Dr. Leela Edwin: Former Director, Central Institute of Fisheries Technology, Kochi and former head of Fishing Technology Division. She has contributed much to the fishing industry especially in the field of crafts and gear and has received advance training in fish gear designing from Fisheries & Marine Institute of Memorial University Canada.

Sustainable marine fisheries development in Kerala

Dr. Leela Edwin
Former Principal Scientist
ICAR-Central Institute of Fisheries Technology, Cochin

Indian Fisheries

Fish has been an important food source for mankind since before recorded history, and it is anticipated that this will continue in future generations.

		India
Length of coastline (km)	:	8,118
Continental shelf (km²)	:	5,30,000
Exclusive Economic Zone (km²)	:	20,20,000
Annual potential yield from EEZ (metric t)	:	4.41
Fishing villages (No.)	:	3,432
Fish landing centres (No.)	:	1,535
Fishermen families (No.)	:	8,74,749
Fisher population (No.)	:	40,56,213
Fish production (2022) (million tonnes)	:	4.12

Source: GoI, 2023

Kerala Fisheries

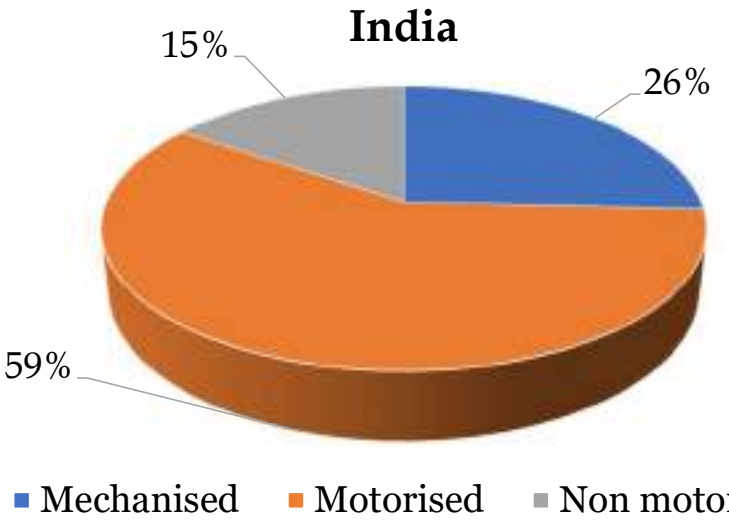
Length of coastline	:	590 km
Continental shelf	:	39139 km²
Exclusive Economic Zone	:	218536 Sq. km
Fishing villages (No.)	:	335
Fish landing centres (No.)	:	1,535
Active Fishermen Registered	:	247849
Fisher population (No.)	:	1044361
Annual potential yield from EEZ	:	7.5 Lakh t
Fish production (2022)	:	6.01 Lakh t

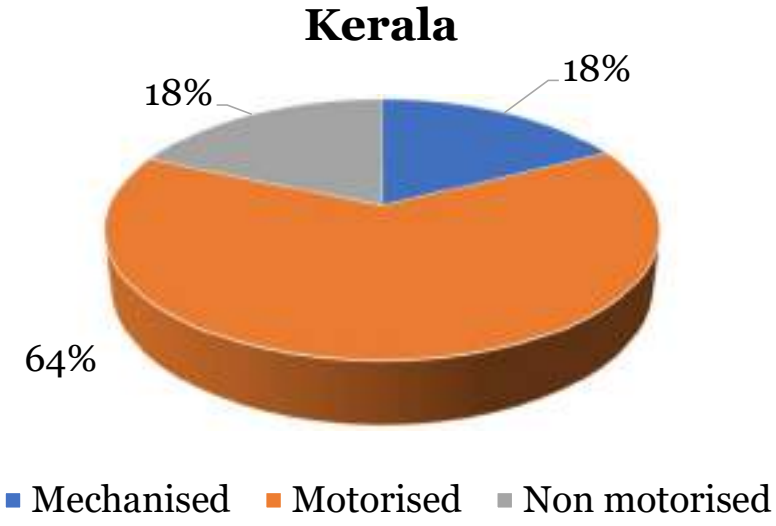
Source: GoI, 2023

B Mechanised Fishing Vessel - A vessel fitted with engine for propulsion, mechanical fishing operations and having permanent super structures

M Motorised Fishing Vessel - A vessel fitted with inboard/ outboard engine for propulsion without super structures and mechanical means for fishing operations

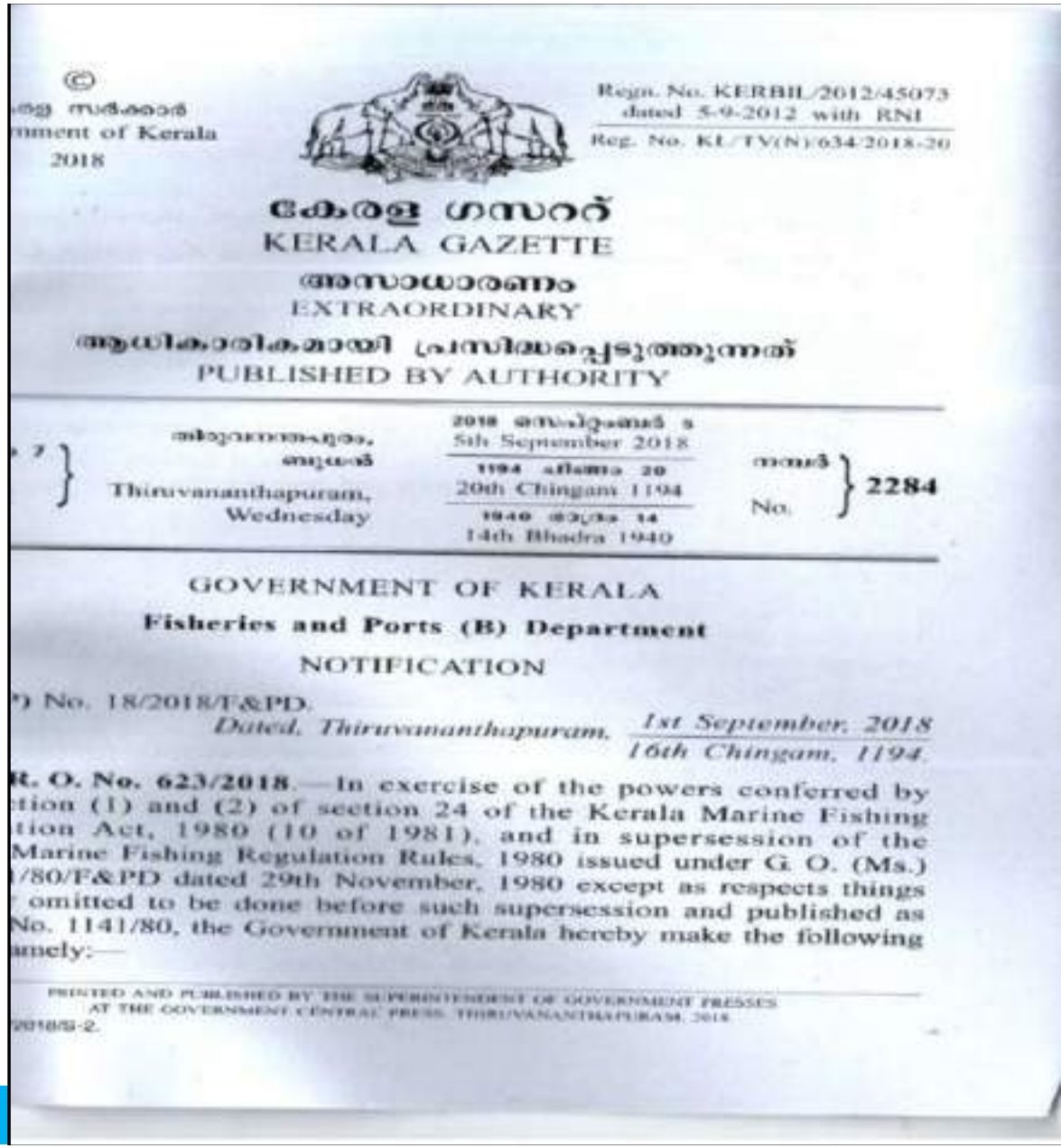
T Traditional Fishing Vessels - A vessel not using any kind of mechanical power for propulsion and fishing operations and not having any super structure





