fund, the survey took place in February and March 2022, and involved sampling 325 vessels categorised by vessel type and gear.

Based on this survey, 22,593 kg plastic fishing gear was estimated to have been 'lost' to the marine environment over the previous year. This averages 116 kg per vessel from those vessels that admitted ALDFG events and provides an indication of the scale of ALDFG from the Sri Lankan fishing industry.

The survey identified ALDFG drivers, including oceanic and meteorological conditions; a lack of education and awareness amongst fishers; and poor waste management facilities both onboard and onshore. The significance of the drivers varied spatially. Gear conflict was universal though the interaction between Sri Lankan fishers and Indian bottom trawlers in the north was highlighted as was the interaction between fishers and the international shipping lane in the south and west.

Changes in national and international policy, as well as more direct national engagement with the issue are recommended, including training, capacity building and the development of better waste

infrastructure. Further evidence is required to explore gear conflict and the interaction between ALDFG and international shipping.

Preliminary Investigation to Estimate the Abandon, Lost, and Discard Gillnet and Traps (pots) along the Coast of Thailand

Santiphong Putsa[1], Nopporn Manajit[1], Nakaret Yasook[1], Watcharapong Chumchuen[1], Taweekiet Amornpiyakrit[1], Isara Chanrachkij[1]*

Training Department, Southeast Asian Fisheries Development Center, P.O. Box 97 Phrasamutchedi, Samut Prakan 10290, Thailand, isara@seafdec.org

Abandoned, Lost or otherwise Discarded Fishing Gear (ALDFG) is widely recognized as a significant component of marine litter and has serious impacts on habitats, and marine species in particular Endangered, Threatened and Protected Species (ETP Species). The Southeast Asia regional concern on the marine debris includes ALDFG has been raised in SEAFDEC Meetings. With that, SEAFDEC under supported by FAO improved the knowledge and skill on ALDFG survey by conducting the survey on the ALDFG, gillnets and traps, at Phang Nga and Krabi Province of Thailand, by using the FAO Fishing Gear Loss Questionnaires for gillnet and trap fisheries.

Three (3) survey trips had conducted during May to October 2021. Total number of questionnaires are one hundred and sixty (160) comprise one hundred and eleven (111) gillnets and forty-nine (49) traps interviewed from small-scale fishers. Results show that estimated total trap loss is 5,154 traps with an associated economic loss of 64,805.08 USD/year. Estimated loss of gillnets is 458.50 units/year with an estimated associated economic loss of 13,467.14 USD/year.

The main cause of the gillnet loss is nets becoming snagged on an obstruction, and the main cause of the trap (pot) loss is conflict with other gears. Due to the survey conducted in two provinces of Thailand, authors recommend expanding the survey to all coastal province of Thailand, both in the Gulf of Thailand and Andaman Sea, as well as to apply to both small-scale and commercial scale fisheries. The result could provide guidance for the development of management actions to reduce ALDFG in the future.

Ghost fishing efficiency in snow crab (*Chionoecetes opilio*) pot fishery

Kristine Cerbule[1,2], Bent Herrmann[1,2,3], Eduardo Grimaldo[1,2], Jesse Brinkhof[1,2], Manu Sistiaga[1,4], Roger B. Larsen[1], Zita Bak-Jensen[3]

[1]*UiT The Arctic University of Norway, Tromsø, Norway, kristine.cerbule@uit.no*

[2]*Department of Fisheries Technology, SINTEF Ocean, Trondheim, Norway*

[3]*DTU Aqua, Technical University of Denmark, Hirtshals, Denmark*

[4]*Norwegian Institute of Marine Research, Bergen, Norway*

Lost, abandoned and discarded fishing gear has a negative impact on the ecosystem through continuous capture of marine animals of target and non-target species (often termed "ghost fishing"). Pot fisheries are generally associated with high ghost fishing risk. The snow crab (*Chionoecetes opilio*) pot fishery in the Barents Sea is conducted in harsh weather conditions that can cause loss of fishing gear, increasing the potential ghost fishing. Due to non-degradable materials in pot design, the gear can remain intact for long periods. In commercial fishery, snow crabs are attracted to pots using bait. The bait decays over time as would happen in case the pots are lost, abandoned or discarded. The ability of

non-baited pots to continue ghost fishing is unknown. This study adapted a method for quantifying the ghost fishing efficiency by lost pots relative to the catch efficiency of actively fishing snow crab pots. The results showed that ghost fishing pots on average attracted 5.79% (CI: 4.72-7.10%) snow crab when compared to actively fishing pots demonstrating continued ghost fishing even when the bait is decayed. This in turn cause concerns about resulting self-baiting of the pots and the efficiency that ghost-fished dead snow crab can further attract conspecifics in this fishery.

Introduction to the Manual for Marking Fishing Gear

Haraldur Einarsson[1]

[1]*Fishing technology and operations team (NFIFO), http://www.fao.org/responsible-fishing/ Fisheries Division (NFI), Food and Agriculture Organization of the United Nations (FAO), Viale delle Terme di Caracalla Rome 00153, Italy, haraldur.einarsson@fao.org*

The manual for marking fishing gear we introduce is a supplement to the Voluntary Guidelines on the Marking of Fishing Gear (VGMFG; FAO, 2019) and provides practical instructions on marking methods for the main types of fishing gear to identify ownership. Gear marking has been recognised since the 1990s as a tool to contribute to sustainable fisheries, improve the state of the marine environment, assist fisheries management, and prevent and reduce negative impacts related to abandoned, lost or otherwise discarded fishing gear (ALDFG) and ghost fishing. It also contributes to improved safety at sea and assists in identifying illegal, unreported and unregulated fishing activities (IUU). Marking fishing gear is necessary to ensure effective traceability to the owner and operator. To date, gear marking has mainly been confined to marking surface marker buoys to locate stationary gears such as gillnets, longlines and pots. However, there are examples of marking the fishing gear units, for example, pots. Even though the benefits for the owner and management purposes are generally well recognised worldwide, relatively few nations have made the marking of fishing gear mandatory. This manual is intended to assist fisheries managers, fishing gear manufacturers and the fisheries sector in meeting the relevant international, regional or national obligations for gear marking. More specifically, it enables all stakeholders to comply with the specific gear marking requirements outlined in the FAO Code of Conduct for Responsible Fisheries and other international instruments and agreements. Organisations or parties concerned with or actively addressing the issue of ALDFG may also find helpful information in this publication.

Fishing gear marking tests in Argentina

Ricardo R. Roth[1]

[1]*Instituto Nacional de Investigación y Desarrollo Pesquero - INIDEP, Paseo Victoria Ocampo N° 1, 7600 Mar del Plata, Argentina, rroth@inidep.edu.ar*

Marking of Fishing Gear is a tool to contribute to sustainable fisheries, to improve the state of the marine environment, and to enhance safety at sea by combatting, minimizing and eliminating abandoned, lost or otherwise discarded fishing gear (ALDFG) and facilitating the identification and recovery of such gear. Also, can be used as a tool in the identification of illegal, unreported and unregulated (IUU) fishing activities (FAO, 2019).

Following the series of "FAO Expert Group Workshops on the Marking of Fishing Gear" that took place towards the end of 2021, in July 2022 a new meeting took place in Ancona (Italy) in which in which results of gear marking trails and related developments were discussed. From that meeting, tags acquired by FAO were obtained.

In recent months in Argentina have carried out experiments with some of those tags, placed in different parts of a bottom trawl net, operated by a commercial fishing vessel.

Also, two meetings were held in with the participation of netmakers, businessmen, fishermen and government officers to discuss the feasibility and manner of implementing a fishing gear marking system.

This paper shows the state of the marks after three months of work, which, according to their location, show different degrees of deterioration.

Incidental occurrence of ALDFG in commercial trawls of Kerala, India

Damaris Benny Daniel[1], Saly N Thomas[1]

[1]*School of Industrial Fisheries, Cochin University of Science and Technology, Lake Side Campus, Cochin, India, damarisbenny@gmail.com*

Commercial fishing activities generate substantial marine litter through abandonment, loss, or discard of fishing gear (ALDFG). ALDFG is considered a stressor to the fishing industry that has the potential to reduce its resilience. However, the presence and impact of ALDFG have been assessed only in a few localized fisheries. The objective of the present study was to assess the quantity and composition of ALDFG in incidental plastic debris caught by commercial trawls in Kerala and to examine its impacts. Plastic debris incidentally captured during fishing was collected from 10 multiday trawlers operating in the Kollam region of Kerala from August 2017 to May 2018, in a participatory mode with the Suchitwa Sagaram mission team. The Suchitwa Sagaram mission is a project of the Government of Kerala and the Kollam District Fishing Boat Operators Association that involves the collection of debris caught during fishing operations by fishers. Among the collected plastic debris, major contributors (by number) were polythene bags (33%), food packaging (28%), plastic sack pieces (11%) and plastic bottles (9%). The major ALDFG was fishing net pieces (6%), synthetic ropes (4%) and floats & buoys (1%). Based on weight, the predominant item was fishing net (22%), followed by ropes (18%), and plastic bottles (13%). The most common problems of ALDFG, according to trawl operators, were restricted catch, hindrance to fishing operations, lost fishing time, and damage to fishing gear. Since multi-day trawlers landed a considerable amount of plastic debris after each fishing trip, expanding Suchitwa Sagaram type debris removal programs to other regions could be a cost-effective strategy to clean the ocean. Establishing proper collection and disposal mechanisms for debris caught during fishing operations can minimize the practice of it being thrown back into the sea, thereby reducing plastic accumulation in the aquatic environment.

Impact of derelict fishing gears on vulnerable coastal ecosystems along west coast of India

DivyaViswambharan[1], Sreenath K R[2], Prathibha Rohit[1], Shobhana K S[2], Geetha Sasikumar[1]

[1]*Mangalore RC of ICAR-CMFRI, Hoige bazar, Mangaluru 575 001, divyaarinu.dv@gmail.com*

[2]*Marine Biodiversity and Environment Management Division, ICAR-CMFRI, Kochi*

Derelict fishing gears are widely distributed around the world and they are found to cause serious threat to marine life as they can trap and kill marine organisms indiscriminately, including those belonging to endangered or of economic importance. Majority of the lost fishing gear is made of nondegradable materials and they sink to the sea floor or drift around in currents. Mostly these derelict gears remain unnoticed until they show up on coral reefs, rocky reefs and in other vulnerable coastal habitats. The studies on the generation of ALDFG by various fisheries and their impact on vulnerable coastal

ecosystems are limited in the Indian context. Therefore, an assessment of the abundance of ALDFGs and their impact on the floral and faunal assemblages of vulnerable ecosystems was undertaken in the rocky outcrops, which are frequent in the west coast of India. These areas act as the natural shelter, breeding and nursery sites for marine organisms especially reef fishes and sessile organisms. The underwater visual census using rapid visual transect was done at two vulnerable ecosystems, having different levels of fishing intensities from May 2018 to December 2022. The biodiversity in the area surveyed is facing harmful effects due to derelict fishing gears. The derelict gears found in these vulnerable ecosystems are mainly influenced by the local fishing activities. The study highlights the effort taken by research organization and NGOs in mitigating the impacts of ALDFGs on vulnerable ecosystems with a social survey- based on fishers' and other stakeholders' perspective and suggestions to mitigate/ reduce ALDFG.

Monofilament Long line: An effective fishing gear alternative to multifilament long line

Harshavardhan D. Joshi[1], Ashok S. Kadam[1]

[1]*Mumbai base of Fishery Survey of India, Sassoon Dock, Colaba, Mumbai-400005, harshjoshicofsn@gmail.com*

Fishing gear is a special device or structure which is mainly prepared to catch the special type of fish in special habitat. Long line, it is mainly used to catch oceanic fishes mainly high in weight and having migration behaviour. Long line is a special passive gear which is having main line (may be more than 30 Km in commercial fishing) and various branch line (length of branch line depends upon thermocline temperature). Fishery Survey of India having four long line survey and research vessels in which two vessels namely Matsya Vrushti and Matsya Drushti are monofilament longliner and Blue Marline and Yellow Fin are multifilament long liner. In this study, critical issues on long line of the world are re-assessed with specific reference to the long line fishing industry. The adaptability, selectivity and seasonality of both monofilament and multifilament long line fishing gears to deep sea, fish species and stretch of the year are re-scrutinized. Furthermore, new innovations in Multifilament and Monofilament are required to improve the effectiveness of gears and thus the long line fishery is expressed in the light of speedy socioeconomic variations within the fishery industry.

Lost gear retrieval exercise through scuba diving and analysis on the fate of derelict gears in Tamil Nadu, India

Harsha K[1,2], Saly N Thomas[1], Sandhya K. M[1]., Aiswariya Ghosh K. A[1]., Mary Baby[1]

[1]*ICAR-Central Institute of Fisheries Technology, Kochi-29, Kerala, India*

[2]*Kerala University of Fisheries and Ocean Studies, Panangad, Kerala-682506, India. harshakrishna2018@gmail.com*

Globally, generation of Abandoned, Lost or otherwise Discarded Fishing Gears (ALDFG) have become a serious concern because these pave way for ghost fishing, entanglement of marine organisms and finally when accumulate on bottom a blanketing effect to the bottom substratum affecting the biological and ecological processes of ocean system. The higher probability of passive gears to become derelict gear and an agent of ghost fishing has been proved scientifically. Retrieval of lost gears is an exercise done to prevent the chances of ghost fishing. In this background, gear retrieval exercise was carried out in the trap fishing grounds along Enayam coast of Tamil Nadu. The dive sites were identified from the fisher's knowledge on the probable derelict gear accumulation areas. The scuba dive study by scanning an area of 700 m2 of sea bottom along Enayam and Enayam Puthenthurai (80 12.886'N ,770 10.874'E)

coast within 20 m depth retrieved derelict traps (71%), gillnets (13.9%), long line (7.5%), trawl (4.1%), ropes (2.5%) and squid jig (1.0%) which totally weighed 33kg. The study also found prominence of geographic and local tidal and current patterns in the rate of gear loss. Occurrence of ghost fishing couldn't confirm in the study. However, examination of retrieved traps showed colonisation of benthic organisms including bivalves (59.14%), echinoderms (16.13%), gastropods (10.75%), chelicerates (8.6%), crustaceans (5.38%) and uncountable smaller parts of poriferans and cnidarians which provide meagre evidence for ghost fishing in these gears. Even if the study substantiates the gear loss rate at a lower level (<50%) from fishers' perception it demands a detailed impact assessment study. Observations from retrieved gears provide minimal evidence for ghost fishing, instead the derelict gears become an aggregating device which harboured organisms from other external influences especially during spawning and advancing stage. This study demands further research in the direction of assessment of gear loss, retrieval and impact assessment in different fishing systems in the Indian waters.

Theme: Survival / Behaviour / Physiology

RAMP scores correspond well with biochemical test indicators: results of in-situ studies

Vishnupriya, M.S.[1]*, Madhu, V.R.[2], Manojkumar, B.[1], Tejpal C.S.[2], Amrutha R. Krishnan[1]

[1] *Kerala University of Fisheries and Ocean Studies, Kochi -06, sasivp2898@gmail.com*

[2]*ICAR-Central Institute of Fisheries Technology, Willington Island, Kochi - 29*

Reflex Action Mortality Predictor (RAMP) is now used for the prediction of escape and delay mortality during fishing. Since assessment of immediate and delay mortality was difficult to access in the field, simulated experiments were conducted using Tilapia (*Oreochromis mossambicus*) by trawl simulation experiment in a towing tank, with three towing times viz. 15 min., 30 min. and 45 min., followed by air exposure for 10 min. Different reflex action were selected to score the vitality impairment on a five-point categorical scale. After scoring for each reflex action, RAMP was calculated as the sum of vitality impairment divided by the total possible reflex action. In addition to scoring, the same fish were used for conducting different biochemical tests like LDH, MDH, AST and ALT to measure changes in body tissues. The overall findings demonstrated a strong correlation between the reflex scores and mortality, demonstrating lower mortality when reflex activity was higher and vice versa. Overall, it was observed that organ damage and biochemical testing associated well with mortality, which was in turn connected to the length of stress events during simulated trawling. The biochemical indicators and mortality estimations also showed good correlations. Based on the findings a preliminary model was developed and the results will be discussed.

Optomotor response in Atlantic cod (*Gadus morhua*) – can it be elicited and manipulated by trawl netting?

Junita D. Karlsen[1]*, Niels G. Andersen[2]

[1]*DTU Aqua, National Institute of Aquatic Resources, North Sea Science Park, Hirtshals, Denmark, jka@aqua.dtu.dk*

[2]*DTU Aqua, National Institute of Aquatic Resources, Kgs. Lyngby, Denmark,*

The optomotor response is when animals move with a moving visual pattern. It is well documented in a wide range of animal groups including fish and is believed to be a major behavioral mechanism of fish in the process of being captured by trawl. Thus, the response has the potential of being utilized to increase trawl selectivity. It is the steady swimming of fishes at the same speed of the moving trawl gear often observed in the front of the trawl mouth on structures inside thee trawl that has been interpreted as the optomotor response. The optomotor response is suggested elicited by the moving trawl netting. However, other confounding stimuli during trawling may be responsible for the observed steady swimming, for example the groundgear in the trawl mouth area, leading to other interpretations of the holding behavior, such as herding.

Movement with moving visual pattern is considered an innate behavior and compulsory to normally performing individuals. Thus, the optomotor response is commonly used in the laboratory to study a range of topics, such as various aspects of the visual systems of fishes, schooling behavior and effect of pollutants. However, the optomotor response has shown to vary between species, and too little is known about the optomotor response in trawls. This study investigated for the first time the optomotor response of wild Atlantic cod (*Gadus morhua*), an important commercial species in demersal fisheries,

using a standard laboratory set-up consisting of a rotating drum with black and white vertical stripes placed outside circular transparent fish tank. Furthermore, in the same set-up, the black and white stripes were replaced by five sets of standard polyethylene trawl netting with different visual appearances, which were tested for their ability to elicit, enhance, or break-up the optomotor response of cod in two ambient light levels. Cod behavior was observed using infrared light (940 nm). The results from the video analysis are presented and discussed in relation to trawl fishery and with focus on inter-individual variability.

Theme: Energy

Greening Trawl Fishing Operation: Optimized Energy Saving, Minimized Seabottom Contact, and Improved Safety at Sea

Thaweesak Thimkrap[1]

Marine Engineering Section , SEAFDEC/TD Suksawasdi Road, Tambon Laem Fa Pha, Phra Samut Chedi District, Samut Prakan 10290 Thailand, thaweesakt@seafdec.org

General

Fishing is one of the most important employers and sources of protein for coastal communities. Bottom trawls are fishing method is that is indiscriminate in what it catches, and kinds of unselective fishing gear are taken an account one of the most destructive ways to catch cause harm to other fisheries and the marine environment by catching juvenile fish, and often juveniles of valuable species damaging the seafloor, and leading to overfishing because the gear is not selective and discards a lot of dead fish. For this reason, bottom trawling has a large bycatch impact, with many non-target species being fished in the process. Overfishing by bottom trawls is a direct threat to local fishing communities. This activity has an impact on biodiversity and means many species are being fished to the brink simply as a consequence of commercial activities, not as the target species. In addition to the turtles, juvenile fish, and invertebrates that get swept up in trawling nets, corals/seafloor are victims of trawling.

Objective

Promoting the appropriate fishing vessel under the concept of Low Impact and Fuel Efficiency “LIFE” will be applied. To reduce the impact of fishing vessels operating in an environment at a low level. The special devices/tools and techniques have been implemented on M.V. Plalung a 29.98 GT-wooden, the multipurpose fishery training vessels that use lesser fuel consumption/less manpower and improve safety while operating at sea to serve as a training model/material for fishers and fishery resources persons in SEA. The upgrading of the new vessel training vessel and model is, therefore.

- Improve/promote responsible fishing and selective fishing gear to reduce the environmental impact of fishing activities, e.g., discards, carbon emission, seabed, and especially the concerned species.
- Implement the concept of an appropriate fishing vessel design on improving energy efficiency, safety at sea for better living conditions, and safety working onboard based on the conventional standard (C-188) including implementation of hygiene of the fishing vessel.
- Improve appropriate fishery machinery, tools, and fishing operation techniques to support the manpower of the fishing vessel in capture fisheries.

Materials and Methods

a) Improve responsible fishing to reduce the negative impacts of trawling vessels by examining the efficiency of energy-saving ability, and performance of fishing gear design. The goal is to conduct good practices to reduce the negative impacts of trawling fishing activities on the seabed, especially noting the negative physical and biological impacts on the marine ecosystem in the study area, e.g. The Gulf of Thailand to reduce carbon emissions to mitigate climate change.

Otter board is the main equipment of a single trawl fishing vessel, and its hydrodynamic performance is an important factor affecting the catch and fishing efficiency. The function of the otter board is to accelerate the settlement of the trawl net by increasing the horizontal expansion of the trawl net.

The V-type horizontal cambered otter board is implemented in the coastal area single trawl training vessel. The hydrodynamic force on the otter boards decomposed into the expansion force. The expansion force is perpendicular to the flow velocity, which effect is increasing the lifting force of the otter boards where the trawl doors do not contact the seabed and minimizing damage to bottom fauna, expansion of the trawl net sweeping area, and directly cutting fuel consumption.