CMFRI-FSI-DoF, 2020, Marine Fisheries Census 2016 - India

The Govt. of Kerala has incorporated the same *in toto* in its amendment of the Marine Fisheries Regulation Act, 2018



© ...ment of Kerala 2018

Regn. No. KERBIL/2012/45073 dated 5-9-2012 with RNI
Reg. No. KL/TV(N)/634/2018-20

കേരള ഗസറ്റ്
KERALA GAZETTE
അസാധാരണം
EXTRAORDINARY
അധികാരികമായി പ്രസിദ്ധപ്പെടുത്തുന്നത്
PUBLISHED BY AUTHORITY

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Thiruvananthapuram, Wednesday

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5th September 2018
1194 ചിങ്ങം 20
20th Chingam 1194
1940 ഭാദ്ര 14
14th Bhadra 1940

നമ്പർ No. 2284

GOVERNMENT OF KERALA
Fisheries and Ports (B) Department
NOTIFICATION

...) No. 18/2018/T&PD. *Dated, Thiruvananthapuram, 1st September, 2018 / 16th Chingam, 1194.*

R. O. No. 623/2018.—In exercise of the powers conferred by ...tion (1) and (2) of section 24 of the Kerala Marine Fishing ...tion Act, 1980 (10 of 1981), and in supersession of the Marine Fishing Regulation Rules, 1980 issued under G. O. (Ms.) .../80/F&PD dated 29th November, 1980 except as respects things ... omitted to be done before such supersession and published as No. 1141/80, the Government of Kerala hereby make the following ...amely:—

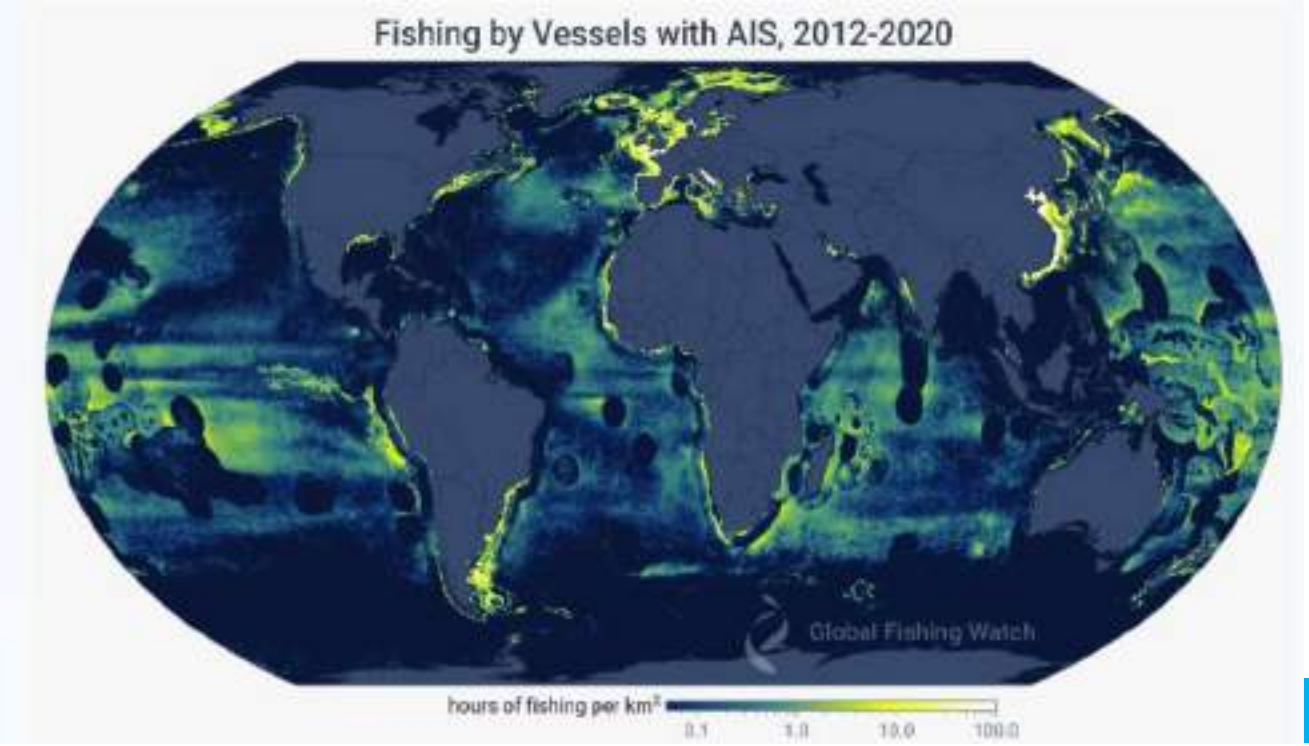
PRINTED AND PUBLISHED BY THE SUPERINTENDENT OF GOVERNMENT PRESSES AT THE GOVERNMENT CENTRAL PRESS, THIRUVANANTHAPURAM, 2018.
2018/S-2.

Unsustainable fishing and mitigation strategies

- Excess capacity in fishing
- Operational impacts of fishing
- Increasing energy use in fishing
- Abandoned, Lost or otherwise Discarded Fishing Gear (ALDFG)
- Marine plastic pollution

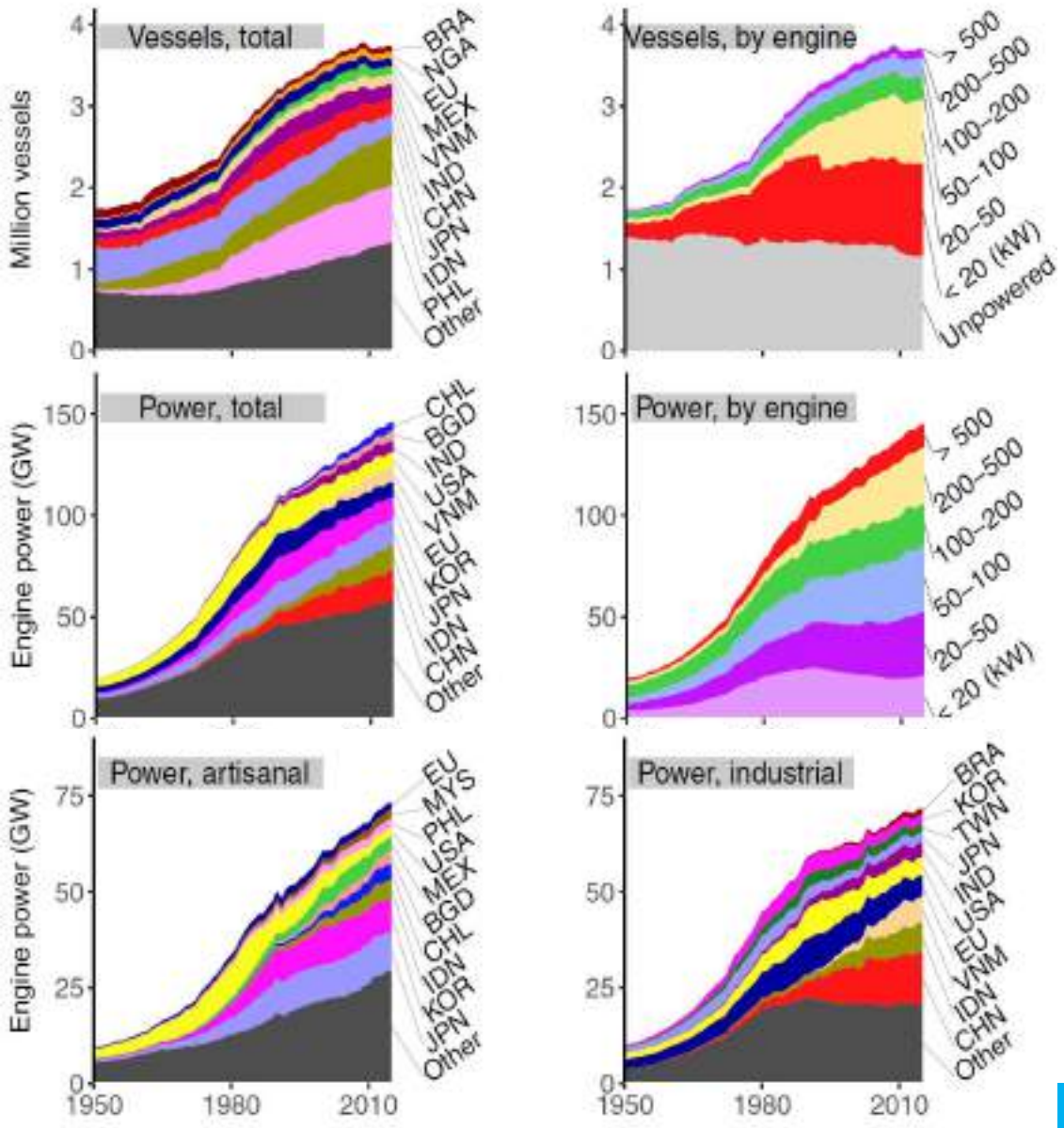
EXCESS CAPACITY IN FISHING

- FAO defines fishing capacity as the amount of fish (or fishing effort) that can be produced of a period of time (e.g. a year or a fishing season) by a vessel or a fleet if fully utilised and for a given resource condition .



- World fishing fleet - 4.56 million
  motorised - 2.86 million
  non-motorised- 1.7 million (FAO, 2020)