To improve good practice, the hydraulic Net drum, and wrap line rope are wide-powered spool for the hauling and shooting process that is used to facilitate wound when hauling up and releasing the trawl nets and wrap line. Type of sources by implementing the power-takeoff from the propulsion engine to haul a trawl net with its catch onboard. Net drum constitutes the hydraulic components placed on the stern portion, and gallows the inverted "U" shape is the most common one for trawl gallows are used to facilitate hitching up of heavy otter boards as well as for shooting and hauling of towing warps. The adjustable gallows are a new design by SEAFDEC/TD with the specific design it being a function as an outrigger or beam trawl when it adjusts to the waterline angle. Use to facilitate the extending on each side of the trawl wrap. The positioning of gallows is important as they must be forward of the rudder axis to allow the vessel adequate maneuverability.

Concerning global warming, several techniques including responsible user are applied to this issue, e.g., the recondition of a propulsion engine, the appropriate engine to the vessel type, and engine size to the generator, monitoring, and awareness building by the installation of fuel flow meter, including engine and vessel maintenances program and accepted the efficient application on board, i.e., led lighting bulbs, the new refrigerant with non-CFC and life fish handling is implemented

b) Concerning promoting the concept of an appropriate fishing vessel design. Referenced to the conventional standard of living of the crew onboard. The appropriate arrangement based on C-188 will be applied e.g., living space, sanitary, food, drinking water, canteen, cabinet, entertainment, etc.

c) Improve appropriate fishery machinery, tools, and fishing operation techniques. (Power take-off for winch drives) The power take-off is the unit to take the power from the main engine for the winch drive. From the power take-off point, the belt drive is preferable to the chain drive as it has more flexibility. The hydraulic drive may prove cheaper than a mechanical drive in the long run, provided that expertise and spare parts are locally available. On a small fishing vessel, the most usual power take-off is for a wrap line winch or Hydraulic oil pump for net drum in the trawl fishery.

Hybrid refrigeration system. In a fishing vessel, the propulsion engine or diesel generator has greater power delivering and a relatively steady amount of torque at both high and low running speeds. Consequently, the propulsion engine drives the compressor for refrigeration by providing enough power take-off as a mechanism to bring its power from at operating speed, therefore just properly matched with the requirement for the refrigeration unit as utilized as the power source.

SEAFDEC/TD designed and constructed the split shaft power take-offs with many advantages, which can make it an excellent option to capitalize on the full potential of fishing vessels. The Split shaft power take-offs are equipment such as a gearbox or power take-off application to allow single or multiple pumps to be driven from a single prime mover. This Multiple/split-type power take-off is a combination of different propulsion technologies

Innovation in Dutch beam trawl fisheries: rubberticklers-twister gear

Allard van Mens[1]; Lennert van de Pol[1]

[1]*Wageningen Marine Research, Haringkade 1, 1976 CP IJmuiden, Netherlands, allard.vanmens@wur.nl*

When the ban on pulse trawling in EU waters was introduced, some fishermen decided to not return to classic beam trawl gear which, according to them, was not a sustainable economic and ecological alternative to pulse fishing. One of the lessons pulse trawling taught these fishermen was the use of lighter gear and subsequent lower fishing speeds resulting in lower fuel consumption. With these lessons in mind, in 2019 an innovation undertaken by the Dutch vessel UK95 'Aart Maaskant', led to the design of a 'rubberticklers' gear, which comprises a set of rubber discs parallel to the fishing direction to startle flatfish from the seafloor. This design uses the square formed nets used for pulse fishing and drastically decreases the weight compared to chain-beam trawl gear. The design was later improved by the addition of 'twisters'. These are dome shaped metal devices placed face down perpendicular to the fishing direction and were originally designed for dethatching shells in Canadian shellfish fishing.

Since July 2021 the UK95 has, together with WMR, been working to improve the gear and create an economically viable alternative to chain-beamtrawl gear for sole fisheries in the North Sea. This resulted in 34 weeks of self-sampling and 1 week of comparative fishing, where a chain-beamtrawl was used to compare catches, survival rates, discard composition and fuel consumption to the innovative gear. Tow tank trials were also undertaken to improve the understanding of 'twisters' on waterflow.

The self-sampling weeks resulted in a dataset following the evolution and various improvements through the 34 weeks of development. In these weeks the innovative gear averaged a return of 1,83 euro per liter of fuel. The rubberticklers-twister gear caught an average of 59.4%, 33.6%, 64.4% of the catches of sole, plaice and turbot respectively, compared to chain-beam trawl during the week of comparative fishing. These results were significant. Although the innovative gear did less well in terms of marketable catch, it also caught 60.8% of the discards per fished area and consumed 60.5% of the fuel compared to the chain-beamtrawl. On some hauls the caught undersized plaice was scored on reflexes and overall quality. The rubberticklers-twister gear had yielded higher quality undersized plaice, with only 23.3% of the scored fish being dead on recording while beam trawl recorded 58% dead when scoring, indicating higher survivability.

To conclude, the innovative gear will need to improve the marketable catch efficiency or further reduce fuel consumption to be a potential alternative to chain-beamtrawl gear for commercial fisheries. The potential reduction in benthic disturbance and improvements to selectivity and survivability of the technique are important factors when considering innovative techniques.

Development of VFDS Otter Boards for Energy Conservation

Remesan, M.P.[1], Paras Nath Jha[1], Madhu, V.R.[1], Baiju, M.V.[1], Prajith, K.K[1], Chinnadurai, S[1], Renjith, R.K[1], Dhiju Das, P.H[1], Dilipkumar, V.N[1], Vipin, V[1]

[1]*ICAR-Central Institute of Fisheries Technology, Kochi- 682 029, India, mpremesan@gmail.com*

In India about 165.2 million liters of diesel is consumed annually by the different category of trawlers. Several attempts were made world over to reduce the fuel consumption in trawl systems. ICAR-CIFT has optimized trawl designs for different category of trawlers for reducing fuel consumption and resource conservation.

Trawl accessories also significantly contribute to the total trawl drag and about 20% of the trawl drag is contributed by the otter boards alone. Studies were also made to reduce the drag of otter boards and to optimize the trawl openings. Slotted otter boards are known for less drag and fuel consumption as it permits water to flow through the openings.

Wooden rectangular boards and V-form steel boards are the two types of sheer devices commonly used in India. V-form otter boards are popular mostly in the west coast of India starting from Kerala to Maharashtra. ICAR-CIFT has recently introduced an innovative V-form double slotted otter board (VFDS otter board) for reducing the drag, fuel consumption and GHG emission of trawlers.

Experiments onboard CIFT research vessel and commercial vessels revealed that depending on the sea conditions 2-3 liters of diesel can be saved per hour of trawling, compared to the existing boards of same dimensions. Trawl telemetry analysis revealed that expansion performance of the new otter boards is better. The technology has been accepted by the trawl owners, especially in Kerala, Tamil Nadu and Karnataka in the southern coast of India. In Indian several million liters of diesel can be saved annually and emission of greenhouse gases can be reduced by adopting VFDS otter boards by the trawlers of all the maritime states.

Using pair trawling to reduce fuel in a demersal fishery

Matthew McHugh[1], Martin Oliver[1], Daragh Browne[1], Rory Campbell[1], Ronan Cosgrove[1]

[1] Ireland's Seafood Development agency (BIM), New Docks, Galway, Ireland. matthew.mchugh@bim.ie

Irish bottom trawlers typically operate individually or 'solo' vessel with one net. BIM recently assessed bottom trawling as a means of improving efficiency. A 150% increase in fuel prices between 2021 and 2022 prompted this investigation. Two identical vessels were chartered to tow a single net without trawl doors using 724 m long sweeps. This pair trawling method is more like seining than trawling with 440 m of heavy 38 mm combination wire rope near the net, eliminating the need for a clump weight. For a solo vessel comparison, data on catches from a vessel operating nearby as well as follow up operational information from the vessels involved were used. Operationally the wing end spread was similar for the trawls used by the pair team and solo trawlers but the sweep divergence (i.e., where they join to the towing warps) was 3.1 times greater when pair trawling giving a greater (3.2×) swept area—7.92 versus 2.84 km2. Catches were 29% greater likely due to this increase in swept area. Fuel consumption and engine load was estimated to be 40% and 38% lower while profitability was 32% greater for each of the pair trawlers. Results suggest that pair trawling is a viable option for Irish bottom trawlers and could also be of benefit to Ireland's commercially important seine-net fleet.

Fuel use and greenhouse gas (GHG) emissions in fisheries

Antonello Sala[1], Jon Lansley[1], Xuechan Ma[1], Tarub Bahri[1]

FAO-NFIFO, antonello.sala@fao.org

The FAO background study provides an overview of the current state of research into energy use and greenhouse gas (GHG) emissions in fisheries with a focus on industrial fleets. Fuel use intensity, or litres of fuel consumed per tonne of landings, resulted typically much higher in low volume fisheries than for many other fishing techniques. There are two widely acknowledged main approaches to estimate the contribution of marine capture fisheries to global fuel use and GHG emissions. One approach uses catch-based fuel use intensity for well-studied fisheries, the second uses fishing effort data to estimate fuel use based on vessel size and fishing times. In our opinion, the two approaches are

found to be complementary to one another, not contradictory, and global estimates of fuel use and GHG emissions from marine fishing should be based on their combination, depending on the data available. However, both approaches have several limitations and rely in many cases on strong assumptions when it comes to "catch or effort reconstruction". The advantages and disadvantages of each method regarding the limits of the nominal effort available for both coastal and industrial fisheries but also of the current algorithms have been largely discussed. The collected information and the identified approaches offer viable opportunities both for the quantification of global fuel use and GHG emissions in fisheries and also an insight on whether there are possibilities to address the reduction of emissions.

Studies on alternate fuel for out board motor (OBM) driven fishing boats in India

Ravichandran A.[1], M G Makhwana[2], K S Vinod[3]

[1]*Central Institute of Fisheries Nautical and Engineering Training, Royapuram, Chennai, aravichandran1965@gmail.com*

[2]*Central Institute of Fisheries Nautical and Engineering Training, Royapuram, Kochi, manjimakwana@gmail.com*

[3]*Central Institute of Fisheries Nautical and Engineering Training, Kochi, ksvinod72@gmail.com*

As per the recent Fisheries statistics 2022, India has more than 130000 Motorized non Mechanical fishing crafts fitted with OBM which are mostly operated with Kerosene/petrol as fuel. The exhaust emissions from the petrol/kerosene fuel based OBMs is creating health hazards to the fishermen as well as contributing to the global warming and also affecting the marine ecosystem.

During 2006, Central Institute of Fisheries Nautical and Engineering Training (CIFNET) had conducted a pilot study on the 'Efficacy of LPG kit on OBMs' with vapor off-take technology (VOT) LPG kit. In this technology, fuel is supplied in the form of vapor to the kit from normal LPG cylinder. The load bearing capacity and fuel efficiency are comparatively lesser in this technology in comparison with Kerosene/petrol fuel OBMs.

Presently, a new LPG kit has been developed with liquid off-take technology (LOT) in which LPG is supplied to the kit in liquid form and converted into vapour form mixed with air to supply to the engine. The kit manufacturer also has made LPG cylinder with customized valve in collaboration with petroleum companies so as to use the LOT LPG kit.

This technology was tested for the usage in the OBM during the period from 20.04.2022 to 14.05.2022. The results indicate that the usage of LPG with LOT Kit on OBM proved to be more efficient & eco-friendly in comparison to Petrol start Kerosene run OBM based on the critical analysis of the data collected. The methodology, economics of operation, cost analysis and overall efficacy are discussed in this paper for disseminating the information to the Fishermen and Fishing Industry.

Experiments with LNG as fuel for fishing vessel propulsion: Indian experience

M.V. Baiju[1], V.R. Madhu[1], Vipin Kumar V. [1], Dhijudas, P.H. [1]

[1]*ICAR CIFT*

There are 42,985 mechanised commercial fishing vessels in India consisting of Trawlers, Gillnetters, Dol netters, Bag netters, Liners, Ring seiners and Purse seiners. The length of these vessels varies from

13 to 24 metres, and their engine power ranges from 40 to 550 horsepower. The bulk of these vessels have length ranging from 13 to 24 metres. The engine power of these vessels ranges from 40 to 550 horsepower. Trawlers make up more than 75% of the vessels in the mechanised sector and depending on the class of trawler, the projected yearly fuel consumption ranges from 12,000 to 54, 000 litres.

LNG was tested as a fuel for trawling operations as part of the worldwide experiments with alternative energy sources to save operational costs and reduce pollution. R.V. Matsyakumari-II, a 17.7 m LOA diesel-powered research vessel, was adapted to run on LNG+ Diesel dual fuel for trawling operations. The vessel was modified to accommodate the dual fuel injection system (targeted substitution of 30–40%), and a cryogenic tank with a capacity of 450 litres was fitted.

A 27.0% substitution of diesel with LNG could be achieved during the experiments. The average consumption of HSD per hour was calculated as 20.8 litres and the quantity of LNG used per hour of operation was concurrently estimated as 8.4 liters. Trials using LNG, showed encouraging results. There were no safety concerns, and the switching processes and power output went without interruption. The findings show that LNG could replace HSD by at least 30% without causing any power loss during steaming or trawling activities

Semi-pelagic self-adjusting otter boards: effects on the catching performance of a demersal trawl

Morteza Eighani[1], Tiago Veiga-Malta[1], Valentina Melli[1], Finbarr G. O'Neill[1]

[1]*National Institute of Aquatic Resources (DTU AQUA), Technical University of Denmark, North Sea Science Park, 9850 Hirtshals, Denmark, moei@aqua.dtu.dk*

Using semi-pelagic otter boards that operate off the seabed can make demersal trawling activities more sustainable and energy efficient. In this study, we investigated if and how replacing conventional seabed-contacting doors with semi-pelagic self-adjusting otter boards (SAO) affects catch efficiency of a demersal trawl. These doors are unique because they have onboard altimeters and adjustable flaps, which gives them the ability to control their position into the water column both vertically and horizontally from the vessel during the fishing operation. Full-scale experimental trials were conducted in a Kattegat fishery targeting demersal fishes with three doors configurations: conventional seabed-contacting otter boards, and the SAO set to maintain a target height over the seabed of 1 and 5 m, respectively. These target heights were chosen to keep the visual herding stimulus of the door while ensuring that there is no interaction between the doors and seabed. The data for this study were collected using the alternate haul method and analyzed using a catch comparison analysis for unpaired data. Replacing conventional doors with the SAO – 1m resulted in loss of catch efficiency for haddock and plaice, while there was no significant difference for cod. On the other hand, increasing the target height of the doors to 5 m over the seabed (SAO – 5m) decreased the catch efficiency for all species with respect to conventional doors. Fuel consumption of the trawler significantly decreased by about 14% at 3.3 knots when replacing conventional doors with the SAO. These results highlight a significant loss of herding effect, even for species where herding is considered neglectable in literature. Our study shows that having the doors in proximity of the seabed is not sufficient to effectively herd species towards the trawl, and additional stimuli may be required to replace the visual and mechanical stimuli produced by a seabed-contacting doors.

Analyzing carbon emission level of motorized fishing sector of Pulicat region

Arun Jenish[1], Velmurugan[2], Neethiselvan[3], Kalaiarasan[4]

[1,2]Department of Fishing Technology and Fisheries Engineering, Dr.MGR Fisheries College and Research Institute, Ponneri, arunjenish@tnfu.ac.in

[3]Fisheries College and Research Institute, Thoothukudi

[4]Assistant Professor, Directorate of Incubation and Vocational Training in Fisheries

Pulicat region is a motorized fishing sector and has two parts such as Pulicat Lake and Pulicat coastal. Adappu valai, Sutthu valai, Baadi valai, Kallu valai, Siru valai, Nandu valai, Konda valai, and Nandu katcha are some of the traditional fishing techniques used in Pulicat Lake. The Pulicat coast also has got different major fishing gears namely Pannu valai, surukku valai, Yeppo valai, Kola valai, Thoondil, Navarai valai, Set valai and Vanjaram valai. As they use powered fishing boats, it uses a significant amount of fuel and releases CO2 into the environment. For the study period of June 2021 to May 2022, the total fuel consumption level by all traditional fishing gears in Pulicat Lake and Pulicat coast was 148515 litres and 1650429 litres, respectively. For the study period, the total carbon emissions from the Pulicat Lake and coast fishing methods were 390594.55 kg and 4340628.27 kg, respectively. According to estimates, fishing in Pulicat Lake and along the coast resulted in emissions of 0.31 tonnes of CO2 and 1.37 tonnes of CO2 for every tonne of fish caught, respectively. When compared to fishing techniques on the Pulicat coast, the traditional fishing methods in the Pulicat Lake emit a very little quantity of CO2. This might be as a result of the little energy required for fishing in Pulicat Lake's tranquil environment and simple capture techniques. Additionally, it was discovered that throughout the study period, the entire motorised fishing sector of the Pulicat region used 0.401 litres and produced 1 kg of fish while emitting 1.06 kg of CO2.

Environmental profiling and life cycle impact assessment on Trawler operated in Thoothukudi, southeast coast of India

Kumarakannan Asokan[1], Pradeep Ramesh[2], Ayesha Jasmin[2], Mohammad Tanveer[2], Paras Nath Jha[3], Ravikumar Thangaraji[4]

[1]Department of Fishing Technology, Faculty of Fisheries Science, Kerala University of Fisheries and Ocean Studies, Panangad, Cochin-682506, India. kumarakannan.a@gmail.com

[2]Department of Aquaculture Engineering, College of Fisheries Engineering, Tamil Nadu Dr. J. Jayalalithaa Fisheries University, Nagapattinam-611001, India.

[3]Fishing Technology Division, ICAR-Central Institute of Fisheries Technology, CIFT road Matsyapuri, Willingdon Island, Cochin-682029, India.

[4]Department of Fishing Technology and Fisheries Engineering, Fisheries College and Research Institute, Tamil Nadu Dr. J. Jayalalithaa Fisheries University, Thoothukudi-628008, India.

The present study focused on establishing the environmental risk associated due to trawl fisheries in particular. The necessary inventory analysis was carried out for the computation of life cycle impact assessment. The case study was considered at the location in Thoothukudi region, Tamil Nadu, India. The steel hulled trawler with the length (LOA) of 21.3 m were considered to obtain necessary inventory values. The popular LCA software namely SimaPro was used for this study. The results presented the end point indicators contribution by the operation of a large trawler going for single-day fishing trip. The study also presented the GHG emission accounted due to usage of trawl fisheries, and comparison with culture fisheries emission values available through literature as special focus. The last part of the

study discussed and suggested the possible mitigation measures to be executed through policy approach from government side in order to reduce environmental impacts. The study also provides the detailed view on different aspects of trawl fishing activity as environmental profiling.

Theme: Gear Design

Simulation of fluid flow across fishing nets for studying the impact of trawling near the seabed

Sarath-Krishnan Karumathil[1] and Finbarr G O'Neill[2]

[1]*Universidade da Coruña, Campus Industrial de Ferrol, Laboratory of Me-chanical Engineering, Ferrol, 15403, A Coruña, Spain, sarath.karumathil@udc.es*

[2]*DTU Aqua, Technical University of Denmark, 9850 Hirtshals, Denmark*

Bottom trawling is a globally used fishing technique where fishing gears are trawled close to or on the seabed to capture species which are located there. This fishing technique often results in large amounts of by-catch, poor fuel efficiency and negative impact on the seabed. Improving the selectivity of bottom trawling and reducing its effect on biodiversity is an area of research that needs more attention. This study presents a computational simulation of the flow through and around netting panels using a porous media model in order to understand some of the basic processes associated with bottom trawling.

Computational simulation of fishing nets is extremely useful in research and development in the fishing industry. Sea trials are costly and time-consuming and computational simulations can give a better idea of where to focus research before doing sea trials. The movement of a fishing net in water is a fluid-structure interaction problem and the fluid part of the problem, in general, is very computationally expensive and almost unachievable even with supercomputers when simulated in the real scale. In this study, to efficiently simulate the problem a porous media model is used, where fishing nets are modelled as surfaces and the cells close to them were selected to apply the hydrodynamic resistance offered by the fishing net.

This approach is used to understand the effect of netting being towed close to the seabed. Multiple simulations of a rigid netting panel are carried out where parameters like the distance from the seabed, the angle the panel makes with the seabed, and the length and porosity of the netting panel were varied. The wall shear stress on the seabed and the hydrodynamic forces on the netting panel are calculated, and in particular, the shear stresses are compared to the critical values for mobilizing sediments of different grain size. The results demonstrate that across a range of normal operating conditions, that the turbulence around netting panels will mobilize sediments from fine silt to coarse sands.

SimuNet - Numerical modelling of fishing gear

Karsten Breddermann[1], Uwe Lichtenstein[2], Daniel Stepputtis[2], Daniel Priour[3]

[1]*University of Rostock, Ocean Engineering, Albert-Einstein-Str. 2, Rostock, 18059, Germany, karsten.breddermann@uni-rostock.de*

[2]*Thuenen Institute of Baltic Sea Fisheries, Alter Hafen Süd 2, 18069 Rostock, Germany, uwe.lichtenstein@thuenen.de, daniel.stepputtis@thuenen.de*

[3]*Ifremer, LCSM, BP70, Plouzane, 29280, France, Daniel.Priour@ifremer.fr*

Fish behaviour in fishing gear is poorly understood. One reason is that the stimuli the fish is exposed to are hardly known. Next to visual light and acoustic sources, especially fluid flow velocities, pressure changes and turbulence fields are believed to play a major role in the fish's reaction to its surrounding.

Measurements of the triggering stimuli is a task nearly impossible to achieve in field tests and requiring a lot of time on a laboratory scale.

A simulation tool that enables viscous flow dynamics simulations and is coupled with another that predicts the shape of the fishing gear can enable the gathering of information on flow, pressure, and turbulence fields. This information could be used to link the fish behaviour to its triggering stimuli. The overall goal of the ongoing SimuNet research project is to create such a simulation tool. The current status, applications and weak points will be presented and discussed here.

Introducing RightFish – a BlueBio CoFund project to reduce environmental impact and greenhouse gas emissions in commercial fisheries

Finbarr G. O'Neill[1], Tiago Veiga-Malta[1], Jens Peter Kofoed[2], Ingunn Marie Holmen[2], Eduardo Grimaldo[2], Sepideh Jafarzadeh[2], Hanne Hjelle Hatlebrekke[2], Emilio Notti[3], Massimiliano Pinat[3], Antonello Sala[3], Einar Skaftason[4]

[1]DTU Aqua, National Institute of Aquatic Resources, North Sea Science Park, Hirtshals, Denmark, barone@aqua.dtu.dk

[2]SINTEF Ocean, Norway

[3]IRBIM-CNR, Largo Fiera della Pesca, 2, 60125 Ancona AN, Italy

[4]Hampiðjan, Skarfagörðum 4, 104 Reykjavík, Iceland

Here we present an overview of RightFish: a new project that is funded under the EU BlueBio Cofund. The BlueBio Cofund supports projects that promote the Blue Bioeconomy, and RightFish contributes to this by developing methodologies to design demersal fishing gears of reduced environmental impact and reduced carbon emissions.

In particular, RightFish will establish criteria for small scale modelling in the Flume Tank that incorporate the contact forces associated with fishing gears being towed over the seabed. Then it will apply these approaches in two case studies, which characterize European demersal trawl fisheries: a single trawl whitefish fishery and a twin trawl Nephrops fishery. and demonstrate the environmental and economic benefits that can be achieved. These gears will be more fuel-efficient, disturb fewer carbon-rich sediments and penetrate less into the seabed. Accordingly, they will ensure that marine resources are managed and harvested in a sustainable way that maintains ecosystem integrity and resilience and reduces greenhouse gas emissions.

Experimental and numerical investigation of hydrodynamics around towed fishing gear to develop selective fishing methods in a sea star fishery

Karen B. Burgaard[1], Stefan Carstensen[2], David R. Fuhrman[2], Finbarr G. O'Neill[1]

[1]DTU Aqua, Technical University of Denmark, barone@aqua.dtu.dk

[2]Department of Civil and Mechanical Engineering, Technical University of Denmark

Towed fishing gears are responsible for a large proportion of global landed catch. However, little is known about the hydrodynamics around these gears, even though it is likely to have a large impact on both catch efficiency, selectivity and impact on the seabed.

An experimental investigation has been carried out in a current flume within the DTU Department of Civil and Mechanical Engineering Hydraulics Laboratory, measuring flow velocities with LDV around a model of the groundgear of a standard fishing gear. The experimental data is used to validate a Reynolds Averaged Navier-Stokes computational fluid dynamics (CFD) model in OpenFOAM using the Wilcox 2006 k-ω turbulence model.

The CFD model is used to improve the sea star fisheries in Limfjorden, Denmark, where they are fished to remove them from mussel beds and for processing into protein powder. The density and settling velocity of starfish have been measured and the results from the CFD model are combined with a particle path model to provide an initial estimate of how the hydrodynamics around the beam affects the sea star dynamics and their catchability in the trawl. Sea trials have been conducted and the results are compared with the simulations of the particle path model.

Nano silicon dioxide incorporated epoxy polymers: Effective solution against lead pollution from fishing gear sinkers

Shifa Jalal[1], Vrinda KR[1], P Muhamed Ashraf[1], Remesan MP[1]

[1]*ICAR Central Institute of Fisheries Technology, ashrafp2008@gmail.com*

Lead based sinkers were extensively employed in fishing operations like trawling, gill netting, purse seining, etc due to its easy availability, cheaper, ease of production, casting, chemical inertness (resistance to corrosion), and density. Its use banned in developed countries but lead sinkers were natural choice among fishers. Fishermen confronted with an issue of leaching and degradation of lead sinkers, thereby losing the efficiency of sinkers. Lead contamination in aquatic environments due to commercial and recreational fishing activities mainly by loss of sinkers, abrasion during fishing gear operations. Present study aimed to provide a nano silicon dioxide reinforced epoxy coating over the lead, and to evaluate its impact on corrosion and physicochemical characteristics. Lead underwent corrosion in seawater and 3.5% NaCl was 0.009 and 0.006 mpy respectively. Reinforcement of SiO2 was confirmed by UV-Vis spectroscopy and FTIR, and the SiO2 was interacted with benzene moiety of the bisphenol A epoxy resin. The SiO2 – epoxy resin exhibited smoother surface with less pore compared to control. Electrochemical evaluation (linear sweep voltammetry and electrochemical impedance spectroscopy) showed 0.5% SiO2 reinforcement in epoxy resin is optimum for enhanced corrosion inhibition. Abrasion test and sinking characteristics of the SiO2 reinforced epoxy coated lead sinkers showed about 50% more efficient in abrasion and comparable sinking speed

Durability studies of ring seine (mini purse seine) gear used along the Kerala coast, India

Dhiju Das P.H.[1], Rithin Joseph[1], Saly N. Thomas[1], Leela Edwin[1]

[1]*Fishing Technology Division, ICAR-Central Institute of Fisheries Technology, Cochin – 682 029, Kerala, India, dhijudas@gmail.com*

Among the various fishing gears employed for pelagic schooling fishes along the Kerala coast, ring seines are the most efficient. Polyamide webbing is generally used for ring seine gear construction. One of the main problems encountered by ring seine fishers is the huge expenses incurred for the periodic replacement and repair of polyamide webbings. To figure out the webbing durability related problems faced by the ring seine fishers, an 18-month durability study of ring seine polyamide webbing of 210Dx2x3 with 20mm mesh size was conducted in natural weather conditions and in simulated lab conditions with accelerated weathering equipment. Apart from this, webbing strength studies were conducted in webbing samples collected from five different locations of the gear. The locations most

subjected to wear and tear were revealed that the strength reduction in ring seine is not uniform and it varied from part to part and the parameters causing deterioration are also different in different gear locations. To attain better service life of gear there is an urgent need of area specific improvisations and use of alternative materials with high strength, high abrasion resistance and high resistance to UV radiation. A model design is suggested using high strength materials like Ultra-High Molecular Weight Polyethylene (UHMWPE), sapphire, bite resistant polyethylene, etc. this would also reduce the damage due to bite by cetaceans.

Side-scan sonar development of sweep modifications to facilitate early release of unwanted catches

Daragh Browne[1], Nicolas Chopin[1], Matthew McHugh[1], Shane Murphy[2], Cóilín Minto[2], Martin Oliver[1], Ronán Cosgrove[1]

[1]*Irish Sea Fisheries Board (BIM), New Docks, Galway, Ireland, daragh.browne@bim.ie*

[2]*Atlantic Technological University, Dublin Road, Galway, Ireland.*

Post release survival of unwanted catches is key if gear based technical measures are to achieve management objectives such as fish stock recovery. The Irish Sea whiting stock is below a critical level (Blim) and the majority of catches occur in the Nephrops trawl fishery. Gear based technical measures have been implemented and include codend mesh size, escape windows and sorting grids. Testing suggests these measures are not effective for small whiting (< 20 cm). Our aim was to develop a gear modification that prioritises early release of small whiting to optimise survival outcomes.

Using side-scan sonar to visualise candidate gear modifications we selected one that had potential to herd fish through an escape route between twin Nephrops trawls. We tested the gear modification against the standard gear and found that it was not successful in reducing catches of small whiting, likely due to their reduced swimming ability and herding response. Trial results also suggest that the gear modification may retain more Nephrops while reducing catches of larger unwanted species such as skates and rays and lesser spotted dogfish. Further testing is needed to confirm these results.

Kiwi cod-end trials in the Dutch mixed demersal beam trawl fishery to improve fish quality and post capture survival of discarded unwanted bycatch

Pieke Molenaar[1]

[1]*Wageningen Marine Research, Haringkade 1, 1967 AB IJmuiden, The Netherlands, pieke.molenaar@wur.nl*

The Dutch demersal tickler chain beam trawl fishery targeting sole (*Solea Solea*) in the North Sea is known to catch substantial amounts of undersized plaice (*Pleuronectus platessa*). Post capture survival studies show that 14% of the discarded undersized plaice survive being caught and discarded. To improve discard survival and fish quality the Modular Harvest System (MHS) concept was customized for the beam trawl fishery, this modified MHS is further referred as the Kiwi cod-end. The concept replaces the traditional mesh tunnel and cod-end of the trawl net with membrane-based modules, comprised of a cone module, escape module and a lift bag. The cone module assures the shape of the other modules. The opening slits in the escape module were tailor made for sole selectivity. The lift bag is a completely closed off module collecting the fish. This module allows the captured fish to keep swimming in~2000 liters of water while hauled on board.

During two 4-day trials in July 2022 the performance of the kiwi cod-end with 62mm 'mesh' openings was compared with a regular 80mm mesh cod-end on a 24m commercial vessel equipped with two chain matrices beam trawls. The first tows were done to optimize the kiwi cod-end performance, with additional underwater video observations on several positions in the kiwi cod-end modules. Marketable catch composition and selectivity for sole and undersized plaice were compared between the regular mesh and kiwi cod-end. Additionally, a subsample of undersized place was assessed for post capture condition, this included external damage and reflex action mortality predictor (RAMP) scores that are an indicator for discards survival.

Although the kiwi cod-end did have slightly lower marketable sole catches, length distribution both sole and undersized place did not differ significantly. Direct mortality of undersized plaice after capture reduced from 25% in a conventional cod-end to 5% in the kiwi cod-end. RAMP scores and external damage scores significantly improved with undersized plaice caught in a kiwi cod-end, indicating a better survival after discarding. The fixated openings in the kiwi cod-end unexpectedly allowed for the escape of colonies of Bryozoa. This feature is of particular interest for commercial fisherman who are contemplating to take up the kiwi cod-end. Additional experiments in the first quarter of 2023 will focus on the application of the kiwi cod-end on larger beam trawlers.

Design and operational details of deep sea pelagic longlines by fishermen of Thoothoor, South-West coast of India

Dinesh Kumar Esakkimuthu[1], Neethiselvan Neethirajan[1], Thangaraji Ravikumar[1], Durairaja Ramulu[1]

[1]Tamilnadu Dr. J. Jayalalithaa Fisheries University, FCRI, Thoothukudi, edineshramukedk@gmail.com

The present study was carried out to analyse the design and operational status of deep sea longlines operated by the fishermen of Thoothoor fishing village complex from the Thengapattinam fishing harbour (Lat 770 15' E and Long 80 23' N) of Kanyakumari district. Among 800 registered deep-sea fishing vessels of Thoothoor fishing village complex of Kanyakumari district which operated from Thengapattinam fishing harbour as base, 100 were found to be Exclusive Longliners (EL) and the remaining 700 vessels were Gill Netter Cum Longliners (GNCL). Four types of longline gears viz., Longline A targeting Sharks, Longline B targeting Yellowfin tuna, Longline C and Longline D targeting Groupers and Snappers respectively were recorded. The gear composition of GNCL and EL also differed notably with the combination of different types of longline gears. The Longline A and B were mainly used by EL while Longline C and Longline D were mainly used by GNCL and only few by EL. There was notable difference in the design features of different types of longline gears. All the longlines were found devoid of swivel in their design. Further, the branch lines of Long line A and Longline C had snood wire while Longline B and Longline D did not have snood wire in their design Hook sizes i.e. hook No. 1, 0 and 00 were found used In Longline A and B, while in Longline C and D, hook No. 4, 5, 6, 7 and 8 were found used. Live flying fishes were found used as baits in Longline A and B and Lesser sardines were used as baits in Longline C and D. Usage of separate longline with Hook No. 14 and 15 was found used to catch bait fishes in Longline A and B. Average duration of fishing voyage ranged from 24 to 30 days. The fishing grounds of Longline A and B were between 7° to 20° N and 60° to 72° E whereas, fishing ground of Longline C and D were between 7° to 20° N and 65° to 74° E and the peak fishing season was found to be from March to May. The study suggested to incorporate a line hauler in the operation system of longline both from GNCL and EL and discuss about various design improvements required for the upgradation of the longline gears to improve the hooking rate.

Bottom set, yet floating pontoon traps for multispecies fishery

Peter Ljungberg[1], Mikael Lundin[1], Stefan Eiler[1], Lars Hillström[1]

[1]*Swedish University of Agricultural Sciences, Institute of Coastal Research, 75007 Uppsala, peter.ljungberg@slu.se*

Swedish coastal fisheries are severely affected by the steady increasing seal populations. In addition, the EU's landing obligation makes coastal fisheries even more complex due to their simultaneous targeting of multiple species. A stronger focus on the advancement of both selective and seal-safe gear is therefore of great importance to sustain coastal fisheries. In Sweden, more than 300 pontoon traps are used in the salmon (*Salmo salar*) and whitefish (*Coregonus lavaretus*) fisheries.

The advantage of the pontoon trap is undisputed however struggles include its ability to catch also other target species. Here we show the development of bottom set, yet floating pontoon traps targeting perch (*Percha fluventalis*) and vendace (*Coregonus albula*). We include the evaluation of selection panel size and type on catch efficiency for the different species and put it in the perspective on potential implementation of the gear in Swedish coastal fisheries.

The FishScanner

Haraldur A. Einarsson[1]

[1]*Marine and Freshwater Research Institute, Fornubúðum 5, 202 Hafnarfjörður, Iceland, haraldur@hafogvatn.is*

Today, fishers have limited information about catch composition from the trawl in real-time when towing. Catching sensors give a rough indication of relative catch levels by detecting the expansion of the codend. A funded project in Iceland is developing a device providing the fishers with real-time information about the catch composition. It cooperates between the Marine and Freshwater Research Institute, StarOddi, and Hampiðjan. The device is called FishScanner. Using the FishScanner will give real-time information on the species composition with length distribution and the total volume of each species entering the codend. That is a significant improvement for science work and a commercial fishery with towed fishing gear. Information obtained from this device will change the intelligence from pelagic and bottom surveys. The obtained data will give a higher resolution on when and where the fish enter any sample trawl and allow sampling species and sizes composition without using a codend by simply having the trawl open behind the FishScanner to leave all sampled animals escaping at the sampling site. This technology can significantly affect commercial fishery. Fishers can use the information to optimise the towing time by knowing the catch composition in the trawl in real-time instead of after the trawl has been taken on board. A version of the FishScanner suiting better for the commercial fishery has been developed. In this presentation, the main parts of the device will be explained and briefly how it works.

Real-time detections of bycatch species in demersal trawl fisheries

Mette Svantemann Lyngby[1], Esther Savina[1], Fletcher Thompson[2], Ludvig Ahm Krag[1]

[1]*DTU Aqua, National Institute of Aquatic Resources, North Sea Science Park, Hirtshals, Denmark, msvly@aqua.dtu.dk*

[2]*DTU Aqua, Section for Oceans and Arctic, Kgs. Lyngby, Denmark*

Catches of unwanted species and sizes still challenge numerous demersal trawl fisheries despite extensive research devoted to developing more species and size selective fishing gears over the past decades. The balance between a fishing gear's selective performance for non-target species and the catch efficiency of target species is difficult to achieve in demersal mixed species trawl fisheries. This study aims to provide an information-based solution to efficiently inform and alert fishers of bycatch via automatic image processing and machine learning. We have developed automatic detection of bycatch species by training supervised machine learning models on underwater images from a real-time trawl camera. In detail, we use deep learning-based object detection methods that localize and classify the bycatch species in the video frames. To be able to estimate the bycatch item counts, we used object tracking methods to couple detections in consecutive video frames. We have thereby developed a bycatch notification tool that, in near real-time, informs the fisher how much, when, and where bycatch is being caught during the single trawl tow.

We have acquired in-trawl video data from the Nephrops (*Nephrops norvegicus*) directed demersal trawl fishery in Kattegat, where cod (*Gadus morhua*) numbers are critically low, to demonstrate a bycatch detector that can detect the presence of cod. The model's performance and perspectives of such real-time decision tools for fishers and managers are discussed.

Theme: General

A review of initiatives in India to lower bycatch and discard rates in trawling

Madhu V R[1]

[1]*ICAR-Central Institute of Fisheries Technology, Matsyapuri, W. Island, Cochin – 29, madhucift@gmail.com*

There has been considerable increase in the understanding of the negative aspects of trawling, in terms of impacts to the bottom integrity and generation of large quantities of non-targeted biota. Trawling contributes more than 55% of the total marine landings in India. Though the total number of trawlers has stagnated over the years, there is an increasing trend in the installed capacity of the trawlers in India. It is estimated that about 30-35% of the catch in the trawlers are constituted by low value bycatch, which predominantly consists of juveniles of commercially important species. The mechanism to reduce bycatch in the Indian trawl fisheries, had been regarding input restrictions, which includes seasonal closures during breeding season and regulations in codend mesh size. The output control is the minimum landing size (MLS) for species. However, in a mixed fishery, this is wrought with problems, due to multitude of species with different life strategies and determining a suitable mesh size in the fishery. To understand and to have more insight into this problem, a total of 29 publications were analyzed, which included works related to selection parameters for species and others that dealt with studies to reduce bycatch in trawls. The results show that the most widely researched and implemented input control is the square mesh codend, which has been adopted legally by five maritime states. The analysis revealed that use of square mesh codend alone, cannot be used as an input restriction, since even with the use of stipulated mesh size, the percentage of juveniles in the codend ranges from 20 to 40 percentage, which means that, a comparatively large mesh size would be required in codend, with significant revenue loss. Among the other technical measures, TED are mandatory, along with seasonal closure for trawling along the east coast of India, to reduce the interaction with breeding migration of olive ridleys. Other technologies, such as off-bottom trawling, that were evaluated to lessen bottom impacts are not widely adopted. It is also noticed that there has been a shift in the resources targeted by trawlers, from shrimp to fish, where vessels operate large sized fish trawls, mostly as pair trawls. The implications related to uncontrolled size of the trawlnets and shift in resources targeted, including areas for future research is discussed.

Fishing Gear Modification: A Solution To Achieve Ecosystem Objectives

Neha Kothari[1], Archana Mishra[1]

[1]*Govind Ballabh Pant University Of Agriculture And Technology Pantnagar 263145, Uttarakhand, India, nehakothari972003@gmail.com*

Fishing gear are devices used for fishing. There have been significant efforts in recent years to alter fishing techniques and equipment to more effectively target specific fish sizes and species as well as other marine animals while also minimizing the impact on habitat on the bottom. There are many different types of fishing gear devices that are made with various technologies and are operated in different ways. The methodology of the use of these gears, their effects on the water body and environment should be discussed. Concerns regarding the impact of non-sustainable fishing practices causing massive fish death have grown over the past few decades. Appropriate knowledge of development of gears instruments and practices that can reduce the impacts of Ghost fishing, otherwise they will reduce biodiversity. Discussion on future development of modern gear to achieve ecosystem

objectives might plays a crucial role in achieving sustainability. Modification in gear technology will eliminate all adverse effect completely.

Keywords: Gear, Habitat, Methodology, Ghost fishing, Sustainability.

Technological inputs for fisheries conservation and management in Kerala, India

Leela Edwin[1]

[1]*ICAR-Central Institute of Fisheries Technology, CIFT Road Matsyapuri, Willingdon Island, Kochi, Kerala, India 682029, leelaedwin@gmail.com*

Among the maritime states of India, Kerala was the first to enact the Kerala Marine Fisheries Regulation Act in 1980 to conserve and manage the marine fish resources sustainably to improve the livelihood of the fishers of the state. Currently, as per the constitution of India, fisheries within 12 nautical miles are under the administrative control of the states and area beyond 12 to 200 nautical miles under the control of the union government. Over the decades and through various notifications and a major amendment regulations have been brought out for effective management. The ICAR-Central Institute of Fisheries Technology has provided technologies/ advisories for sustainable exploitation of fishery resources in the territorial waters. This includes measures for reduction of bycatch/ juveniles by stipulatory measures like, use of CIFT-TED, square mesh for trawls, optimum mesh size for all types of fishing gears used, gear marking and registration, use of safety and navigational devices onboard, ensuring vessel and crew facilities as per international regulations, restricting of engine horsepower etc. ICAR-CIFT has also assessed the environmental impact of various fishing systems currently in use in the state. Co-management was first time introduced in the country by the Department of Fisheries, Kerala state through the establishment of Fisheries Management Councils (FMCs) at the village, district and state levels. The monitoring control and surveillance system envisaged by the state and steps to create awareness regarding all management measures is however weakly implemented due to various technical reasons. The department also lays emphasis on improvement fishermen education, studying impact of climate change and its mitigation strategies. This communication presents the major technological inputs for design and operation of fishing gear and vessels, use of appropriate materials for construction/ fabrication of fishing systems and their potential environmental impacts. These can be effectively implemented only through co-management measures where all stakeholders voluntarily participate.