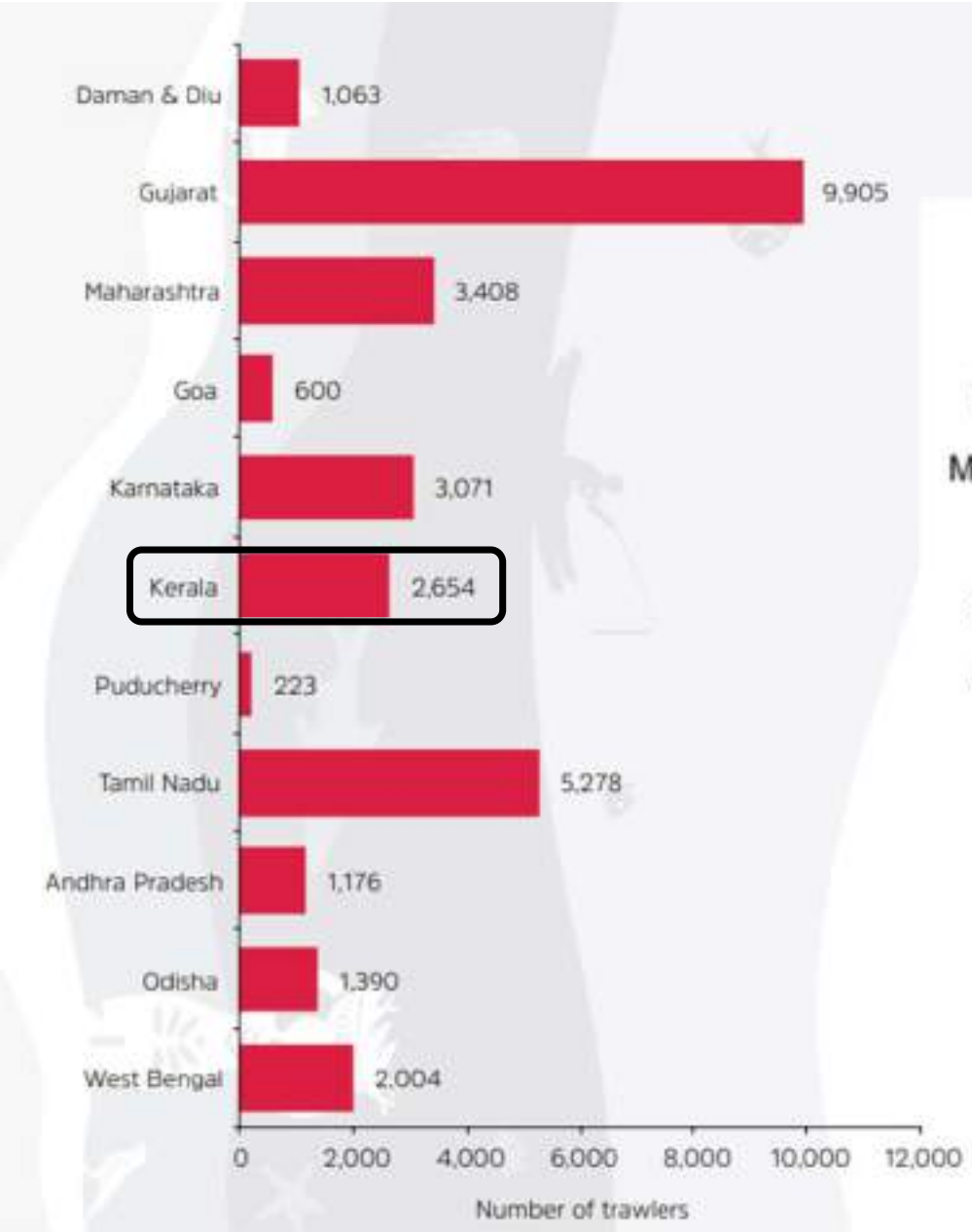
- decline of 2.8 percent decrease from 2016

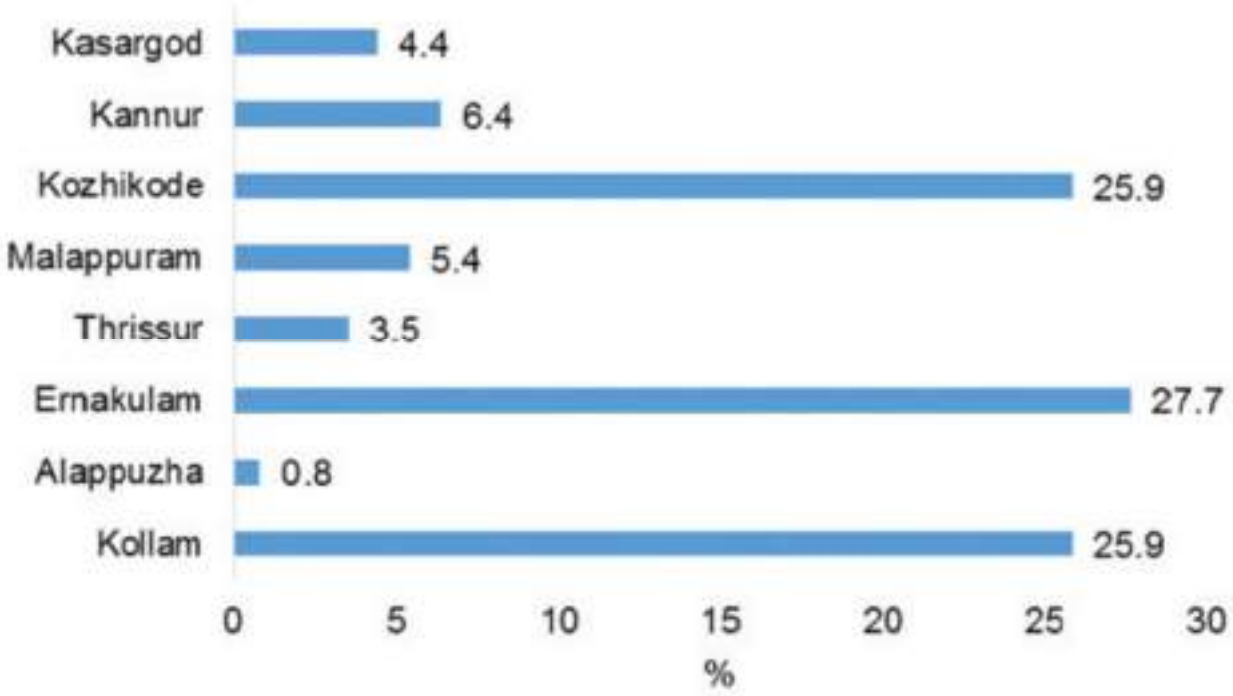


- Number of vessels in the global marine fishing fleet doubled from 1.7 in 1950 to 3.7 million in 2015.
- In the past three decades, however, the growth of industrial fleets has slowed considerably.
- The total engine power of the powered artisanal sector is equal to that of the industrial.

Rousseau et al., 2018

Trawling





Distribution of trawlers along coastal districts of Kerala

CMFRI, 2020

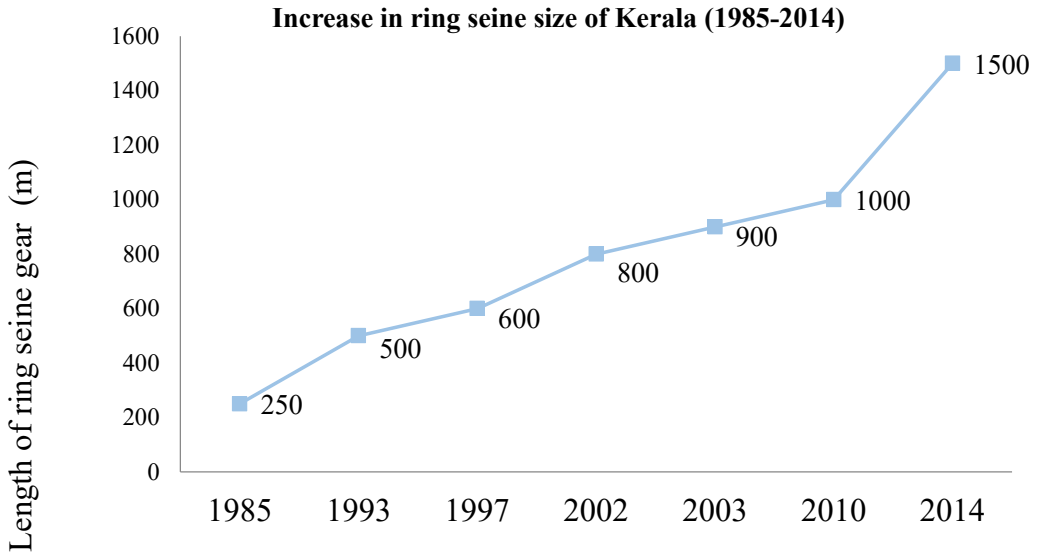
There is significant excess capacity in the fishery.