Preserving the tradition: Fishing crafts of artisanal fisherfolks in Bay of Bengal

Swaminathan Jayaraj[1], Pandian Krishnan[1], Murugesan SriHari[1]

[1]*Bay of Bengal Programme Inter-Governmental Organisation, Chennai, India – 600 018, s.jayaraj@bobpigo.org*

Construction of traditional boats in the Bay of Bengal region dates back to Third millennium BC. In the region, traditional boats are constructed in many places with region-specific types of boats Kattamaran (Boat kattamarans and Raft kattamarans) is one of the major craft that dominate along the east coast of India, from Puri in Odisha and Kanyakumari in Tamil Nadu. These boats are used for near-shore fishery. Since the Kattamaran can easily penetrate breakers and avoid capsizing, it is best suited for the harsh conditions along the east coast of India. Fishermen consider that the nava, a traditional boat of Odisha, is suitable for the deep-sea fishery. The other popular traditional fishing crafts along the Indian coast are masula boats, dingies and dhonies. The traditional boats of Bangladesh are either plank-built or dug out. Chandi, plank-built boat is one of the most widely used traditional fishing boats in Bangladesh and gill net is operated from these boats. Traditional fishing boats in Thailand do not vary much in shape

and structure, and they are mostly used for fishing in the shallow waters and the surrounding mangrove forest. Sri Lanka's traditional crafts consist of dugouts with or without outriggers, log rafts and planked craft. They are mainly utilized for coastal and lagoon fishing. The teppams are widely used in the lagoons and backwaters for catching small fishes and juveniles. While, in Maldives masudhoni, vadhudhoni and bokkura are traditional crafts which are used for fishing. Several million small-scale fishermen in the Bay of Bengal fish with crafts that have seen little change from generation to generation. In recent days, due to modernization, most of the traditional crafts are motorized and the original traditional boats are getting replaced. Though fishing with traditional crafts is considered to be primitive and dangerous, it is necessary to preserve the crafts along with the traditional knowledge of the fishers.

The Fisheries of Uganda. Current and future perspectives from an African Inland Fishery

Drake Ssempijja[1]

School for Marine Science and Technology, University of Massachusetts Dartmouth, 836 South Rodney French Boulevard, New Bedford MA 02744 USA, dssempijja@umassd.edu

Global inland fisheries resources are important for food security, nutrition, economic development and sustainable livelihoods development especially in the least developed and developing nations of Asia and Africa. FAO estimated the global catches in inland waters in 2020 at 11.5 million tonnes and remain at a historically high level. This has been attributed to improved reporting and assessment by the producing countries. Africa accounts for over 25 percent of this production, which represents an important source of income and food security, particularly in the case of landlocked and low-income countries like Uganda. However, a lot of the inland fisheries resources currently face existential threats from over exploitation, climate change, pollution and environmental degradation as well as poor management mainly because of limited human and financial resources to monitor and manage them. FAO's global threat map for inland fisheries indicates that 55 percent of inland fisheries are under moderate pressure and 17 percent under high pressure. Uganda is ranked the biggest producer from inland fisheries on the African continent producing an estimated 570,000 metric tonnes of fish accounting for 5percent of global inland capture production. This presentation provides background, challenges, emerging threats (ALDFG) and current and future perspectives from an African inland fishery with a case study of the Lake Victoria fishery of Uganda.

The beach seine ban / phase out in Mozambique - tasks, opportunity and challenges

Júlio Zitha[1]

[1]*Senior Navegation and Fisheries Technologist, SCDPA – MIMAIP/MZ, Mozambique, jzithamoz@gmail.com*

Mozambique has a territory of 799.380 km^2, on which 786.380 km^2 are land (+ 13 000 km^2 of territorial sea). It has a coastline of almost 2 700 km, the fourth largest in Africa and the exclusive economic zone (EEZ), which extends from the coast to 200 nautical miles (370 km) off the coast is large 572 000 km^2.

The total of fish Production is around 448.000 tons (2021) and the per capita of fish consumption is around 16kg / year. More than 90% of the fish production comes from artisanal fisheries. The main group of species are shallow water shrimp, demersal rock fish, deep water crustaceans (shrimp, lobster, crayfish), big and small pelagic, molluscs and other invertebrates. The industrial fleet is dominated by trawlers (vessels more than 24 m length) targeting shallow water shrimp and deep water crustaceans.

There is also an emerging longline fleet targeting tuna and tuna-like species. Semi-industrial fleet (vessels between 13m<LoA<24m) composed by trawlers and line fleet targeting bottom fish.

The artisanal fisheries are a multi-specie fishery using a variety of fishing gears and methods (beach seines, gillnets, purse seine, traps, line fish, harpoons and hand collectors targeting invertebrates). Beach seine is one of the most important fishing gear, considering the quantity of catches and number of labour employed. However, due to its impact on seabed, seaweeds and juveniles (most of the beach seines uses mesh sizes less than 1 inches) the Government adopted a Decree, in October 2020, to phase-out the beach seine in 3 years and apply a total ban in 2023/2024. The decree states that a phase-out plan needs to be designed and implemented.

The plan includes the socio-economic impact of the beach seine ban, a technological proposed alternative of using other fishing gears and methods, and the challenges and opportunities arising from this measure. For the ICES-FAO WGFTFB annual, this presentation is an opportunity for Mozambique to exchange ideas and experiences on similar initiatives worldwide.

Dissension on modern fishing technology: the bizarre saga of Blue Revolution in Sri Lanka

K.H.K.L.Piyasiri[1], Oscar Amarasinghe[2]

[1]*Sri Lanka Forum for Small Scale Fisheries, kaumi.khklpiyasiri@gmail.com*

[2]*Ocean University of Sri Lanka*

Introduction of outboard motors to motorize the traditional crafts, introduction of new mechanised crafts along with new fishing catching technology using nylon nets and hooked lines, in early 1960's, mark the onset of the Blue Revolution in Sri Lanka. The revolution led to a movement of fishing loci away from the coast and fishers started exploiting the offshore waters. Fish Production increased at a very fast pace, reaching 530,000 tons by 2017 from 25,000 MT in 1950, while fishing incomes were on the rise unremittingly. However, this growth was also accompanied by heavy fishing pressure on coastal waters, pervasive use of destructive gear, declining catch per boat for small scale fishers, and more recently the fuel crisis preventing many crafts from fishing. This study aimed at examining the process of blue revolution in Sri Lanka, to find reasons for the above situation and to propose a road map for securing a sustainable fisheries sector, based on secondary information which consisted of both published articles, statistical reports and grey literature. Evidently, the blue revolution has led to significant increases in fish production and fishing incomes, by means of year-round fishing, exploiting previously unexploited resources, using modern fishing methods, etc. The process was facilitated by state sponsored credit and subsidy schemes which were channeled through fisheries cooperatives allowing the asset poor to have access to the new technology. Nevertheless, due to governance and management failures, the process also led to increased fishing pressure on resources and the use of environmentally unfriendly gear which were considered destructive. Moreover, some studies have shown that the tendency towards constructing longer multiday crafts would lead to declining net returns making the technology non-viable. Recent energy crisis has made things worse for all. Small scale fishers suffer from lack of kerosene for their outboard motors, increased cost of production and declining incomes, while the offshore sector suffered from rising fuel prices and falling supplies. In conclusion, we propose a road map which aims at redressing the current situation and moving towards securing a sustainable fisheries sector. The major propositions include, establishment of a regulatory authority for regulating technological change, further research on profitability of craft operations, strictly enforcing law against destructive fishing, shifting fishing effort towards less exploited resources and alterative livelihoods, and establishing an expert panel to probe into the issue of improving fuel use efficiency in fishing crafts and to seek alternative sources of energy for propulsion.

An update on the gear characteristics of trawls operated off the Karnataka Coast, eastern Arabian Sea

Geetha Sasikumar[1], Prathibha Rohit[1], V. R. Madhu[2], Divya Viswambharan[1]

[1]*ICAR-Central Marine Fisheries Research Institute, Mangalore Regional Centre, P.B. 244, Hoige Bazar Mangalore-575 001, geetha.sasikumar@icar.gov.in*

[2]*ICAR-Central Institute of Fisheries Technology, Matsyapuri, Kochi- 682 029*

Trawling accounts for nearly 70% (2021) of marine fish landings along the Karnataka Coast. Trawls have evolved in response to technological advancements in the fishing industry and over the years, there has been a noticeable change in the size as well as the designs of trawls used by the trawl fleet. In Karnataka, records of basic vessel attributes and gear types are accessible through the state machinery, but accurate information regarding gear characteristics is lacking. This study outlines the trawl gear characteristics in the mechanized fishing sector of Karnataka. The gear information has been collected by interviews during field visits to the fishing harbours; interviews with the fishermen onboard vessels and from net fabricators. Information on the trawl characteristics, target species, vessel horsepower, trawling technique, and depth were all recorded. The mechanized trawling fleet in the state of Karnataka includes boats ranging from small vessels undertaking daily fishing in the nearshore waters (<9.75 m LOA) to medium-sized vessels that range in size from 9.75 to 15.0m LOA. There has been a progression toward larger and better-equipped trawlers over time, but with the increase in the LOA limit, the trend towards larger vessels (up to 23.78m) has been accelerated. These trawlers have a steel body and are powered by engines with more than 350 hp. The earlier smaller trawl nets, typical of the industry since the commencement of trawl fishing in the region, have evolved into larger gears as the vertical height and length of the net have increased. In contrast to the bottom trawling, the mesh size of the fore part of the presently operated trawls has increased several folds, to reduce drag for semi-pelagic operations. The fishing capacity of the vessels has increased due to the introduction of powerful engines, more robust winches, and improved fishing gear designs.

Innovative technological interventions in harvesting methods for minimizing the impact of fishing on fish quality and post-harvest losses

Sarasan Sabu[1]

[1]*School of Industrial Fisheries, Cochin University of Science and Technology (CUSAT), Cochin, Kerala, India, PIN-682016 Email: sabuif@cusat.ac.in*

The freshness of fish and nutritional quality has to be at their finest right from the first stage of the value chain, as the quality lessened in this phase cannot be enhanced at a later stage. Fishing gears have multiple impacts on the quality and freshness of fish. The fish-catching method should be as gentle as possible, and the mortality must not be high during capture. Studies pointed out that soaking times for various fishing gears vary, and fishes suffer stress when crowded in the fishing net. The longer the soaking time, the lower the quality of the fish. The fish caught using trawl nets are more exhausted and have little or no reserve energy than those caught from purse seining. Gill net is one of the most popular environmentally safe fishing gears, resulting in poor quality catch due to the prolonged struggle of fish under the water and extended soaking time. Hand line, jigging, traps, and pole and line fishing are comparatively better fishing methods for the quality of fish harvested. Gaffing injuries in long lines; bruises, scale loss, and discoloration in trawl-caught fish; skin loss, and piercing of net into the body of fish in gill nets are some of the significant quality concerns that need to be addressed. Fishers must be imparted the technical skills to handle the fish according to the fishing method and apt on-board fish preservation techniques to extend the freshness and storage life of fish and minimize fish spoilage and

post-harvest loss. Technological interventions to address these concerns include developing and popularizing: (i) innovative fish harvesting technologies with minimum fish struggle; (ii) fishing gear materials and implements generating the least damage to the fish body; (iii) bycatch reduction and catch sorting devices; and (iv) species-specific on-board fish handling techniques. Minimizing the adverse effects of fishing through the proposed technological interventions shall ensure superior catch quality, better returns for the fishers, and a reduction in post-harvest fish losses, thus leading to food safety and food security.

Understanding the research needs of pelagic fisheries using a research prioritisation exercise

Hannah Fennell[1], Michel Kaiser[1], Eric Gilman[2]

[1]*Lyell Centre, Heriot Watt University, Riccarton, Edinbugh, Scotland, UK* hf4@hw.ac.uk

[2]*Hawai'i Pacifc University, Honolulu, Hawaii, USA*

On the 23rd April 2020, a sub-group of WGFTFB met virtually and discussed the need to identify priority research questions related to the mitigation and by-catch of endangered, threatened and protected species in pelagic fisheries that could be addressed through meta-synthesis approaches. The goal of the work was to ensure the research conducted by the subgroup met the needs of industry, decision-makers, and conservationists and identified shared research priorities between these stakeholder groups. An online questionnaire was circulated to members of the working group, who were asked to circulate it among their professional networks. Participants were asked to provide up to ten knowledge-needs that they feel should be a research priority and would be answerable within a three- to five-year period. An expert working group then met to discuss the submissions and identify whether they were suitable for a meta-analytical approach. The remaining knowledge needs were then grouped thematically, before a final prioritisation occurred using input from a wider stakeholder group. Priorities that were identified across stakeholder groups included knowledge needs about bycatch, bycatch avoidance, and fisheries monitoring.

Assessment of stocks to understand trends of data-poor marine capture fisheries of Bangladesh

Mohammed Shahidul Alam[1], Qun Liu[2]

[1]*Department of Fisheries, University of Chittagong, Chattogram-4331, Bangladesh,* alamms@cu.ac.bd

[2]*College of Fisheries, Ocean University of China, Qingdao-266003, China,* qunliu@ouc.edu.cn

According to the Yearbook of Fisheries Statistic of Bangladesh, the marine capture fisheries of Bangladesh are expanding in terms of total landings. This, however, is not the complete picture. While total landings are increasing, the proportion of high-value fish and shrimp species in this landing is declining alarmingly, with low-value fish and shrimp species taking their place. Therefore, immediate management measures are necessary to prevent further deterioration and rebuild the stock's biomass of those high-value species. Scientific information based on reliable stock assessments is urgently required to formulate effective management measures. However, given the data-poor condition, scientific information is lacking, and management frequently fails to take necessary steps. As a result, these fisheries exploit resources without an adequate management plan. Again, assessing all fish's stock is impractical given the limited resources. Therefore, this study selected twelve common and high-value fish and shrimp species as indicators for evaluating their stock status to understand the fisheries' current

trends and provide policymakers with scientific information. The stock health of eight fish species (*Tenualosa ilisha, Harpadon nehereus, Bregmaceros mcclellandi, Escualosa thoracata, Ilisha filigera, Johnius belangerii, and Coilia dussumieri*) was assessed using length-based methods. The stock status of four high-value fish and shrimp species (*Pampus argenteus, Pampus chinensis, Penaeus monodon, and Metapenaeus monoceros*) were assessed using catch-based methods. Results revealed the depleted stock biomass of eleven of the twelve species. Existing management measures are also found to be ineffective in preventing the biomass depletion of the species. Based on the findings and lessons learned from previous studies, this study concluded with viable recommendations on lower length limits, total allowable catch limit (TAC) for all species of interest, and a focus on reforming current rules and regulations for sustainable marine capture fisheries in Bangladesh.

Deep-sea Ichthyofaunal Assemblages in South-Eastern Arabian Sea (SEAS) Through a Combination of Conventional Taxonomy and eDNA Meta-barcoding

Mujeeb Rahiman. K.M[1], M. Harikrishnan[1]

[1]*School of Industrial Fisheries, Cochin University of Science and Technology, Cochin- 682016, Kerala, India, rkmmujeeb@gmail.com*

In India, exploration of deep-sea resources is important for increased fish production as the catches from pelagic and demersal fisheries becoming unsustainable. Continuous and comprehensive studies are to be conducted for a proper understanding of deep-sea resources and their status in the Indian EEZ and beyond. The data regarding the deep sea fishes beyond 1000m depth are scarce and the information generated from the previous studies is not sufficient to understand the diversity and the identity of the deep-sea resources beyond 1000m depth. Considering the importance of Ocean sciences for sustainable development of the country, the Ministry of Earth Science, Govt. of India has recently launched Deep Ocean Mission which aimed at developing technologies to explore deep ocean for resources and their sustainable use, growing the country's marine and maritime economy. One of the focusing areas of this deep ocean mission is the screening of Deep- Sea metagenomic libraries by constructing deep- sea metagenome clone libraries and development of process to screen large scale metagenome libraries. The project idea discuss the ichthyofaunal diversity inhabiting the South Eastern Arabian Sea (SEAS) beyond 1000m depth by undertaking morphological and molecular taxonomy of deep sea fishes of fishery exploitation potential. The project will throw light on the conservation and ecological consideration of the deep-sea ichthyofauna and the result will be used as a basic data for future plans related to deep ocean mission and deep ocean fishing.

Exploitation status of Ochre-banded goatfish *Upeneus sundaicus* (Bleeker, 1855) fishery from Tamil Nadu, India waters using surplus production models.

Sajeevan M. K[1], Abinaya. R.[1]

[1]*Department of Fisheries Resource Management, Kerala University of Fisheries and Ocean Studies, Kochi, 682506, Kerala, India, sajeevanfsi@gmail.com*

In light of the dramatic increase in marine fish production of Tamil Nadu, it is important to analyze the fishery status of major economically important fish species in order to determine their long-term sustainability. The purpose of this study is to assess the sustainability of the Ochrebanded goatfish *Upeneus sundaicus* (Bleeker, 1855) fishery and estimate its current status in Tamil Nadu maritime waters when data is limited. Historical catch and effort of the Ochrebanded goatfish in Tamil Nadu marine water from 2001 to 2020 were reconstructed and analysed using fishery specific stock

assessment tools Catch and Effort Data Analysis (CEDA), Catch-Maximum Sustainable Yield (C-MSY), and the Bayesian Schaefer production model (BSM). The best-fitting model was chosen from the CEDA results to investigate the biological reference points (BRPs) of maximum sustainable yield (MSY), biomass yield MSY (BMSY), and fishing mortality yield MSY (FMSY). By correlating the BRP results from both cases and taking B/BMSY and F/FMSY into account, it is clear that the Ochrebanded goatfish fishery resource has reached an optimally exploited stage and that an additional fishing fleet is not recommended for this fishery. As a result, it is suggested that the fishing effort for this fishery be maintained at its current level, without any additional development, and that timely action, such as proper forecasting and legislative implementation, be taken to ensure their long-term exploitation.

Exploitation status of marine fishery resources of Tamil Nadu, India waters using a surplus production modelling approach.

Abinaya R[1], Sajeevan MK[1]

[1]*Department of Fisheries Resource Management, Kerala University of Fisheries and Ocean Studies, Kochi, 682506, Kerala, India, abinayabfsc@gmail.com , sajeevanfsi@gmail.com*

Surplus production models can be performed in any stock assessment framework that incorporates catch and effort data. To determine the marine fishery status of Tamil Nadu, annual catch and effort data from 2001 to 2020 were reconstructed and analysed using the catch effort data analysis (CEDA) software. The average annual landings of Tamil Nadu marine stocks were 5.44 lakh tonnes, with the highest and lowest being 7.74 lakh tonnes in 2019 and 2.87 lakh tonnes in 2005, correspondingly. The estimated biological reference points such as maximum sustainable yield (MSY), biomass producing maximum sustainable yield (BMSY) and fishing mortality producing maximum sustainable yield (FMSY) with the best fit Schaefer- Log Normal using the initial proportion (IP) value of 0.5 were 5.32 lakh tonnes, 35. 3 lakh tonnes and 0.151, respectively. The result of the reference points indicated that the stocks are in a safe condition, and it is recommended that the current level of fishing be sustained to retain the stock at near optimal fishing pressure. Future stock biomass was forecasted by varying total allowable catch (TAC) and future effort levels and it was discovered that a TAC of 2.87 lakh tonnes and effort of 167 million horse power days will yield to stock biomass exceeding total biomass during the next decades.

Does shrimp trawling contribute to the decline of Sciaenid stocks?

N.M.S. Jayasekara[1], D.C.T. Dissanayake[1]

[1]*Department of Zoology, University of Sri Jayewardenepura, Gangodawila, Nugegoda, Sri Lanka; chamari@sjp.ac.lk*

Although trawling is widely used to exploit shrimp resources worldwide, it is considered a highly destructive fishing method due to its high by-catch and discards. By-catch levels in shrimp trawling are reported to be in the range of 5–10 times the target catch and consist mostly of fishes belonging to the families Carangidae, Mullidae, Gerridae, Nemipteridae, Leiognathidae, Sciaenidae, Dasayatidae, Siluridae, Lutjanidae, Cynoglossidae, and Sphyrenidae, especially in the subtropics and tropics. Thus, this study aims to assess the status of sciaenids landed by mechanized shrimp trawls, off Handala, Sri Lanka.

Shrimp and by-catch data and samples were collected at the Handala fish landing site (6°59'25.5"N 79°52'27.9"E) by making biweekly field visits from January 2021 to February 2022. On each sampling

day, 50–60% of trawlers operating in the shrimp fishery were randomly sampled, and by-catch samples (n = 3) of ~2 kg each were collected to identify the taxonomic status of sciaenids and their composition in the by-catch.