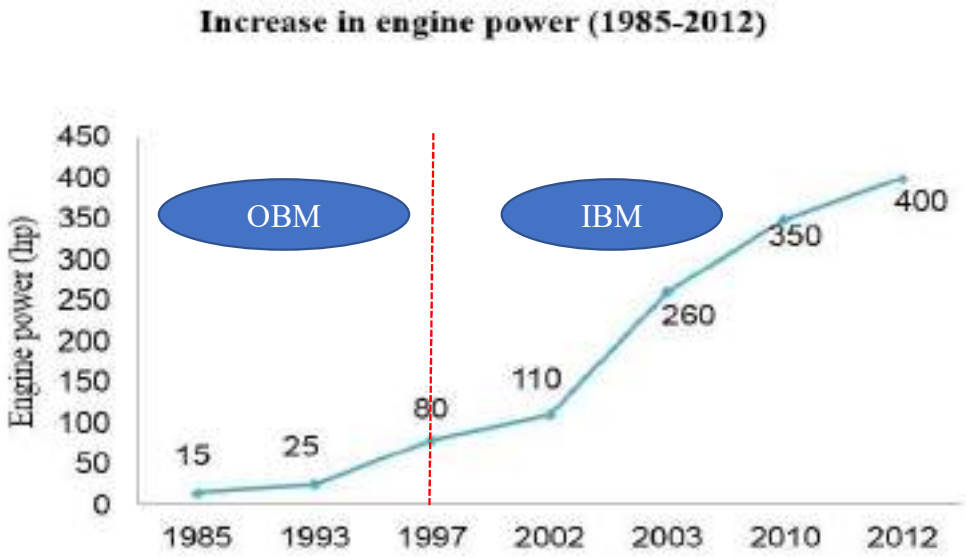
A phased removal of excess fishing capacity is recommended with buy-back schemes or for conversion to Low Impact Fuel Efficient (LIFE) fishing methods.

Trawl nets of Kerala

Type of trawl	Vernacular name	Head rope length (m)	Foot rope length (m)	Target species
Shrimp trawl	*Chemmeen vala*	23.4	25.2	*Metapenaeus dobsoni, M. affinis, Fenneropenaeus indicus, Parapenaeopsis stylifera*
		34.2	44.0	
		51.0	58.0	
		58.0	62.0	
Deep sea shrimp trawl	*Pullan vala*	40.0	43.7	*Aristeus alcocki, Heterocarpus woodmansoni, H. gibbosus, Plesionika ensis*
Fish trawl	*Meen vala*	39.6	39.6	*Stolephorus sp., Trichiurus sp., Pampus sp., Sphyraena sp., Sardinella fimbriata, S. gibbosa Rastrelliger kanagurta, Megalaspis cordyla, Cynoglossus sp., Nemipterus sp. and other fishes.*
	Thalayan vala	40.0	40.0	
		63.7	72.8	
		72.0	72.0	
	Meen vala	76.5	80.0	
	Chooda vala	64.0	71.0	
	Ayala vala	82.0	87.0	
	Manthal vala	39.6	39.6	
		58.0	62.0	
Cephalopod trawl	*Kanava vala*	54.0	54.0	*Sepia* spp.
	Koonthal vala	57.6	61.2	*Loligo* spp.

Edwin et al., 2014





Source: Panicker et al.,(1985); Edwin (1993); D,Cruz (1998); Krishna et al. (2004); Edwin et al. (2010); Das et al. (2012) Edwin et al. (2014)

Management of Ring seines

- Optimise the number of fishing units [originally300]
- Optimise the dimensions of the units -600x 60x 60hp
- Optimise mesh sizes as recommended in KMFRA
- Use ADD to prevent damage of nets

Regulation on mesh size of Gillnets

Name of Gear	vernacular name	Minimum mesh size (mm)	Type of mesh	Maximum Dimension (hung length and hung depth)
Gill net/ Drift net*				
Sardine net	Mathi/Chaalavala	33	Diamond	2000 m X 10 m
Mackerel net	Aiylavala	50	Diamond	2000 m X 10 m
Seer fish net	Ayakoora/ Ney-meenvala	104	Diamond	5000 m X 18 m
Pomfretnet	Avolivala	126	Diamond	5000 m X 18 m
Prawn net	Konchu/ chem-meenvala	38	Diamond	2000 m X 10 m
Tuna net	Chooravala	80	Diamond	5000 m X 18 m
Croaker net	Kora vala	40	Diamond	2000 m X 10 m

*Stretched mesh sizeSource: CIFT, Kochi

Polyamide (nylon) monofilament

- Increased volume of gear deployed
- Material lasts for a fishing season
- Absence of collection centres or proper disposal mechanism

… results in

- low quality of fish caught
- Ghost fishing
- Increased marine debris

… so

- ensure manufacturing quality
- ban very fine twines
- Regulate gear dimensions
- arrange for proper disposal
- create awareness among fishers

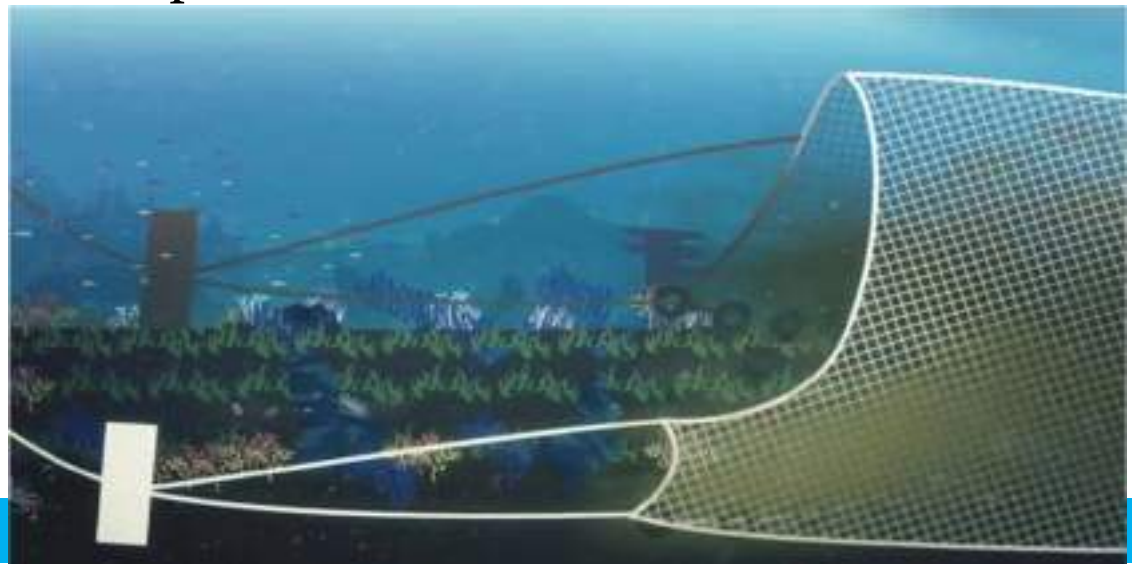
Management of gillnets

- Uncontrolled increase in the size of gear needs to be controlled. The maximum dimension of monofilament gillnets for operation is to be restricted to 2000 m length x 10 m depth for the small mesh (<45 mm mesh size) and medium mesh (45-70 mm) nets and for the large mesh (>70 mm) to 5000 m x 20 m depth
- Monofilament yarn of less than 0.20mm diameter is to be banned in fishing gears as materials thinner than this gets easily damaged. BIS standard (IS 7533: 2017) to be ensured
- Monofilament production units are to be monitored and the working of units producing low-quality material need to be closed down
- Authorities have to provide proper disposal facilities at landing centers and harbours for damaged nets so that fishers do not discard old and damaged material in water bodies and on beach.