The size at first sexual maturity (L50) and population parameters of highly dominant species, *Otolithes ruber*, *Johnius belangerii*, *Johnius macropterus*, *Kathala axillaris* were also assessed. Of the estimated total annual by-catch of 25.55 Mt, 26% were from the family Scianidae. Fourteen Sciaenid species belonging to 8 genera including *Johnius (Johnieops) dussumieri*, which is a new record for Sri Lanka, were reported in this study. *Otolithes ruber* (27%) made the highest contribution followed by *K. axillaris* (21%), *J. belangerii* (15%), *J. macropterus* (15%), *J. borneensis* (10%), *J. dussumieri* (6%) and N. maculata (1%). The size at first sexual maturity of 4 dominant species was assessed and it was estimated that 18% of *O. ruber*, 1% of *J. macropterus* and *J. belangerii* and 2% of *K. axillaris* were caught before reaching first sexual maturity. Fishing mortality (F, yr-1) and exploitation rate (E) of these species were reported as 1.41, 1.30, 0.33, 1.84 and 0.74, 0.28, 0.51, 0.72, respectively. The high level of exploitation of this non-target sciaenid species by shrimp trawling appears to have some impact on this valuable fish resource, and further studies and immediate management measures are recommended.

Indian Marine Capture Fisheries- Gear and effort-oriented stock assessment approaches

Eldho Varghese[1], Jayasankar Jayaraman[1], Mini K.G.[1], Sindhu K. Augustine[1], Sijo Paul[1]

[1]*Indian Council of Agricultural Research- Central Marine Fisheries Research Institute, jjsankar@gmail.com*

The gears and their extent of utilization is the most unassuming commentary about any marine fishing paradigm. Indian marine capture fisheries scenario is replete with situations where the effort both in quality and quantity had decided the quantum of landings and thereby directly or indirectly moderated the whole set of dashboard components from sustainable fishing to optimal market efficiency. The overall dynamics of mechanized and motorized fishing efforts expended in the fifteen years period-2007-2021 has in it all that could make an analyst undergo an involuntary SWOT mode.

This paper focuses on the recent shots in arm received on the stock assessment front at more than one plane. One such plane is the gear and effort centred modeling of stock abundance. Though most of the famed biological reference points are built around the stock- subpopulation-population- species workflow, the situation in a multi-gear multi-resource fishery, where there is a very thin line between what is primarily targeted and what's next needs an approach that views the scenario through the gear advancement prism. Three candidate models which have the gear details both at generic as well as specific levels are being tried with the twenty years data so a to see their role in guiding the tracking of travails of the most common marine resources of India. A couple of indices that are based on the gear-combinations are also suggested to the intelligentsia for critical review. In a way this work aims at laying down a framework for practical Ecosystems Approach to Fishery Management for the fisheries that are in action in the subcontinent.

Review on marine fisheries management measures in South Asian countries

Murugesan SriHari[1], Pandian Krishnan[1], Rajdeep Mukherjee[1], Elayaperumal Vivekanandan[1]

[1]*Bay of Bengal Programme Inter-Governmental Organisation, Chennai, India – 600 018, sriharimurugesan94@gmail.com*

Marine fisheries in South Asian countries are small-scale in nature, but deploy a large number of boats and use low technology. Like other tropical fisheries, the countries have multi-species and multi-gear fisheries, with heavy dependence on natural fish resources for livelihood by a large fisher population. The major problems facing the fisheries in these countries are unsustainable fishing including overcapacity, depleting fish stocks, and conflicts within the sector and with other sectors. This review summarizes the management measures and regulatory enforcement practiced in four South Asian countries Bangladesh, India, Maldives and Sri Lanka with the objective of assessing the fisheries management performance towards sustainable fisheries. For the purpose of this review, legal documents such as Acts and Policies were retrieved from FAOLEX and websites of country-specific sources. Legal framework that plays an important role in regulating and managing the fisheries in the four countries focus primarily on input control measures such as fishing effort regulation/limitation, restrictions on gear including mesh size, zoning systems, Marine Protected Areas, and restrictions on seasons and time of fishing. The review shows that a few regulations in the region are not adequately designed and implemented, so they are less effective. Data collection on fish catch, fishing areas and distribution pattern on fish assemblages needs improvement. Issues related to regulation of overcapacity needs to be addressed in order to ensure long-term sustainability of fisheries. In addition, output control measures need to be introduced to complement input controls. As problems in managing marine fisheries are interconnected with other issues such as habitat degradation, pollution and climate change, the laws on management should have an expanded scope with ecosystem considerations and co-management as the fulcrum. As the four countries have close national boundaries and the fish resources are shared between the countries, sustainable conservation and management of shared fish stocks and other living marine resources needs to be ensured through regional cooperation. In conclusion, there is a strong need for policy reforms to meet Sustainable Development Goal (SDG) 14 of the 2030 Agenda for Sustainable Development.

Indian Marine Fisheries- inherently robust or intuitively buoyant?

E. M. Abdussamad[1], Jayasankar Jayaraman[1], Eldho Varghese[1], Somy Kuriakose[1], Ramachandran C.[1], Reshma Gills[1]

[1]*Indian Council of Agricultural Research- Central Marine Fisheries Research Institute, jjsankar@gmail.com*

In states (countries) where fishing is propelled by a workforce that is driven by traditional passion and urge of subsistence in major parts, the study of resource health would be quite dicey. The fishermen, whose creative genius is at its best in face of adversity, occupies the centre stage much before the pundits take a call. Thus, the EAFM and other fisher- ecosystem- resource kinds of approach do form the silent majority of the fishing nations as is evidenced by the reports of various RFMOs. Thus, any transparent and well-founded approach to categorize, analyse and predict a fishery would be heavily dependent on the dynamics of what the fisheries is made of from the fishermen point of view.

This work attempts to analyse the marine fish landing data pertaining to Indian mainland from 2012 to 2021 with a view to arrive at the easiest yet sturdy indicator of the health of common resources that are regularly exploited. With the sensitivity of fish stock status (FSS) approaches mooted by Froese et

al(2019) and the Kobe Plot based Overfished- Tending to overfish kind of quadrant based advisories going for a toss in face of certain sudden shifts in fishing patterns that could flummox the seasoned observer, wherein what is targeted turned into a bycatch overnight while that was incidental swaps roles, the kind of fisheries that are in exhibition in India and neighborhood needs to have an out of box way of looking at these falls or spikes in catch rates alongside the evolution of fishing methods. This study focusses on four such measures that help one arrive at the status of fishery health, especially its sustainability, while yielding additional sneak peeks onto the resource resilience and adaptability in short and medium terms. These measures used in tandem or individually are capable of explaining certain unique phenomenon as expressed in Indian marine fishing scenario, wherein stock depletion, rebuilding etc. are quite a complex narrative to set to fore. Thus, these indicators would well establish the undercurrent that marks up the quintessential inner robustness of the ecosystem coupled with the fleeting ingenuity of the fishermen who make the most of their liberty to adopt modes of fishing as much much as their intellectual choice-band. The work comes out with a couple of factors that are pivotal to scale, compare and rank fisheries that fall in this unique range of diverse resources and much more diversified fishing initiatives.

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Structural Breaks in Fishing Efforts in the Indian EEZ

Eldho Varghese[1], Jayasankar Jayaraman[1]

[1]*Central Marine Fisheries Research Institute, eldhoiasri@gmail.com*

Assessing the status of fish stock is of utmost importance in developing management strategies for the sustainable harvest of marine fishery resources. To make a reasonable assessment of the stocks, information on the fishing effort expended by various gears over the years is very pivotal. This information enables individual catch rates to be evaluated concerning fishing mortality and is commonly used as a basic input in fish stock assessment models. India is one among few countries where a system based on sampling theory is used to collect data pertaining to marine fish landings and fishing efforts and through stratified multistage random sampling design (SMRSD), the Central Marine Fisheries Research Institute (ICAR-CMFRI) estimates landings and fishing efforts each month for smaller non-overlapping geographical regions referred to as fishing zones, covering the entire coast. In this presentation, an attempt has been made to explore the changes in the fishing efforts expended by major fishing gear over the last few decades in the Indian EEZ.

Need for an action plan for stock validation, fishery management and efficient utilization of myctophid resources in India EEZ

P.M. Vipin[1], M.P. Remesan[2], V. R. Madhu[2], K. Pradeep[1], M.R. Boopendranath[2]

[1]*Central Institute of Fisheries Nautical and Engineering Training, Kochi - 682 016, India, cifnethq@yahoo.com*

[2]*ICAR-Central Institute of Fisheries Technology (CIFT), Cochin-29, India, aris.cift@gmail.com*

Mesopelagics are among the most abundant group of fishes which offers excellent scope for development of fisheries in Indian Ocean. Stock sizes of mesopelagic fishes, of which myctophids are predominant, has been estimated as 263 million t and 102 million t, in the Western Indian Ocean and Eastern Indian Ocean respectively. It is mainly used for the production of fish meal and oil and a small percentage is used directly for human consumption. Many of the mesopelagic fishes are known to have

high content of wax esters. However, myctophids have the potential to become a major source of fish protein, when efficient harvesting and appropriate processing and value addition technologies are evolved. Currently, commercial exploitation of world mesopelagic resources is minimal due to the unavailability of optimized resource specific harvesting technology and inexpensive processing technologies.

Though there has been no targeted fishery for myctophids in the eastern Arabian sea, they constituted a significant proportion of bycatch generated. This present paper is based on the work carried out under the project "Assessment of Myctophid Resources in the Arabian Sea and Development of Harvest and Post-harvest Technologies" as part of MoES, Govt. of India/CMLRE funded project. During the period of 2009-10 a total by-catch of deep-sea shrimp trawlers was estimated at 11,488 t, of which myctophid constituted about 32% (3676 t). Available estimates on abundance and the new information indicate that about 16 species of myctophids occur in Arabian Sea as per the present study, and if sustainably harvested with economically viable mid-water trawling and judiciously utilized, can form a significant source of fish protein and contribute to the nutritional security. While the present catch levels are sustainable, the stocks can become unsustainable when the fishery expands and intensifies in the future, particularly due to increasing demand from the fish meal industry unless a proper fishery management plan is adopted. Since this resource plays such a crucial role in the ecosystem, there is a need for better resource management and governance. Techniques for unlocking nutritional quality are also needed, as is the development of harvest technology that is biologically sustainable and socioeconomically viable for commercial use.

Mortality of sharks and other large pelagics in Indian tuna fisheries

Sijo P Varghese[1], Ayoob AE[1], Jacob Thomas[1], Sujit Kumar Pattnayak[1], Solly Solomon[1], R Jeyabaskaran[1]

[1]*Fishery Survey of India, fsikochi@yahoo.co.in*

The at-haul mortality of sharks and other large pelagics caught during the longline; gillnet; hook and line and pole and line fishery targeting tunas were studied for drawing inferences on the ecological risk of these fisheries and to estimate the survival of sharks, rays, bill fishes, tunas and tuna like fishes caught as bycatch in the tuna fishery of Indian seas. The data gathered during survey voyages of tuna longline vessels of Fishery Survey of India, the observations recorded onboard the pole and line fishing vessels during the tuna tagging exercise during the period 2005 - 2008 and the in-person interview of the fishermen involved in gillnet and hook and line fisheries were used for the present analysis. The study revealed that the thresher sharks (*Alopias spp*, 91 ± 5.2%), pelagic stingray (*Pteroplatytrygon violacea*, 96.2 ± 3.2%) and common dolphin fish (*Coryphaena hippurus*, 75.7 ± 12.5%) recorded minimum at - haul mortality while the sword fish (*Xiphias gladius*), skipjack tuna (*Katsuwonus pelamis*) and the long snouted lancet fish (*Alepisaurus ferox*) had maximum mortality in long line fishery. Maximum survival rate was observed in pole and line fishery (100%) followed by hook and line whereas in gillnet fishery the at-haul mortality rate was high irrespective of the species being caught. The study indicates that the type of hooks used (circle vs J hooks; barbed vs barbless), immersion time, the extent of time since the fish being hooked and the site of hooking had a significant role in the survival rate. Based on the observations and the factors influencing the mortality the study helps to get an idea on the post release survival rates as well.

Prospects and potential of artificial reefs in replenishing coastal and neritic fishery resources in India

Solly Solomon[1], Sijo P Varghese[1], Ayoob AE[1], Jacob Thomas[1], Sujit Kumar Pattnayak[1], R Jeyabaskaran[1]

[1]*Fishery Survey of India, fsikochi@yahoo.co.in*

The rich and diverse coastal and neritic waters are often put under immense anthropogenic pressure by fishing, navigation, tourism and wide extend of pollution by marine as well as terrigenous inputs. Though the fishing potential of India is estimated to be 5.31 million metric tonnes, the lion's share of fishing operations at present are concentrated just within the coastal waters. Reefs and rocky grounds act as natural shelter and breeding ground for various commercially important species. The global rise in temperature coupled along with ocean acidification alters the pace of calcareous deposition in the marine ecosystem and cause wide spread damage to the reefs and the reef associated/depended fishery resources. The increasing fishing pressure coupled with habitat degradation heighten the pace of fishery resource depletion. To tackle this decline in fishery resources and increasing unemployment, replenishing the nearshore waters with artificial reefs that restores the natural fishery resources is found to be an effective, eco-friendly and sustainable management program. In a country like India with multi-gear and multispecies fisheries along with widespread and active regional and international maritime activities the introduction of artificial reefs should be carried out after proper scientific studies so as to specifically identify the most suitable site which can be explored. This mini review will bring to limelight the various parameters that has to be the prime checkpoints in site selection for successful deployment of artificial reefs to augment fishery resources.

Addressing issues of fisheries bycatch in the Indian Seas on a conservation angle

Rekha J Nair[1], E. M. Abdussamad[1], A Gopalakrishnan[1]

[1]*ICAR -Central Marine Fisheries Research Institute, Kochi 682018, Kerala, rekhacmfri@gmail.com*

Bycatch is defined as the incidental take of undesirable size or age classes of the target species, or to the incidental take of other non-target species or protected, endangered, or threatened species (FAO, 2010). Bycatch can be sold, or it may be unusable or unwanted for a number of regulatory and economic reasons and therefore thrown back to sea (i.e., discarded), either alive with injuries or dead (Harrington et al. 2006, FAO, 2010). Bycatch and discards in trawl fishing is a serious issue that requires prompt interventions. Different management measures are being followed to mitigate this issue among the catch in the form of juveniles is harmful as it reduces future yield. As juvenile fish catching became rampant and started affecting the total catch, the government has brought out a list of minimum legal size for various species which was based on the recommendations of Central Marine Fisheries Research Institute.

Studies on Spiny cheek grouper, the main commercial grouper resource showed that in 2009-2010, individuals of this species landed in trawls ranged from 10-32 cm, and immature individuals constituted 74% of the catch and a further 26% were nearly mature (predominantly 1+ year class fish). In 2011-2012, immature individuals also dominated trawl landings (CMFRI 2011-2012). In the

Bycatch poses a significant threat to marine megafauna such as elasmobranchs comprising sharks, rays, skates and sawfish. Recent research suggests that with fishing effort increasing worldwide, there is a need to evaluate strategies intended to reduce marine megafauna bycatch. A concerted effort by the Government to ear mark fishing grounds from the areas of juvenile occurrence/spawning and breeding grounds of fishes may be a small step in the bycatch reduction process. The paper will evaluate recent trends and possible solutions

Studies on the distribution and abundance of yellowfin tuna, Thunnus albacares in the east coast of India using GIS

Babu Chelliah[1], Anntonet Daffodil Agilus[2], Anrose Antony Pillai[3], Jeyabaskaran R[4], Tiburtius Antony Pillai[5]

[1]*Central Institute of Fisheries Nautical and Engineering Training, Royapuram, Chennai, babufsi@gmail.com*

[2]*Anna University, Chennai , daffodilbabu@gmail.com*

[3]*Fishery Survey of India, Chennai , anrosefsi@gmail.com*

[4]*Fishery Survey of India, Mumbai,jbcmfri@gmail.com*

[5]*Fishery Survey of India, Chennai tibufsi@yahoo.co.in*

In this paper, an attempt has been made to map the Yellowfin Tuna *Thunnus albacares* using Quantum Geographical Information System (QGIS) based on the data collected from the survey cruises of the vessel Matsya Drushti during the period 2015-2019. The abundance of the species in the east coast of India is evident from the fact that the average catch rate obtained has been 71.54Kg/1000 hooks constituting 68.75% of the total monofilament long line catches. The area wise hooking rate in 1oNx 1oE indicates that highest hooking rate of 4.92% recorded in the area 14oN/84oE. The studies revealed that during October-December Yellowfin Tuna are abundant in east coast of India. The monthly variation in the catch shows that the December recorded the highest hooking rate of 0.83%. The potential Tuna fishing areas and seasonal abundance of Yellowfin Tuna in east coast of India are mapped using QGIS.

Keywords: GIS, Yellowfin Tuna, Longlining, Abundance

Implication of shifting spawning seasons on marine fisheries management: A case study from Gujarat

Shikha Rahangdale[1], Rajan Kumar[1], Abdul Azeez P.[1], Vinayakumar vase[1]

[1]*Central Marine Fisheries Research Institute, Kochi, Kerala-682018, India, shikharahangdalecife@gmail.com*

Temporal closure is one of the effective means of regulating and managing fisheries, especially in the tropical marine ecosystem. The Marine Fisheries Regulation Acts (MFRAs) enacted by maritime states of India empowers the state to declare temporal closure as a part of the marine fisheries management plan. At present, India has a uniform monsoon ban of two months along east and west coast of India. The ban is intended to provide a refuge for the spawners from fishing to ensure sufficient recruitment in the following fishing season. However, the climate change has been hypothesized to alter the spawning season of the fish stocks, making temporal management of fisheries an increasingly cumbersome task. A study was conducted at Gujarat to identify the peak spawning season of the major commercial fisheries resources, including finfishes and shellfishes. The identified peak season was compared with the previous reports from the NW coast of India to visualize any shift in the breeding season. For most of the selected species, the post-monsoon or winter season were identified as the peak spawning season. Interestingly, the direction of shift in breeding season was different for pelagic and benthic resources. A marginal shift of peak breeding season towards winter is observed in demersal predator species, whereas a shift towards post monsoon is observed in some of the pelagic and

crustacean resources. The study highlights the need to revisit the current temporal closure and its effectiveness towards ensuring sufficient recruitment for sustaining long-term harvest from the fishery.

Length-weight relationships of eight pelagic carnivore fishes by longlines of Gulf of Mannar, India

Kathavarayan Vasanth[1], Kalaiarasan Muthupandi[1], Vinayagamoorthy Naganandhini[1], Manoj Kumar[1], Amrutha Krishnan[1], Harsha[1], Kalidoss Radhakrishnan[1]

[1]*Kerala University of Fisheries and Ocean Science, kvasanthkvasanth29122@gmail.com*

The length-weight relationships were estimated for 8 pelagic carnivore species caught in the Gulf of Mannar, India using experimental longlines. The experimental study from January to October 2022 in fortnightly intervals, using longlines (3000 m for needlefish and 11,250 m for carangids) equipped with each 600 various "J" type fishing hooks (straight, reversed, kirbed). The hook sizes used were standard size numbers 8 and 11 were carangids and needlefish respectively. The longlines fabricated with polyamide monofilament line were operated from 1-2 m for needlefish and 20 to 25 m for carangids depth for 3 – 5 hours each time. Overall, 21,150 hooks were deployed in 24 fishing trials for each experimental longline. The total length and total weight of the combined sex group were recorded nearest to 0.1 cm and 0.01g, respectively. By using the logarithmic transformed data, linear regression analysis was performed to calculate a and b values for eight fish species to establish length-weight relationships. The parameters for the length-weight equations for three species are provided along with the respective coefficient of correlation and the 95% confidence intervals. A new maximum total length was recorded for four needlefish species, viz., for *Strongylura strongylura (80), Tylosurus choram (91), T. crocodiles (97), Ablennes hians (96), and carangids species Caranx bajad (60.5), Alectis indicus (62), C. ignoblis (69), S. commersoninaus (74).*

Artificial reefs in coastal systems - productivity power stations and new avenues for community-based fishery management and conservation frameworks

Joe K. Kizhakudan[1], Shoba Joe Kizhakudan[1], L. Remya[1], V. Seetharamacharyulu[1]

[1]*ICAR-CMFRI, MRS of CMFRI ,75 Santhomme High Road CHENNAI, TN India 600028, jkkizhakudan@gmail.com*

Since 2005, ICAR-CMFRI, through its Madras Regional Station, has carried out deployment of artificial reefs in nearly 150 sites in the coastal waters of Tamil Nadu on the south-east coast of India. Impact assessments on productivity, fisheries, market avenues and socio-economics of the fishing communities indicate positive upscaling from pre-deployment status. Areas where reefs have been deployed have evolved into good productivity zones, with distinct succession in faunal assemblage, which serves the dual purpose of resource enhancement and improved fisheries, especially for the artisanal sectors operating line gear.

Discernible patterns of change in the fauna reefs and surrounding habitats include diversity of resources with incoming migrant and foraging groups as well as frequent appearances of rare and vulnerable species. The populations and densities are enviably greater than the ones noticed on the adjacent natural reefs and obviously greater than the plains with no reefs. Samplings and observations on the reef fauna assemblages and cycles of occurrence and movements provide possible cues for the aggregation and settlement of biota. The patterns of zooplankton blooms coinciding with clear waters and migration of large numbers of whale sharks over the reef sites is a typical example. The concept of forage and shelter in reef sites holds good for several less-mobile groups, while large pelagic fishes move in to these locations to prey upon aggregations of smaller fishes and plankton that constitute their preferred diet.

Such behavioural patterns probably indicate the physical cues like the swarms of planktons glowing florescent in the new moon phases, and the possibility of the cumulative species-specific acoustic signature sounds travelling in water.

While fisheries management frameworks in India are directed towards judicious exploitation of target species with the primary goal of maximizing production through sustainable fisheries, artificial reef sites provide avenues to take these frameworks several strides further. Sustainable fishery management frameworks should ideally adopt an approach equally levelled at interlinked fish stocks, habitats, and livelihoods. All these are easily achieved in artificial reef areas, where the active participation of fishing communities strengthens implementable regimes and ensures success stories that stand as examples for habitat enhancement, resource enhancement, community involvement, sustainable fishing methods and conservation actions. Each artificial reef site can stand as independent functional units and at the same time contribute to the larger picture. If developed in the right perspective, artificial reef sites can very well progress towards becoming "other effective area-based conservation measures" (OECMs) in India's marine fisheries sector.

Technology and solutions to tackle illegal fishing across the Central and Western Indian Ocean regions

Dr Claire Collins[1,2], Professor Divya Karnad[3], Sneha Satheesh K[3], Abhishek Dudi[3], Lasuni Chathurima[4], Dr. Mohamed Shainee[5]

[1]*Institute of Zoology, Zoological Society of London, UK and Institute of Zoology, Zoological Society of London, Regent's Park, London NW1 4RY, UK, Claire.Collins@ioz.ac.uk*

[2]*Centre for Ecology and Conservation, College of Life and Environmental Sciences, University of Exeter, Penryn, Cornwall, TR10 9FE, UK*

[3]*Ashoka University, India*

[4]*Oceanswell, Sri Lanka*

[5]*Virginia Tech, Blacksburg, VA 24061*

Illegal fishing is a key threat to socioecological sustainability of fisheries globally. Accordingly, there is an increasing number of proposed solutions to tackle it including enhancing vessel tracking technology, enhancing traceability and labelling of seafood, and bilateral and regional collaboration to tackle key social drivers. The suitability of solutions is highly context-dependent, and uptake will be constrained by factors such as political and economic barriers and specific social drivers of illegal fishing.

This poster will highlight the work of our interdisciplinary and multilateral project that is researching progress, challenges and opportunities to tackle illegal fishing at the local, regional and national level across the Central and Western Indian Ocean (IO) area. It will identify research being done at local and national level in Sri Lanka and India by early career researchers. It will also outline research findings from an expert elicitation process that has engaged with individuals across ten IO countries to identify key proposed solutions to tackle illegal fishing including mean weights and ranking scores for impact of solutions as well as a diagram of top solutions with associated justification.

Overall, we will present an overview of the regional suitability of technology and solutions to tackle illegal fishing and encourage engagement with a related conference session. This abstract submission is for a poster presentation. It aligns with the 'new ideas and projects' topic by highlighting the novel research that is ongoing around the Indian Ocean (IO) area to tackle illegal fishing, a key fisheries

management issue. It will also identify salient issues around fisheries technology, such as vessel satellite monitoring systems, that we are researching as a project cohort. This poster is also intended to encourage engagement with the planned conference session on, "how best to tackle illegal fishing in the NW Indian Ocean region".

Abandonment of end-of-life FRP fishing boats along the beaches: a growing hazard on Kerala coast

Sreejith S. Kumar[1], Manju Lekshmi N. [1], Leela Edwin[1]

[1]*ICAR-Central Institute of Fisheries Technology, P. O. Matsyapuri, Willingdon Island, Cochin – 682029, manjuaem@gmail.com*

Fibreglass or glass-reinforced plastics (FRP or GRP) are thermosetting plastic polymer matrices reinforced with glass fibres that are preferred for marine boat construction because of their production capabilities, corrosion resistance, long shelf life, low operating costs, water resistance, maintenance, and good strength to weight ratio when compared to conventional materials. In the initial phases of the replacement of boat building materials, wood/plywood was sheathed with FRP and the latter hull was completely transformed to FRP. As the number of fishing boats is increasing, the abandonment of FRP/sheathed fishing boats is a common practice and the coastal zones are impacted by an escalating intensity of disposal. Impacts relating to aesthetics, loss of public access, reduction in space for fishing, etc are the generally associated issues with boat disposal. Hence, FRP is developed from polymers and monomers, it cannot be separated or recycled. However, limited knowledge is available about the contamination of the marine environment by microplastics, weathered minerals, heavy metals, and, the generation of highly toxic PCDD/Fs that are both airborne and components of the residual ash through open burning. A survey was conducted by ICAR-CIFT to assess the extent of disposal of abandoned FRP fishing boats. The marine districts of Kerala were grouped into the South region (Thiruvananthapuram, Kollam, Alappuzha), Central region (Ernakulam, Trissur, Malappuram) & North region (Kozhikkode, Kannur, Kasaragod) with the selection of nine fish landing centers for the study. The major types of abandonments observed are discarded in the high tide line, disposal sites (huge numbers of abandoned boats), disposed of in water, backyard burning, and landfilling of end-of-life boats. Based on the intensity of boat disposal in each location, GIS mapping was carried out with the help of QGIS software. A total of 292 abandoned boats were observed across nine landing centers, with abandonment ranging from 13 to 48 nos/km (average = 29 km-1) and the ecological effects were also assessed. The results will be baseline data for further studies and formulating guidelines for FRP fishing boat abandonments in the marine environment.

Selectivity characteristics of Rainbow *Sardine Dussumieria* acuta Valenciennes, 1847 with respect to diamond and square mesh cod ends in Indian Trawl Fishery from Bay of Bengal

Raghu Prakash Reghu[1], Kamai,Gaihiamngam[1], Utravalli Sreedhar[1]

[1]*Research Centre of Central Institute of Fisheries Technology, Ocean View Layout, Pandurangapuram, Visakhapatnam- 530 003, Andhra Pradesh, India, drraghuprakash@gmail.com*

Selectivity studies help gear technologists to isolate the elements of gear or the harvesting procedures that permit the escapement of unwanted bycatch. Huge quantities of bycatch are generated from trawl nets due to their low selectivity and high efficiency. Large quantities of undersized fishes and invertebrates are discarded in the trawl fishery along the Indian Coast. The size and shape of meshes in the codend of trawls play a very vital role in the exclusion of juveniles. In contrast to diamond mesh, square mesh is more selective, for several species. The present study was undertaken to study the size

selectivity of diamond and square mesh cod ends with respect to Dussumieria acuta in Bay of Bengal. The L25, L50 and L75 for D.acuta in respect for 40 mm diamond mesh cod end were 12.7, 14.7 and 16.7 mm, respectively. The selection range, selection factor and selection ratio were 3.9, 4.9 and 1.3, respectively. The L25, L50 and L75 values for D. acuta were 14.6, 15.9 and 17.2 mm, respectively for 40 mm square mesh. The SR, SF and SRA were 2.5, 3.2 and 0.5 respectively

Assessing the barriers to uptake of Vessel Monitoring and Automatic Identification Systems for improved fisheries management

Lasuni Chathurima Gule Godage[1]

[1]*Ocean University, Mahawela, Tangalle, Sri Lanka, lasunichathuri@gmail.com*

Technology plays a substantial role in improving fisheries management. Vessel Monitoring Systems (VMS) and Automatic Identification Systems (AIS) are technologies used to provide continuous and accurate vessel location information in near-real time to monitoring authorities. Potential benefits of VMS tracking include efficient monitoring of fleet dynamics and vessel behaviour, combatting illegal fishing in foreign Exclusive Economic Zones (EEZ) and reduced costs of violence-related investigations, while AIS enables safe navigation and avoidance of vessel collisions.

Through this work I seek to identify the barriers and opportunities for the uptake of VMS and AIS which are tools used for monitoring, controlling and surveillance of fishing vessels at the national as well as international levels. I intend to discuss the conference topics “implementation and implications for fisheries management” and “technical solutions to help investigations” by submitting this abstract. Further, the preliminary findings from this study will be presented during the conference.

Initial results from pilot studies across the Western and Eastern provinces of Sri Lanka revealed that fishers have sufficient technical knowledge of VMS and AIS. Based on the findings, lack of trust in governing bodies and lack of trust in whether battery power will last the journey are two attributes that act as barriers to the uptake and utilisation of VMS and AIS. Overall, these preliminary findings will help inform the overarching research that can potentially ensure more successful implementation of fisheries management policies in Sri Lanka. Further, this study is being done as part of a wider project "Human dimensions of the blue horizon: behavioural insights for compliance and deterrence" that aims to draw specific management and policy recommendations for improving fisher compliance and deterrence in the region.

Developments in the major fishing methods along the Northwest coast of India: dynamics in fishing attributes and species composition

Vinaya Kumar Vase[1], Jayasankar Jayaraman[1], Rajan Kumar[1], Shikha R[1]., Ajay Nakhawa[1], Mohammed Koya[1], Sreenath K. R[1]., Gyanaranjan Dash[1], and Prathibha Rohit[1]

[1]*ICAR-Central Marine Fisheries Research Institute, Ernakulam North, P.O., Kochi-682 018, Kerala, India, v.vinaykumarvs@gmail.com*

No historic spatial fishing information is available to understand the expansion of fishing, depth of operation, catch rates, etc. along the northwest coast of India. Real-time spatial fishery data is limited due to high cost, a vast area to cover, poor infrastructure, and scarce research vessels. The fishing data at the temporospatial scale is crucial in fishery management plans, shifts in fishing grounds, habitat modeling, and marine spatial planning. The Haversine functions are used for arriving at the GPS location of fishing grounds based on the input data like geocoordinates of the landing center, distance

travelled (in kilometers), and bearing (in degrees from North) (van Brummelen and Glen Robert, 2013). We investigated the developments in major fishing methods like mechanized Dolnetter (MDOL), multi-day trawlers (MDTN), mechanized gillnetter (MGN), mechanized trawler (MTN), outboard dolnetter (OBDOL), and outboard gillnetter (OBGN). The significant expansion in fishing grounds was observed in terms of distance recently by major fishing crafts like MDOL (28.4±17.5 km), MDTN (104.6±68.2 km), MGN (96.6±67.2 km), MTN (16.8±8.4 km), OBDOL (11.3±7.5 km), and OBGN (15.1±9.1 km). A prominent increase of non-penaeid prawns, penaeid prawns, ribbonfish, and croakers was observed in dolnets. Resources like cephalopods, lizardfishes, threadfin breams, rock cods, and other perches significantly increased in trawl catches in recent times. The depth of fishing was highest for MGN (101.4±58.0 m), followed by MDTN (81.5±33.3 m), MDOL (33.4±13.7 m), OBGN (25.4±10.5 m), MTN (24.6±9.5 m), and OBDOL (19.4±8.6 m). The mechanized fleet in the region indicated an increase in the distance and depth of fishing with modifications in mesh size, engine power, realm-wise operation, craft remodeling, etc. The key factors like poor catch rates in the coastal waters, conflicts with the motorized sector, and demand for resources like ribbonfish, cephalopods, perches, and large pelagic are directing fishers to deeper and farther grounds. Fishing by the major fleet concerning spatial expansion is key for resource monitoring, spatial planning & management, and habitat modeling.

Keywords: fishing attributes; northwest coast of India; georeferenced fishing grounds; market-driven

Application of geostatistics in the mapping of bycatch distribution from mid-water trawlers in the north-eastern Arabian Sea: A step towards the Marine Spatial Planning

P. Abdul Azeez[1,2], Prathibha Rohit[1], K. Mohammed Koya[1], Latha Shenoy[2], Ashok Kumar Jaiswar[2], Mini Raman[3], Shikha Rahangdale[1], Divu Damodaran[1]

[1]*ICAR- Central Marine Fisheries Research Institute, Cochin- 682018, Kerala, India, azeez.cr7@gmail.com*

[2]*ICAR-Central Institute of Fisheries Education, Fishery Resources, Mumbai- 400061, Maharashtra, India.*

[3]*Space Applications Centre, Indian Space Research Organisation, Ahmedabad- 380015, Gujarat, India.*

nformation on the distribution of bycatch in fishing grounds is essential for developing spatial conservation planning to reduce fisheries' adverse impacts on ecosystems. The lack of such information limits the spatially explicit management measure for managers and policymakers in Indian waters. Therefore, a preliminary spatio-temporal distribution study of nine key species of mid-water trawlers targeting largehead hairtail (*Trichiurus lepturus*) was analyzed on the northwest coast of India to identify the most persistent areas of key bycatch species. Spatio-temporal distribution patterns of fish were analyzed using semi-variogram models, and maps obtained by kriging interpolation revealed significant differences in bycatch abundance by species and associated habitat or depth preferences. Furthermore, a significant positive correlation between species observed in bycatch abundance indicated that few share the same habitat in the region. Key bycatch species were concentrated in the inshore area (<70 m depth) during the post-monsoon and summer seasons, but their density decreased significantly in winter. The new knowledge of the spatial pattern and temporal distribution of key bycatch species in the fishery will support the future application of spatial management measures, such as the designation of no-fishing zones and their integration into a conservation network. Furthermore, this framework can be applied more broadly to inform ecosystem management and priority areas for conservation or fisheries regulation.

Towards Electronic Monitoring (EM) in Indian marine fisheries: How far to go?

Akhilesh, K.V[1], Anulekshmi C. [1], Muktha M[1], Ajay D. Nakhawa[1], Santosh Bhendekar[1], Rajan Kumar[1], Shoba Joe Kizhakudan[1], Abdussamad E.M. [1]

[1]*ICAR-Central Marine Fisheries Research Institute, Kochi, Kerala, India, akhikv@gmail.com*

In the last few years, the structure of ocean usage by mankind has changed significantly. The fishing industry has become increasingly regulated as awareness of the impact of fishing on marine resources has increased. Fisheries dependent data collection and monitoring has also increased, as more data is needed to assess the status of fish stocks, and evaluate impact of fishing and anthropogenic activities. The importance of marine capture fisheries to the Indian economy is increasing, especially in livelihood, nutrition support, and appropriate use of resources. For years, India has been focusing on increasing capture production from the EEZ, ABNJ and under-exploited regions of the sea to support nutrition, increase foreign exchange, and manage its fisheries sustainably.

Nearly 0.25 million fishing vessels venture into Indian seas from a coastline of over 8000 km and they operate in 2.02 m km2 EEZ. However, the fishing details in its EEZ and beyond namely area of operation, crew, duration, catch composition and discards are limited and collection of such information is challenging, putting a significant gap in Monitoring, Control, and Surveillance (MCS) systems in Indian seas. As the focus on sustainable fisheries is increasing and monitoring is emphasized by global, regional and national fisheries management bodies, it is the right time to focus attention and address the critical gaps in MCS in Indian marine fisheries which can affect maritime security and sustainable resource utilization.

Though some attempts have been made towards improving MCS systems in Indian marine fisheries, they have been limited to small trials or to a limited area. In this article, we review the MCS system currently existing in India with respect to the surveillance systems available, apps developed and fleets currently being subjected to MCS. In addition, we provide a plan for improving MCS systems in India. An improved and effective MCS system will facilitate enhanced traceability and ensure that an increasing amount of seafood is sourced from sustainable fisheries. Moreover, an effective MCS system will also improve sea safety particularly in the offshore, distant and high seas thereby ensuring security to life and livelihoods.

Keywords: Blue economy, maritime security, fisheries, livelihood, monitoring, High sea fisheries, surveillance, MCS

Using Vessel monitoring technologies to detect the fishing ships in Mumbai Harbor

Abhishek[1]

[1]*Ashoka University, India, Abhishek_phd22@ashoka.edu.in*

Understanding the regional and global ecological impacts in marine ecosystem is directly linked with the patterns of human activities in the ocean. From a scientific perspective mapping and monitoring of these dynamic human patterns has played a crucial role in sustainably managing the oceanic activities. Use of vessel monitoring technologies has assisted in enforcing management measures to ensure the ecological and biological sustainability of the marine areas. AIS (Automatic Identification System) has been used in past for detection of fishing ships however, data for the Indian Exclusive Economic Zone (EEZ) is very limited due to small number of fishing vessels having AIS installed. Therefore, this study uses both AIS and SAR (Synthetic Aperture Radar) satellite images to detect the fishing vessels in Mumbai Harbor region. This poster will highlight the results of detected fishing ships using SAR and AIS data for the Mumbai Harbor. This distinction of fishing vessels from other types of ships will aid

in knowing the vessels involved in fishing. In addition, study is using the participatory GIS tools in order to improve the accuracy of the fishing ship detection. The poster addresses the conference objective focused on "examining the feasibility and impacts of current management and policy to tackle the illegal fishing by foreign fleets". The poster is presenting the initial research works conducted in Mumbai which will provide an outline of the long-term research focused in the Indian EEZ area.

The operating management and maintenance strategy of an Indian Fishing vessel. The factual observance and practice of a case study

K.B. Bijumon[1], S. Shaji[1], A.S Arun[1], S. K. Sreekanth[1]

[1]*Central Institute of Fisheries Nautical and Engineering Training, (CIFNET), Fine Arts Avenue, Kochi-16, Kerala, India, cifnethq@yahoo.com, cifnet@nic.in*

The mechanized Fishing vessels are intended to operate various fishing gears such as trawls, long lines, gill nets, purse seines etc. Right from the construction to the operational stage, these fishing vessels has to comply with various rules and regulations exerted by competent Government authorities. First of all, the vessel has to construct with a registered boat building yard/ship building unit as per the regulations of Department of fisheries to avoid overcapitalization. Subsequently, irrespective of steel hulled or wooden hulled, the vessels are registered with concerned Department of fisheries wherein licensing of fishing is issued. With regards to safe manning requirements, a comprehensive rule is applied by Mercantile Marine Department (MMD), Govt. of India, in case of vessels with 20 m. Over All Length (OAL) and above or otherwise as per rules existing with Department of Fisheries. Since, the vessel is plying up to EEZ or in high sea, the safe manning requirement is mandatory for sea safety. As a conservative management measure and sea safety precautions, the fishing vessels need to obey an array of fishing regulations and rules implemented by various costal states of the country. Further, the trawling ban is implemented for a specific period in every year, along both east and west coast of the country, wherein the mechanized fishing is regulated/restricted as a conservative management and stock replenishment strategy. Regarding maintenance and repair of steel hulled or wooden hulled fishing vessels, it needs to be dry docked in every two years or once in every 5 years in case of fishing vessel with an OAL of 20 m and above as per MMD rules under the supervision of a surveyor or otherwise as per instructions/rules existing with State Fisheries Department to enable the vessel sea worthy. This paper discuss various issues and practices needs to be taken up with the operation of a fishing vessel on the basis of a case study.

Keywords: MMD, MFRA, OAL, Dry docking.

Can we use low-res satellite images to study the impact of COVID on fishing activity in a small-scale fishery?

David Stanley[1], Jose Cappelletto[1], Paul Kemp[2], Deepayan Bhowmik[3], Bindi V. Shah[4], Nikita Gopal[5], Bethan O'Leary[6], Richard James MacCowan[7], Madhu V R[4], Sandhya K M[4], Rejula K[4]

[1]*Centre for In Situ and Remote Intelligent Sensing, FEPS, University of Southampton, UK*

[2]*International Centre for Ecohydraulics Research Faculty of Engineering and the Environment, University of Southampton, UK*

[3]*School of Computing Newcastle University, UK*

[4]*Department of Sociology, Social Policy & Criminology, University of Southampton, UK*

[5]*ICAR-Central Institute of Fisheries Technology, Matsyapuri, Cochin, Kerala, India*

[6]*University of Exeter, Penryn Campus, Penryn, UK*

[7]*Biomimicry Innovation Lab, York, UK*

madhucift@gmail.com

We investigated how satellite imagery and machine learning (ML) techniques could be used to estimate the potential impact of COVID-19 restrictions in 2020 on small scale fishing activities off the coast of Kerala, India. A Before and After study was conducted by monitoring small fishing vessel activity during the period 2019-2022.

Gathering social science data on this impact is time consuming and difficult to do remotely. Meanwhile, manually labelling small vessels in typical satellite images (10m/pixel) is time consuming and difficult. ML models would allow us to automatically detect such objects in satellite images quicker than humans can and potentially more accurate.

We evaluated 4 different ML architectures against 4 loss functions for their suitability in detecting ships on a small set of RGB images from the ESA's Sentinel-2 satellite that we had manually labelled, before settling on the U-Net architecture combined with the Lovasz Softmax loss function. We trained this model and used it to infer detections of fishing vessels in 175 Sentinel-2 image products, across a region 28,258 km2 in size, and for 174 dates between February and July in the years 2019-2022.

These ML inferred detections were then filtered based on; whether their position is estimated as cloud by the Sentinel-2 scene classification data product, whether detection from the images would be more difficult due to rougher sea states expected during dates of cyclonic storms in the region, and whether few ships would be expected for the date of the image based on social science data for when fishing workers do not typically operate.

Our results show how fishing activity varies over the geographical region of interest and their temporal variation is suggestive of a possible slight decline in fishing activity in 2021 and 2022 compared to 2019 and 2020. We have demonstrated how satellite imagery can be combined with ML models to infer the presence of ships at a given location and how ancillary data sources can be used to filter out false-positives and otherwise improve confidence in temporal analysis.