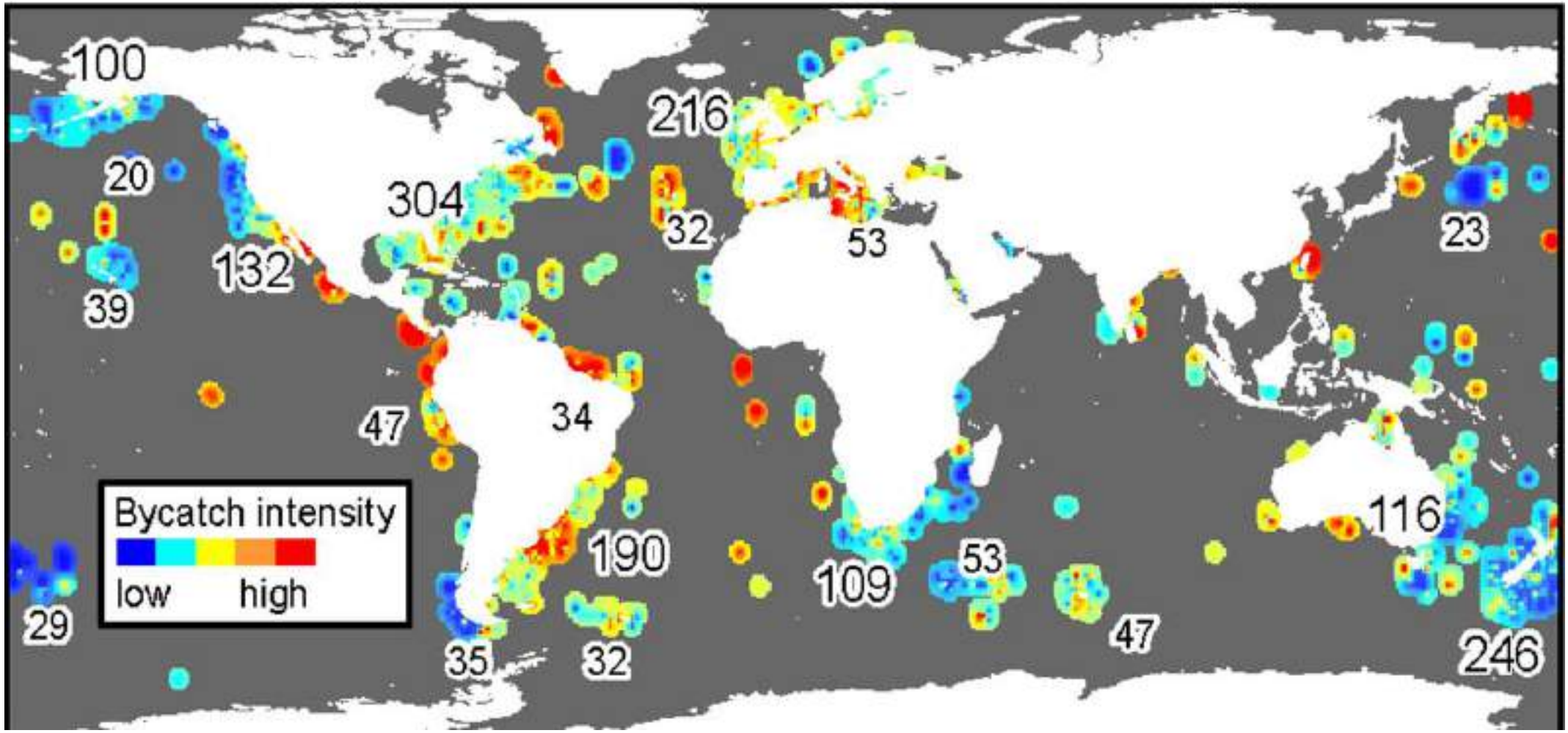
OPERATIONAL IMPACTS OF FISHING

Disturbance to the sea bottom

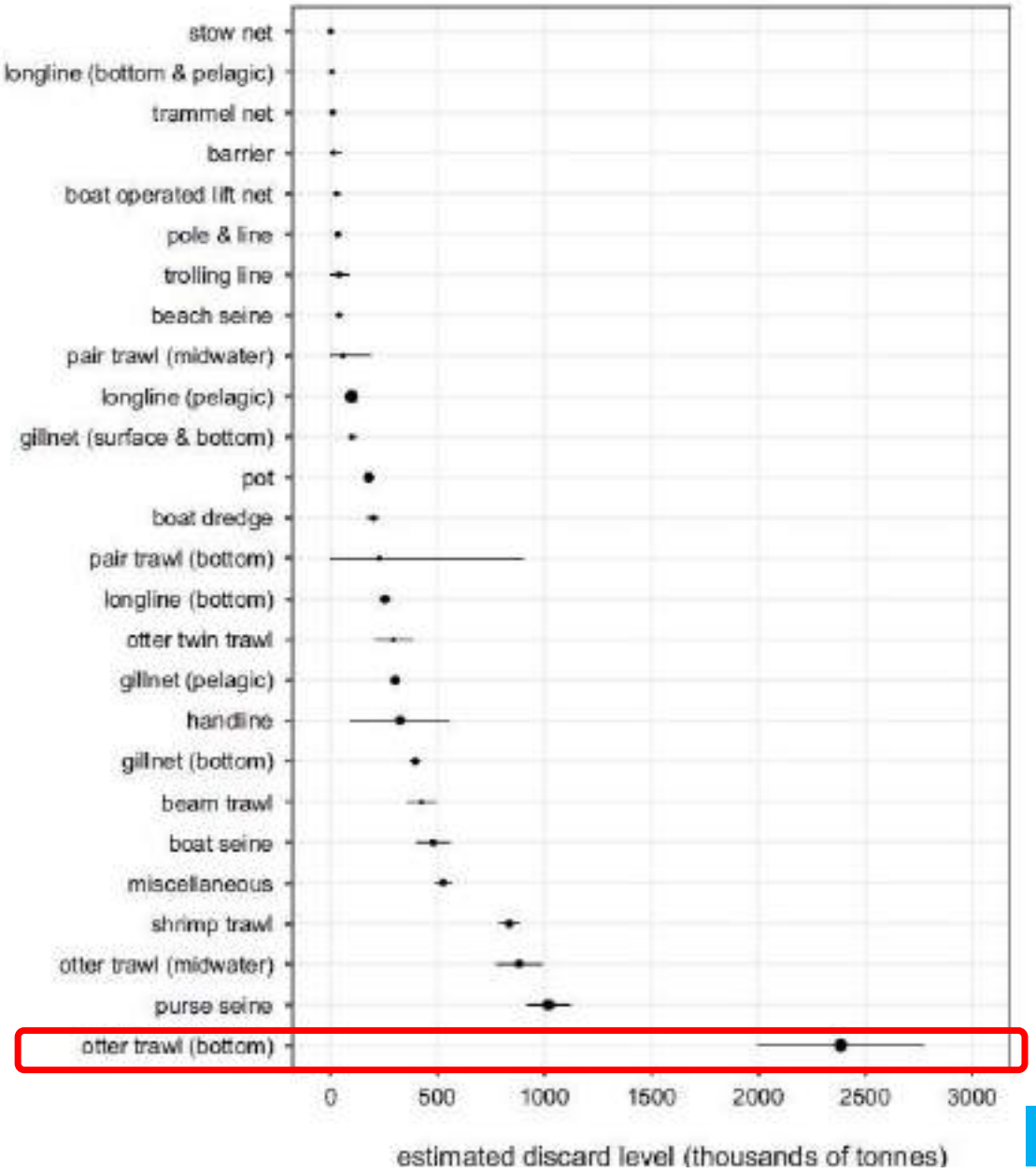
- Bottom trawls interact physically with the sea bottom and churns up the bottom sediment resulting in
  - destroying the natural seafloor and bottom habitats (corals, oysters, sponges etc.)
  - resuspension of bottom sediment (low light, nutrient changes)
  - decrease in biomass and production of benthic species
- Dredging affects the sea floor organisms