Chronicles of deep-water shrimp fishery (2007-2020) along the southwest coast of India: trends & potential

Rekha Devi Chakraborty[1], Laxmilatha P[1], T. M. Najmudeen[1], Kuriakose Somy[1], Sindhu K Augustine[1], L. Sreesanth[1], N. Ragesh[1]

[1]*Central Marine Fisheries Research Institute, India, rekhadevi7674@gmail.com*

The annual average estimated shrimp landings were 43611 tons during 2007-2020 off Kerala. Deep-sea shrimp catch was 9137 tons with the penaeid group accounting to 51% and the rest by non penaeid shrimps exploited from the mechanised multiday trawlers (MDTN) at a depth of 200-500 m. Deep-sea shrimp resource formed a seasonal fishery from September to April with a peak in landings during December to February (46%) forming the most productive period in terms of catch and catch rate. Catch trend analysis showed highest landing in the year 2018 (17,486 t) and lowest during 2010 (4975 t). District wise deepsea shrimp landings during 2013-2020 from MDTN Kerala, revealed Kollam on top position (86%) followed by Ernakulam (11.2%). Species composition at Kollam (MDTN) during 2013-2020 revealed the dominance of *M. andamanensis* (32.4%), followed by *H. chani* (19.8%), *A. alcocki* (19.6%), *P. quasigrandis* (17.5%), *H. woodmasoni* (9.1%) and *P. semilaevis* (1.0%). Deepsea shrimps

have longer life span and less fecundity in comparison to inshore shrimps which needs continuous monitoring for effective conservation and sustainable management of the resource.

Keywords: Deep-sea, trawl, fishery, trends, species diversity.

An Analysis on the Management of Navigation Aids onboard Research Vessels Based on Internet of Things [IoT]

Dr.D.Rajasekhar[1], D.Narendrakumar[1], P.S.Deepak Sankar[1], Ananthakrishna[1]

[1]National Institute of Ocean Technology, Chennai, India, 600100, rajasekhar@niot.res.in

Currently, most of the research activities at sea are being undertaken by dedicated research vessels. State-of-the-art research vessels make marine research in extreme sea conditions, which maximizes the frequency of accidents during research at sea. The risk of these marine research can be reduced by providing systematic and appropriate safety information about them. For this, navigation aids are actively being used. However, because navigation aids are managed and maintained by using a seafarer's visual observation, as well as by using a lighthouse and a buoy tender, checking the position error of a mooring buoy and its real-time condition becomes impossible. In accordance with this, conducting an overall review and an advance research on maritime transportation system on coastal waters should be conducted to systematically manage maritime transportation conditions, which makes it is necessary to develop a method of systematic management and efficient operation of navigation aids to help guarantee safe navigation on both coastal and international waters.

As a solution, this study analyzed the problem of current navigation aids management by conducting a literature study and an interview with relevant field experts. It suggests a method to manage navigation aids, which is applicable to IoT (Internet of Things) technologies.

Investigation of the common defects and damages of the Fiberglass reinforce Plastic boats operated along the coast of Tamil Nadu

Thangaraji Ravikumar[1], Swaminathan Jayaraj[2], Pandian Krishnan[2], Munuswamy Krishnamohan[2], Neethirajan Neethiselvan[1]

[1]Department of Fishing Technology and Fisheries Engineering, Fisheries College and Research Institute, Thoothukudi – 628 008, India, ravikumar@tnfu.ac.in

[2]Bay of Bengal Programme Inter-Governmental Organisation, Chennai – 600 018, India

The study dealt with knowing the the current status of construction defects, operational and berthing damages of FRP boats being used along Tamil Nadu coast. A detailed survey was conducted along the coastal districts of Tamil Nadu such as Thoothukudi, Kanyakumari, Nagapattinam, and Chennai. The common defects found with respect to construction were, the use of unapproved designs of mold, low-grade FRP mats, resins, catalyst, accelerator and using improper tools, improper lamination practice for construction of FRP boats and also the construction was done by inexperienced personnel. The common damages observed concerning the operation were abrasion and delamination of the gel coat due to dragging of the boat on the beach, blisters and stringer damage due to crack and collision, stagnation of bilge water and fatigue, and damages on gunwale due to collision. It was very interesting to find some indigenous technologies developed by the fishermen during the study for protection engines and boats. However, proper training must be given to the fishermen to rectify the defects and damages of FRP boats.

Mapping of domestic shark trade chains and utilization in India with implications for sustainable management of coastal shark fisheries

Shoba Joe Kizhakudan[1], Akhilesh K.V.[1], Sujitha Thomas[1], Muktha M.[1], Swatipriyanka Sen[1], Najmudeen, T.M.[1], Purushottama G.B.[1], Mahesh V.S.[1], Ambarish P.G.[1], Livi Wilson[1], Shikha Rahangdale[1], Subal Kumar Roul[1], Remya L.[1], Manojkumar, P.P.[1], Rekha J. Nair[1], Rajesh Pradhan[1], Zacharia P.U.[1], Kim Friedman[2], A. Gopalakrishnan[1]

[1]*ICAR-Central Marine Fisheries Research Institute, Kochi, India, shoba.joe@icar.gov.in*

[2]*Food and Agriculture Organization of the UN, Rome, Italy*

Sharks (including sharks, rays, skates, sawfishes, and guitarfishes) are exceptional fishes, among the earliest inhabitants of the seas, and highly vulnerable to overexploitation because they are long-living with slow growth and maturation rates, and low fecundity. In India, sharks are utilized fully and fetch good value whether caught as targeted catch or bycatch of multi-gear, multi-species fisheries. Though cursory information exists on shark utilization in India a detailed analysis was lacking. In 2017, as a part of an FAO Global study, ICAR-CMFRI undertook a study on non-fin shark and ray commodities in trade and utilization in India. This was the first study of its kind with a pan-India coverage and with a specific focus on sharks and rays. A national level assessment of domestic demand for all shark products using structured questionnaires, and mapping of trade/marketing chain of all shark's non-fin products within India and export routes was carried out from 34 landing centers across all maritime states of mainland India. Here we present a bird's eye view of the results and future directions of study needed.

The study indicated that the key drivers encouraging the landing and trade of all sharks caught is increasing national and international demand for various shark and ray products, coupled with poorly controlled trade. Increasing consumer acceptance and a regular occurrence in the marine landings drive domestic shark markets, particularly for meat in fresh and dried forms. Around 39% of the landed sharks in the country are procured by auctioneers from the fishermen; wholesalers, retailers and local vendors procure 15, 18 and 24% respectively, directly from the fishermen at the landing center. About 4% of the elasmobranchs (mostly sharks) are taken home by the fishermen for their own consumption.

The study was able to elucidate the major shark species in domestic trade in the country along with pattern of utilization in the country. Sharks are primarily consumed fresh or dried, in the country. While the domestic trade chain within the country is supported by meat, other products like shark jaws, liver oil, ray gill plates, cartilage and dried skin are also traded. We were able to identify the major production hubs and trade hubs of sharks in India along with the trade chain across the country. There is considerable inter-state movement of sharks and their non-fin commodities; often export takes place from centers that are far away from the original source. Market chain structures also varied across the country and products, ranging from direct sale to auctioneers, to complex chains involving retailers, vendors, and wholesalers. The price structure of various non-fin shark commodities was also evaluated across the different states of India. The importance of sharks in different communities and societies was also highlighted.

With the expansion of fisheries and concerns of sustainability, there is a global consensus that trade and utilization of vulnerable groups such as sharks need to be monitored. The inclusion of several species of sharks under CITES Appendices since 2014 necessitates a close look at national and international trade movements of these resources, and calls for integrating trade chains and fishery drivers while evolving sustainable fishing practices and conservation measures for sharks.

Crustacean Fishery along the North-eastern Arabian Sea Coast of India: Catch Composition, Species Monthly Wise Landing, Morphometric Relationship and Some Biological Aspects.

B. Sureandiran[1], T. H. Dave[1], K. Karuppasamy[2], N. K. Suyani[1], Shivani Tandel[1]

[1]*Department of Fisheries Resource Management, College of Fisheries Science, Kamdhenu University, Veraval, Gujarat, India – 362265, sureandiranbfsc@gmail.com*

[2]*Tamil Nadu Dr. J. Jayalalithaa Fisheries University, Dr. MGR. Fisheries College and Research Institute, Ponneri, Tamil Nadu, India - 601204*

Crustaceans are the regular constituent in the commercial and bycatch of the mixed species harvested by the different gears from the Gujarat, north-west coast of India along the Veraval fishing harbour, forming approximately 20% of total marine fish production of Gujarat in past years. The crustacean fishery, catch composition analysis, species composition, species wise landing, morphometric relationship and some biological aspects of some species were studied during 1st June 2022 to 15th December 2022. During the study period average shrimp catch was 80.2 %, crab 18.7 % and lobster 1.1 % of total crustacean fishery, stomatopods are not forming much important fishery aspect hence our study not focused on that group. The highest catch was observed during the month of September to November with ~ 40885 kg and the lowest catch was observed during the month of July and August with ~ 7225 kg due to the implementation of the fishing ban by Government of India. A total of 50 species of crustaceans (shrimp, crab and lobster) belonging to 13 families of 22 genera were observed during the course of our study. The most dominant crustacean family in the landings were Sergestidae, Penaeidae, Portunidae and Solenoceridae in volume and number. The landings were dominated by *Acetus indicus*, *Parapenaeopsis stylifera*, *Charybdis feriatus* and *Portunus sanguinolentus*. The trawlers (multiday + single day trawlers) contributed a major share of the total landing of crustacean during the period, followed by gill net and dol net. The monthly wise species landing is described and some biological aspect of 2 species were determined. The morphometric relationship (Carapace Length, Carapace Width and Total Length with respect to Total Weight) was computed for 10 species. The study provides the updated information on the crustacean fishery in the Veraval fishing harbour, Gujarat, North-west coast of India.

Fish Diversity in Hooghly Matlah estuary near Sunderban, West Bengal

Amrutha R Krishnan[1], N A Talwar[2]

[1]*Kerala University of Fisheries and Ocean Studies, Kochi – 06, amrutha.ir@gmail.com*

[2]*West Bengal University of Fisheries and Ocean Studies, Kolkata - 94*

Winter migratory bagnet fishery is a seasonal fishery at the sea face of estuary in West Bengal, where the fishermen from the upper stretched of Ganges makes transitory camps during winter season from October to February. The study was conducted to determine the catch composition and species diversity of indigenous Winter Migratory Coastal Set Bagnet (CSBN) operating in Hooghly-Matlah Estuary. A total of forty eight (48) hauls was made in twelve (12) days of fishing trials. Two complete days were expended with an average of four trials in every fortnight sampling during both flood current and ebb current. The soaking period was fixed to six (6) hours for each trial including the time of setting and hauling. Software 'PAST' was used to analyze the diversity indices and indices like Shannon Wiener diversity index (H'), Margalef richness index, Evenness index (e^H/S), Dominance index, (D) and Simpsons Index (1-D) etc are estimated to analyse the species diversity. The Shannon Wiener diversity index (H') and Simpsons Index (1-D) values were found maximum in December 2016 and the minimum

in February 2017. The maximum value of Margalef richness index (d) 4.046 was recorded in November 2016. However, the minimum value was found during the month of December 2016 (3.685). The maximum value of evenness index (e^H/S) was recorded in January 2017 (0.6732). The maximum value of Dominance index, D was found in February 2017 while in case of, the maximum value was observed in December 2016.

Keywords: Winter migratory coastal set bagnets - fish diversity - diversity indices

A comparative study of mechanical properties of untreated rubber wood and rubber wood treated with nano CuO added Cashew Nut Shell Liquid

Mosaraf Hossain[1], B Manoj Kumar[1], Leela Edwin[2], Devika Pillai[1], Manjulekshmi N[2], Amrutha R Krishnan[1]

[1]Kerala University of Fisheries and Ocean Studies, Kochi – 06, manojkumarbnair@yahoo.com

[2]ICAR – Central Institute of Fisheries Technology, Kochi-682029, Kerala, India

Although wood is one of the most widely used as a boat building materials, main problem is that wood when exposed to the marine environment is easily deteriorated by large density of bio deterioration agents. Wood is the most common material used for the construction of boats, especially for the traditional country crafts in many parts of India. But the material wood is very prone to deterioration due to its prolonged used in the marine and inland water bodies. So a good knowledge on the wood deterioration is very essential to increase the life of wooden fishing vessels. Cashew Nut Shell Liquid(CNSL) is an indigenous preservative used by the local fishermen in India. In this study CNSL is incorporated with Nano CuO to know the efficiency interms of its mechanical property while using in the estuarine environment for a period of four months. Rubber wood panels were treated with Colloidal suspension of CNSL with nano CuO at different concentrations viz., 0.05%,0.1% and 0.2%. Better mechanical properties were also observed in case Colloidal suspension of CNSL with nano CuO (0.2%) treated wood panels with highest maximum load and compressive strength at maximum load.

Keywords: Traditional wooden boats- nano CuO treated wood- Mechanical properties

Augmenting commercial lobster fisheries through sustainable capture-based mariculture in open sea cages

Mayur Shivdas Tade[1,2,3], Damodaran Nair Divu[2,3], Suresh Kumar Mojjada[3], Jaishree Bhardwaj[3], Aarsha Subramanian[3]

[1]Kerala University of Fisheries and Ocean Studies, Panangad, Kochi, Kerala 682506, INDIA, mayur.tade@gmail.com

[2]ICAR-Central Marine Fisheries Research Institute, Kochi-682 018, Kerala, INDIA.

[3]Veraval Regional Station of ICAR- Central Marine Fisheries Research Institute, Veraval-362 269, Gujarat, INDIA.

Lobster is one of the highly valued seafood commodities with well-established export markets across the globe. Lobster fisheries are tremendously significant to the economies of many nations due to the ever-growing demand for this priced seafood. The wild lobster resources have been severely depleted through overfishing and poor enforcement of regulations. Globally, enormous efforts have been initiated to protect natural lobster populations through various means. The majority of lobster fishing along the Indian coast is limited to the northwest, southwest, and southeast areas of Indian seas. The

annual catch of lobster has dramatically decreased owing to destructive fishing practices. Mud spiny lobster (*Panulirus polyphagus*) is one of the key potential species in India that commands a strong national and international market. Trawl nets are mostly used for the lobster fishing along the northwest coast of India, which is exclusively non-selective in nature leading to capture of large as well as small undersized lobster juveniles. These undersized lobster does not fetch good price in the market and reduces the economic income of fisherman. The value addition can be done by subjecting it for fattening in open sea cages which will allow fish farmer to gain good market value without putting any additional pressure over the wild stock. Additionally, as the hatchery produced seed availability of lobster lacks in India, the idea of Capture Based Mariculture (CBM) of lobster in open sea cages is proposed to meet the ever-increasing demand without affecting lobster fishery in a sustainable manner. Mariculture is not a cure, but technically sound sustainable management plans may contribute more to better economics, systematic management of dwindling resources and its resource efficiency while improving the livelihoods of dependent traditional fishers. The research done along the coast of Saurashtra in the Indian state of Gujarat revealed the potential of capture-based open sea cage mariculture of mud spiny lobster to enhance the wild lobster population through concerted scientific measures such as release of gravid females back to the open seas from the farm reared ones.

Keywords: Lobster fishery, trawl nets, open sea cage farming, capture-based mariculture, livelihood

ANNEX IV
MEDIA COVERAGE OF THE EVENT

മത്സ്യബന്ധനവുമായി ബന്ധപ്പെട്ട സുസ്ഥിര പദ്ധതികൾ ചർച്ച ചെയ്യുന്നതിനുള്ള രാജ്യാന്തര സമ്മേളനം, കൊച്ചിയിൽ കേന്ദ്ര ഫിഷറീസ് വകുപ്പ് സെക്രട്ടറി ജതീന്ദ്രനാഥ് സ്വെയിൻ ഉദ്ഘാടനം ചെയ്യുന്നു.

മത്സ്യബന്ധനം: രാജ്യാന്തര സമ്മേളനം തുടങ്ങി

08 | 2023 ഫെബ്രുവരി 14 ചൊവ്വ

സമുദ്രമത്സ്യബന്ധനം സുസ്ഥിരമാക്കണം; വഴിതുറന്ന് രാജ്യാന്തര സമ്മേളനത്തിന് തുടക്കം

Society T

സുസ്ഥിര സമുദ്ര മത്സ്യബന്ധനം: രാജ്യാന്തര സമ്മേളനത്തിന് തുടക്കം

മത്സ്യബന്ധനവുമായി ബന്ധപ്പെട്ട സുസ്ഥിരപദ്ധതികൾ ചർച്ച ചെയ്യുന്നതിനുള്ള രാജ്യാന്തര സമ്മേളനം കേന്ദ്ര ഫിഷറീസ് സെക്രട്ടറി ജതീന്ദ്രനാഥ് സ്വയിൻ ഉദ്ഘാടനം ചെയ്യുന്നു

Mid-day Gujarati Inquilab

mid-day

India's marine scientists emphasise on artificial reefs to aid production, fishermen's livelihood

Scientists from the ICAR-Central Marine Fisheries Research Institute (CMFRI) said the deployment of artificial reefs (AR) on the sea bed would enhance the growth of marine fauna and flora, and stimulate natural settings for fish production.

Artificial reef is a sheltered human-built structure, submerged on the sea bed as a substitute for natural habitats.

Having a fixed scientific design, it functions as a self-sustaining production system on the sea bed.

According to a report presented by the CMFRI during the session, a total of 280 AR sites have been deployed in India's coastal waters, including 243 in Tamil Nadu and 28 in Kerala.

The artificial reefs could offer opportunities for a substantial increase in fish catch, especially ... small-scale fishers using hook and line. It will help save costs besides offering a lot more ...ironmental benefits such as enhancement of biodiversity, reduction of the carbon footprint ...he fishing operation, reduction of wave energy and thereby coastal erosion, and stabilisation ...lands," said the CMFRI report prepared by its director A Gopalakrishnan, VVR Suresh and Kizhakudan.

Mathrubhumi മാതൃഭൂമി

സുസ്ഥിര സമുദ്രമത്സ്യബന്ധനം രാജ്യാന്തര സമ്മേളനം തുടങ്ങി

കൊച്ചി• മത്സ്യമേഖലയിൽനിന്നുള്ള വരുമാനം കൂട്ടാനുള്ള ശ്രമങ്ങളാണ് സർക്കാർ നടത്തുന്നതെന്ന് കേന്ദ്ര ഫിഷറീസ് വകുപ്പ് സെക്രട്ടറി ജതീന്ദ്രനാഥ് സ്വെയിൻ പറഞ്ഞു.

prospect...

EXPRESS NEWS SERVICE

ARTIFICIAL reefs will increase fish production and promote fishermen's livelihood, marine scientists said. Participating in a brainstorming session held on the sidelines of the symposium on innovations in fishing technologies, marine scientists from the Central Marine Fisheries Research Institute (CMFRI) said the deployment of artificial reefs on the sea bed would enhance the growth of marine fauna and flora, and stimulate natural settings for fish production.

An artificial reef is a shelter placed on the sea bed as a substitute for natural habitats. Having a fixed scientific design, it functions as a self-sustaining production system on the sea bed.

According to a report presented by the CMFRI during the session, a total ... artificial reefs have been ...ed in India's coastal waters including 243 in Tamil and 28 in Kerala. ...artificial reefs would offer ...ortunities for a substantial ...rease in fish catch, especially ...for small-scale fishermen ...hook and line. It will help ...costs besides offering a lot more environmental benefits such as enhancement of biodiversity, reduction of the carbon footprint of the fishing operation, reduction of wave energy and thereby coastal erosion, and stabilisation of ...lands", the report said.

However, the CMFRI ...tained that artificial reef... be deployed only at design... sites after a competent au...ity carries out a study. Th... port was prepared and pre...ed by director Gopalakrishnan, and princ... scientists V V R Suresh and K Kizhakudan.

"Over 300 species coexist in settled artificial reef habitat. The commercia varieties include breams, groupers, snappers, perches, cobia, sea bass, rabbit fishes, silver bid-dies, seer fish, barracuda, mackerel, trevallies, queen fishes, etc", said Joe.

Union fisheries secretary Jatindra Nath Swain said the artificial reefs and sea ranching present a solution to the crisis prevalent in the sector. Sufficient fish availability could be ensured in the near-shore waters with these technologies, he said.

NEWS18 മലയാളം | പണം Powered by moneycontrol

കൂടുതൽ മീൻ കിട്ടാൻ കടലിൽ കൃത്രിമ ആവാസവ്യവസ്ഥ; റീഫുകൾക്കൊപ്പം സീകൃഷി രൈഡെവിംഗും

കൊച്ചി: കടലിൽ മത്സ്യോൽപാദനം കൂട്ടാനും അതുവഴി മത്സ്യത്തൊഴിലാളികളുടെ വരുമാനം വർധിപ്പിക്കാനും സഹായകരമാകുന്ന സാങ്കേതികവിദ്യയായ കൃത്രിമ ആവാസവ്യവസ്ഥ ചർച്ചയാകുന്നു. കടലിനടിയിൽ സ്ഥാപിക്കാവുന്ന കൃത്രിമ മത്സ്യആവാസവ്യവസ്ഥ (ആർട്ടിഫിഷ്യൽ റീഫ്) ശാസ്ത്രീയ മാതൃകയിൽ നിർമിച്ച ഇവ ...ൻ കൂടുകയും ചെയ്യുമെന്ന്

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...ക്കാനുള്ള ചർച്ചകൾക്ക് ...ളനത്തിനു തുടക്കം

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Feb 14, 2023 Page No. 7
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BHASKAR LIVE

ENGLISH NEWS

Marine scientists bat for artificial reefs

Kochi, Feb 15 (IANS) India's marine fisheries is on the verge of a transformation, with marine scientists proposing artificial reefs to increase fish production and promote fishermen's livelihood.

The scientists opened up on this topic at a brainstorming session held on the sideline of the ongoing symposium on innovations being held here.

Scientists from the ICAR-Central Marine Fisheries Research Institute (CMFRI) said the deployment of artificial reefs (AR) on the sea bed would enhance the growth of marine fauna and flora, and stimul... natural settings for fish production.

Artificial reef is a sheltered human-built structure, submerged on the sea bed as a substitute for ... habitats.

Having a fixed scientific design, it functions as a self-sustaining production system on the sea be...

According to a report presented by the CMFRI during the session, a total of 280 AR sites have b... deployed in India's coastal waters, including 243 in Tamil Nadu and 28 in Kerala.

LOKMAT TIMES

Marathi | Hindi

Marine scientists bat for artificial reefs

By IANS | Published: February 15, 2023 06:09 PM

Kochi, Feb 15 India's marine fisheries is on the verge of a transformation, with marine scientists proposing artificial ...

Marine scientists bat for artificial reefs | Marine scientists bat for artificial reefs

Kochi, Feb 15 India's marine fisheries is on the verge of a transformation, with marine scientists proposing artificial reefs to increase fish production and promote fishermen's livelihood.

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OMMCOM NEWS

People's Voice

Marine Scientists Bat For Artificial Reefs

Kochi: India's marine fisheries is on the verge of a transformation, with marine scientists proposing artificial reefs to increase fish production and promote fishermen's livelihood.

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...f is a sheltered human-built structure, submerged on the sea bed as a substitute for ...ats.

08 | 2023 ഫെബ്രുവരി 15 ബുധൻ

ചെറുകിട മത്സ്യത്തൊഴിലാളികളുടെ സംരക്ഷണം

രാജ്യങ്ങൾ തമ്മിൽ ഗവേഷണ സഹകരണം അനിവാര്യമെന്ന് വിദഗ്

UNI United News of India

BREVITY ACCURACY SPEED

India's Multi Lingual News Agency

Tuesday, Feb 21 2023 | Time 12:04 Hrs(IST)

Artificial reefs offer a bright prospect for marine fishe...

Kochi, Feb 15 (UNI) India's marine fisheries is on the verge of a transformation, with ... scientists proposing artificial reefs to increase fish production and promote fishermen... livelihood.

Some experts call it a milestone in the sector as the innovative technology creates add... areas as fish habitats.

During a brainstorming session held on the sideline of the ongoing symposium on inn... in fishing technologies, scientists from the ICAR-Central Marine Fisheries Research I... (CMFRI) on Wednesday said the deployment of artificial reefs (AR) on the sea bed w... enhance the growth of marine fauna and flora, and stimulate natural settings for fish production.

Please log in to get detai...

Tags: #Artificial reefs offer a bright prospect for marine fisheries

INDIA New England NEWS

Tuesday, February 21, 2023

Marine scientists bat for artificial reefs

Kochi- India's marine fisheries is on the verge of a transformation, with marine scientists proposing artificial reefs to increase fish production and promote fishermen's livelihood.

The scientists opened up on this topic at a brainstorming session held on the sideline of the ongoing symposium on innovations being held here.

Scientists from the ICAR-Central Marine Fisheries Research Institute (CMFRI) said the

മത്സ്യോൽപാദനം കൂട്ടാൻ കൃത്രിമ മത്സ്യആവാസവ്യവസ്ഥ

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സ്വന്തം ലേഖിക

കൊച്ചി

ദേശാഭിമാനി Thu, 16 February 202 https://epaper.deshal

Call to blend innovations with indigenous knowledge to help small-scale fishers

Marine scientists and experts from across the globe called for blending technological innovations with indigenous traditional knowledge in respective regions to improve the livelihood of fishermen. They were participating in a panel discussion on future proofing of small-scale fisheries on the sidelines of the ongoing international symposium on innovations in fishing technology in Kochi on Thursday.

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On the major challenges in small-scale fisheries, John Lansley, Fishery In... the Food and Agriculture Organisation of the United Nations, said cultu... technologies significant to respective regions needed to be developed to e... contribution of fishing to food security.

"Relevant innovations are crucial to meet a set of targets such as sustain... coastal waters, mitigating climate change, developing mariculture, reduc... among multiple users of coastal zones, tackling trade barriers, and devel... chain," he said. In addition to scientific and technological innovations, e... utilisation of age-old indigenous traditional knowledge existing in differ... much as possible is important to develop small-scale fisheries and impr... of traditional fishers, he added.

മെട്രോ വാർത്ത

സമുദ്രമത്സ്യ മേഖലയിൽ വഴിത്തിരിവാകാൻ കൃത്രിമ ആവാസവ്യവസ്ഥ

മത്സ്യോത്പാദനം കൂട്ടാൻ സഹായകരമാകുമെന്ന് സിഎംഎഫ്ആർഐ

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... call for blending

ചന്ദ്രിക

മത്സ്യത്തൊഴിലാളികൾക്ക് ഇൻഷുറൻസ് പരിരക്ഷ വേണം;വിദഗ്ധർ

കൊച്ചി: കാലാവസ്ഥാ വ്യതിയാനത്തെ തുടർന്നുള്ള പ്രകൃതി ദുരന്തങ്ങൾ, ചുഴലിക്കാറ്റ്, മത്സ്യസമ്പത്തിലെ കുറവ് എന്നിവ വർധിക്കുന്ന സാഹചര്യത്തിൽ ചെറുകിട മത്സ്യത്തൊഴിലാളികൾക്ക് സാമ്പത്തിക സുരക്ഷിതത്വം ഉറപ്പാക്കുന്ന ഇൻഷുറൻസ് പരിരക്ഷ പോലുള്ള സംവിധാനം ...

ലങ്ങളിലെ തദ്ദേശീയ പരമ്പരാഗത അറിവുകൾ സംയോജിപ്പിക്കണമെന്നും നിർദേശമുയർന്നു.

ഭക്ഷ്യസുരക്ഷക്കായി മത്സ്യമേഖലയിൽ നിന്നുള്ള സംഭാവന മെച്ചപ്പെടുത്താൻ ഓരോ പ്രദേശത്തിന് അനുയോജ്യമായ സാങ്കേതികവിദ്യകളാണ് വികസിപ്പിക്കേണ്ടതെന്ന് ...

വിളികൾ നേരിടാൻ സാങ്കേതികവിദ്യ വേണം. ഇതിനു പുറമെ, ശാസ്ത്രീയ മത്സ്യത്തൊഴിലാളികൾക്കിടയിൽ നിലനിൽക്കുന്ന പരമ്പരാഗത അറിവുകൾ പ്രയോജനപ്പെടുത്തുകയാണെങ്കിൽ ഈ മേഖലയിൽ ഉപജീവനം നടത്തുന്നവരുടെ വരുമാനം വർധിപ്പിക്കാൻ കഴിയുമെ...

Mathrubhumi മാതൃഭൂ

സുസ്ഥിര മത്സ്യബന്ധനം: സമ്മേളനം തുടങ്ങി

കൊച്ചി▸ മത്സ്യത്തൊഴിലാളികളുടെ ഉപജീവനം മെച്ചപ്പെടുത്താൻ സാങ്കേതിക വിദ്യകാംക്കൊപ്പം പരമ്പരാഗത അറിവുകളും സംയോജിപ്പിക്കണമെന്ന് വിദഗ്ധർ. സുസ്ഥിര മത്സ്യബന്ധനവുമായി ബന്ധപ്പെട്ട അന്താരാഷ്ട്ര സമ്മേളനത്തിലെ പാനൽ ചർച്ചയിലാണ് ഈ നിർദേശം ഉയർന്നത്. ഓരോ പ്രദേശത്തിനും അനുയോജ്യമായ സാങ്കേതികവിദ്യകാം വികസിപ്പിക്കണമെന്ന് ലോക ഭക്ഷ്യ കാർഷിക സംഘടനയിലെ ഫിഷറി ഇൻഡസ്ട്രി ഓഫീസർ ജോൺ ലാൻസ്ലി പറഞ്ഞു.

കാലാവസ്ഥാ വ്യതിയാനത്തെ തുടർന്നുള്ള പ്രകൃതി ദുരന്തങ്ങാം ഏറി മത്സ്യസമ്പത്തിൽ കുറവ് വരുന്ന സാഹചര്യത്തിൽ ചെറുകിട മത്സ്യത്തൊഴിലാളികാംക്ക് ഇൻഷുറൻസ് പരിരക്ഷ പോലുള്ള സംവിധാനം ഏർപ്പെടുത്തണമെന്നും വിദഗ്ധർ ആവശ്യപ്പെട്ടു.

മത്സ്യത്തൊഴിലാളികൾക്ക് ഇൻഷ്വറൻസ് പരിരക്ഷ വേണമെന്ന് വിദഗ്ധർ

കൊച്ചി: കാലാവസ്ഥാവ്യതിയാനത്തെ തുടർന്നുള്ള പ്രകൃതി ദുരന്തങ്ങൾ, ചുഴലിക്കാറ്റ്, മത്സ്യസമ്പത്തിലെ കുറവ് എന്നിവ വർധിക്കുന്ന സാഹചര്യത്തിൽ ചെറുകിട മത്സ്യത്തൊഴിലാളികൾക്ക് സാമ്പത്തിക സുരക്ഷിതത്വം ഉറപ്പാക്കുന്ന ഇൻഷ്വറൻസ് പരിരക്ഷ പോലുള്ള സംവിധാനം ഏർപ്പെടുത്തണമെന്ന് വിദഗ്ധർ. സുസ്ഥിര മത്സ്യബന്ധനവുമായി ബന്ധപ്പെട്ട രാജ്യാന്തര സമ്മേളനത്തിൽ നടന്ന ചർച്ചയിലാണ് ഈ നിർദേശം.

ഭക്ഷ്യസുരക്ഷക്കായി മത്സ്യമേഖലയിൽ നിന്നുള്ള സംഭാവന മെച്ചപ്പെടുത്താൻ ഓരോ പ്രദേശത്തിനു അനുയോജ്യമായ സാങ്കേതികവിദ്യകളാണ് വികസിപ്പിക്കേണ്ടത്. മത്സ്യോല്പാദനം കൂട്ടൽ, കാലാവസ്ഥാ വ്യതിയാനത്തിന്റെ ആഘാതം കുറയ്ക്കൽ, വ്യാപാരം മെച്ചപ്പെടുത്തൽ തുടങ്ങിയ വെല്ലുവിളികൾ നേരിടാൻ സാങ്കേതികവിദ്യ വേണം. ഇതിനു പുറമെ, ശാസ്ത്രീയ മത്സ്യത്തൊഴിലാളികൾക്കിടയിൽ നിലനിൽക്കുന്ന പരമ്പരാഗത അറിവുകൾ പ്രയോജനപ്പെടുത്തുകയാണെങ്കിൽ ഈ മേഖലയിൽ ഉപജീവനം നടത്തുന്നവരുടെ വരുമാനം വർധിപ്പിക്കാൻ കഴിയുമെന്നും ലോക ഭക്ഷ്യ കാർഷിക സംഘടനയിലെ (എഫ്എഒ) ഫിഷറി ഇൻഡസ്ട്രി ഓഫീസർ ജോൺ ലാൻസ്ലി പറഞ്ഞു. മത്സ്യമേഖലയിലെ സാങ്കേതികവിദ്യകളെക്കുറിച്ച് ഇന്ത്യ, ശ്രീലങ്ക, മാലിദ്വീപ് പ്രതിനിധികൾ പാനൽ ചർച്ചയിൽ റിപ്പോർട്ട് അവതരിപ്പിച്ചു.

30 രാജ്യങ്ങളിൽ നിന്നുള്ള പ്രതിനിധികൾ സംബന്ധിക്കുന്ന രാജ്യാന്തര സമ്മേളനം ഇന്ന് സമാപിക്കും.

മത്സ്യത്തൊഴിലാളികൾക്ക് ഇൻഷ്വറൻസ് പരിരക്ഷ വേണം: വിദഗ്ധർ

കൊച്ചി: കാലാവസ്ഥാവ്യതിയാനത്തെ തുടർന്നുള്ള പ്രകൃതി ദുരന്തങ്ങൾ, ചുഴലിക്കാറ്റ്, മത്സ്യസമ്പത്തിലെ കുറവ് എന്നിവ വർധിക്കുന്ന സാഹചര്യത്തിൽ ചെറുകിട മത്സ്യത്തൊഴിലാളികൾക്ക് സാമ്പത്തിക സുരക്ഷിതത്വം ഉറപ്പാക്കുന്ന ഇൻഷ്വറൻസ് പരിരക്ഷ പോലുള്ള സംവിധാനം ഏർപ്പെടുത്തണമെന്ന് വിദഗ്ധർ. സുസ്ഥിര മത്സ്യബന്ധന...

യ്ക്കൽ, വ്യാപാരം മെച്ചപ്പെ... ത്തൽ തുടങ്ങിയ വെല്ലുവിളി... നേരിടാൻ സാങ്കേതികവിദ്യ... ണം. ഇതിനു പുറമെ, ശാസ്... യ മത്സ്യത്തൊഴിലാളികൾ... യിൽ നിലനിൽക്കുന്ന പര... ഗത അറിവുകൾ പ്രയോജ... ടുത്തുകയാണെങ്കിൽ ഈ ... ലയിൽ ഉപജീവനം നടത്തു... രുടെ വരുമാനം വർധിപ്പിക്... കഴിയുമെന്നും അദ്ദേഹം പ...

മത്സ്യത്തൊഴിലാളികൾക ഇൻഷുറൻ പരിരക്ഷ വേണം: വിദഗ്ധ

...വസ്ഥാവ്യതിയാനത്തെ തുടർന്നുള്ള പ്രകൃതി ...റ്റ്, മത്സ്യസമ്പത്തിലെ കുറവ് എന്നിവ വർധി... ൽ ചെറുകിട മത്സ്യത്തൊഴിലാളികൾക്ക് സാ... ഉറപ്പാക്കുന്ന ഇൻഷുറൻസ് പരിരക്ഷ പോലു... പ്പെടുത്തണമെന്ന് വിദഗ്ധർ. സുസ്ഥിരമത്സ്യ... പ്പെട്ട രാജ്യാന്തര സമ്മേളനത്തിൽ നടന്ന പാന... നിർദേശം.

...ക്ഷക്കായി മത്സ്യമേഖലയിൽ നിന്നുള്ള സംഭാ... ഓരോ പ്രദേശത്തിന് അനുയോജ്യമായ സാ... വികസിപ്പിക്കേണ്ടതെന്ന് ഐക്യരാഷ്ട്രസഭക്... ഭക്ഷ്യ കാർഷിക സംഘടനയിലെ (എഫ്.എ.ഒ.) ... ഓഫീസർ ജോൺ ലാൻസ്ലി പറഞ്ഞു. ...യിലെ സാങ്കേതികവിദ്യകളെകുറിച്ച് ഇന്ത്യ, ശ്... നിനിധീകരിച്ച് പാനൽ ചർച്ചയിൽ റിപ്പോർട്ട് അ... ഓഫ് ബംഗാൾ പ്രോഗ്രാം (ബി.ഒ.ബി.പി.) ഡയ... ണൻ, ജർമനിയിൽ നിന്നുള്ള ഡോ ഡാനിയൽ ...റ്റ് ഡയറക്ടർ ഡോ ജോർജ് നൈനാൻ, ഡോ... ഇ വിവേകാനന്ദൻ, സെബാസ്റ്റ്യൻ മാത്യു... എന്നിവർ സംസാരിച്ചു. 30 രാജ്യങ്ങളിൽ നി... സംബന്ധിക്കുന്ന രാജ്യാന്തര സമ്മേളനം ഇ... മാപിക്കും.

വേൾഡ് മലയാളി വോയ്സ് WMV WORLD MALAYALEE VOICE

Blend tech with indigenous knowledge to improve fishermen's livelihood: Experts

MARINE scientists and experts from across the globe have called for blending technological innovations with indigenous traditional knowledge in respective regions to improve livelihood of fishermen, online news sites report quoting IANS.

They were speaking at a panel discussion on future proofing of small-scale fisheries on the sideline of the ongoing international symposium on innovations in fishing technology, here on Thursday.

Referring to major challenges in the small-scale fisheries (SSF), John Lansley, Fishery Industry Officer of the Food and Agriculture Organisation of the UN said culturally appropriate technologies significant to respective regions need to be developed to enhance the contribution of fishing to food security.

"Relevant innovations are crucial to meet a set of targets such as sustaining production in coastal waters, mitigating climate change, developing mariculture, reducing conflict among multiple users of coastal zones, tackling trade barriers and developing value chain. In addition to scientific and technological innovations, effective utilisation of age-old indigenous traditional knowledge existing in different localities as much as possible is of utmost importance to develop the SSF and improve the livelihood of traditional fishers", said Lansley.

Dr P Krishnan, Director of the Bay of Bengal Programme-Inter Governmental Organisation (BOBP-IGO) said modernising the small-scale fisheries sector is the need of the hour, to deal with the concerns such as low productivity, low price realisation and labour issues.

'Modernizing small-scale fisheries sector crucial'

TIMES NEWS NETWORK

Kochi: A panel discussion on future proofing of small-scale fisheries was held here on Thursday as part of the ongoing international symposium on innovations in fishing technology, organized by the Bay of Bengal programme (BoBP) and other organizations.

Experts suggested that blending technological innovations with indigenous traditional knowledge in respective regions could help improve the livelihood of fishermen.

"Relevant innovations are crucial to meet a set of targets such as sustaining production in coastal waters, mitigating climate change, developing mariculture, reducing conflict among multiple users of coastal zones, tackling trade barriers and developing value chain," fishery industry officer of Food and Agriculture Organisation John Lansley.

INT'L FISHERIES MEET

BoBP director P Krishnan said modernizing the small-scale fisheries sector was the need of the hour, to deal with concerns such as low productivity, low price realization and labour issues. The panel discussion proposed ensuring financial covers such as credit and insurance to small-scale fishers. It also suggested taking urgent actions for innovations concerning craft and gear improvisation, hygienic fish handling, economical post-harvest, safety of fishers and easy access to advanced communication and information technologies.

At the meet, there were suggestions that small fishing vessels be fitted with onboard freezing and sorting facilities.

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'ചെറുകിട മത്സ്യത്തൊഴിലാളികൾക്ക് ഇൻഷുറൻസ് പരിരക്ഷ അത്യാവശ്യം'

കൊച്ചി● കാലാവസ്ഥാ മാറ്റത്തിൽ പ്രകൃതിദുരന്തങ്ങളും ചുഴലിക്കാറ്റുകളും ഉണ്ടാകുകയും മത്സ്യസമ്പത്തു കുറയുകയും ചെയ്യുന്ന സാഹചര്യത്തിൽ ചെറുകിട മത്സ്യത്തൊഴിലാളികൾക്കു സാമ്പത്തിക സുരക്ഷ ഉറപ്പാക്കാൻ ഇൻഷുറൻസ് പരിരക്ഷ അത്യാവശ്യമാണെന്നു വിദഗ്ധർ.

സുസ്ഥിര മത്സ്യബന്ധനവുമായി ബന്ധപ്പെട്ട രാജ്യാന്തര സമ്മേളനത്തിലെ പാനൽ ചർച്ചയിലാണു നിർദേശം. ഭക്ഷ്യസുരക്ഷയ്ക്കു മത്സ്യമേഖലയുടെ സംഭാവന മെച്ചപ്പെടുത്താൻ ഓരോ പ്രദേശത്തിനും അനുയോജ്യമായ സാങ്കേതികവിദ്യ വികസിപ്പിക്കണമെന്ന് ഐക്യരാഷ്ട്ര സംഘടനയ്ക്കു കീഴിലുള്ള ലോക ഭക്ഷ്യ കാർഷിക സംഘടനയിലെ (എഫ്എഒ) ഫിഷറി ഇൻഡസ്ട്രി ഓഫിസർ ജോൺ ലാൻസ്‌ലി പറഞ്ഞു.

ബേ ഓഫ് ബംഗാൾ പ്രോഗ്രാം (ബിഒബിപി) ഡയറക്ടർ ഡോ. പി. കൃഷ്ണൻ, ജർമനിയിൽ നിന്നുള്ള ഡോ. ഡാനിയൽ സ്റ്റെപ്പുട്ടിസ്, സിഫ്റ്റ് ഡയറക്ടർ ഡോ. ജോർജ് നൈനാൻ, ഡോ. ബി. കെ. ദാസ്, ഡോ. ഇ. വിവേകാനന്ദൻ, സെബാസ്റ്റ്യൻ മാത്യു, ഡോ. എം. വി. ബൈജു എന്നിവർ പ്രസംഗിച്ചു. സമ്മേളനം ഇന്നു സമാപിക്കും.

ICES CIEM

DEPARTMENT OF FISHERIES

Food and Agriculture Organization of the United Nations

ICES/FAO Working Group on Fishing Technology and Fish Behaviour (WGFTFB23)

and

Symposium on Innovations in Fishing Technologies for Sustainable and Resilient Fisheries

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