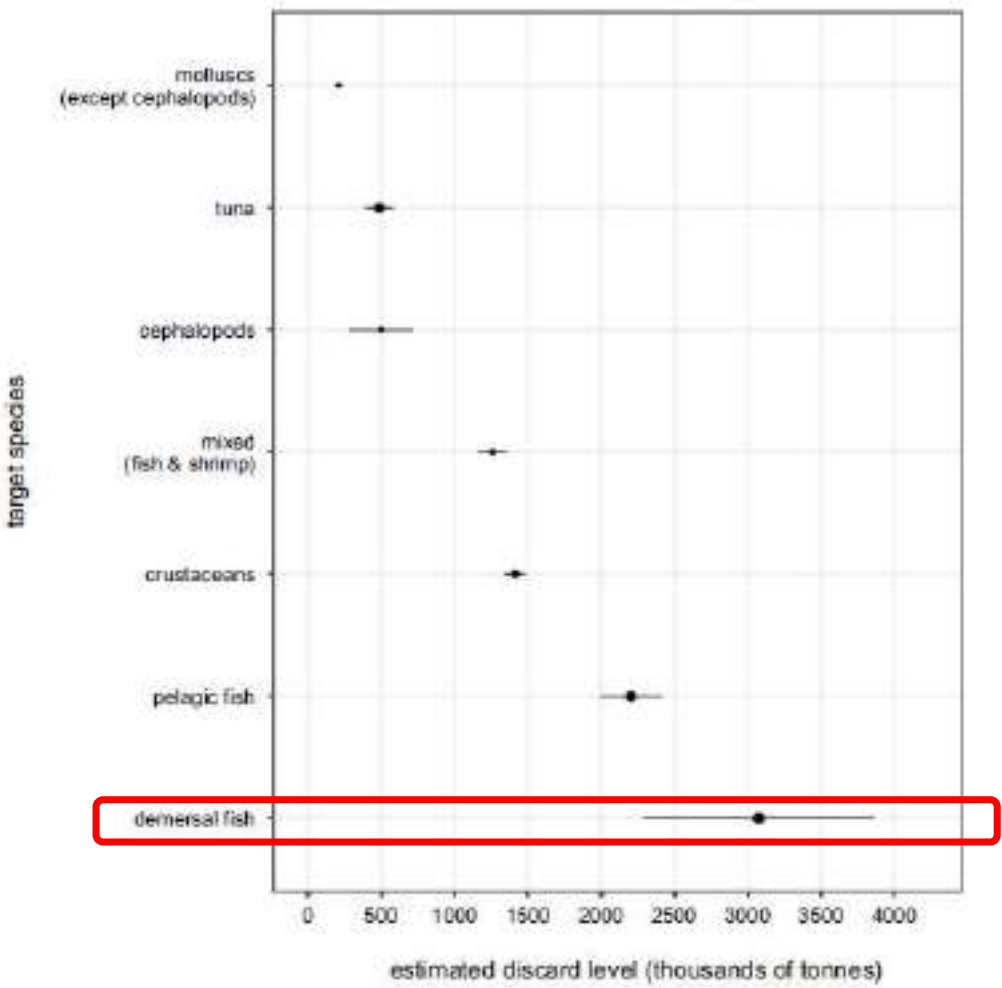


Bycatch and Discards



Lewison et al., 2014



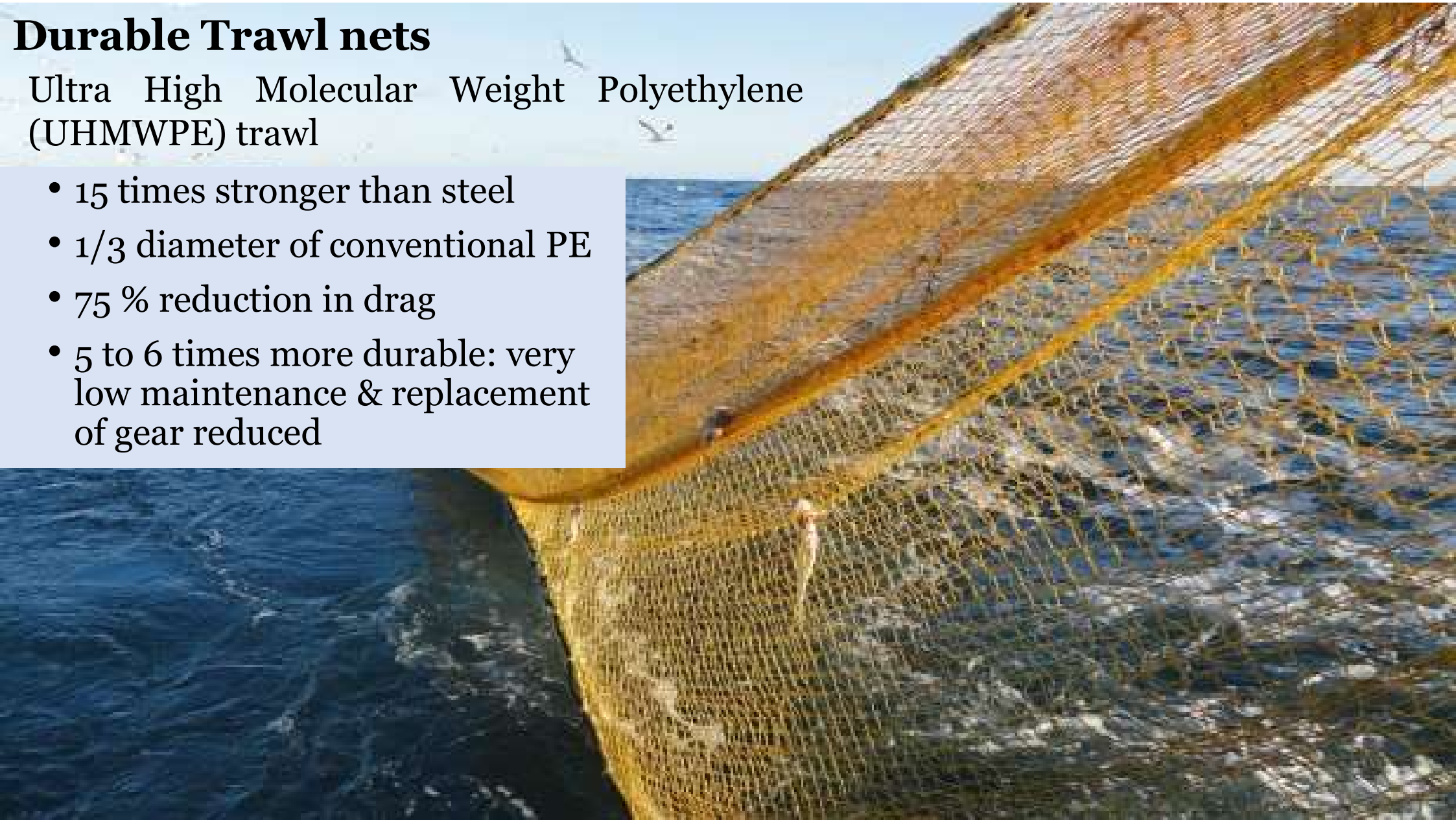


Gilman et al., 2020

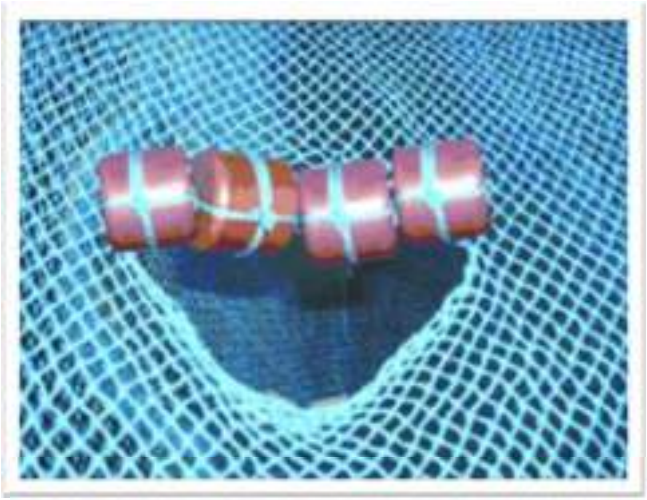
Durable Trawl nets

Ultra High Molecular Weight Polyethylene (UHMWPE) trawl

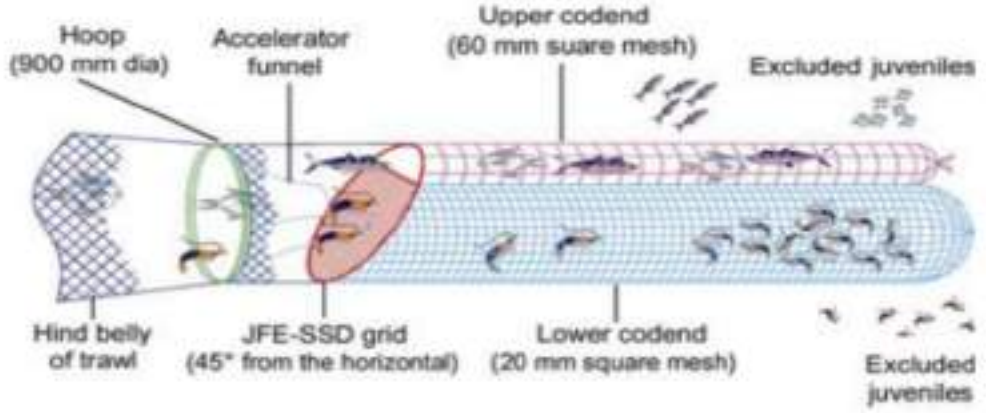
- 15 times stronger than steel
- 1/3 diameter of conventional PE
- 75 % reduction in drag
- 5 to 6 times more durable: very low maintenance & replacement of gear reduced



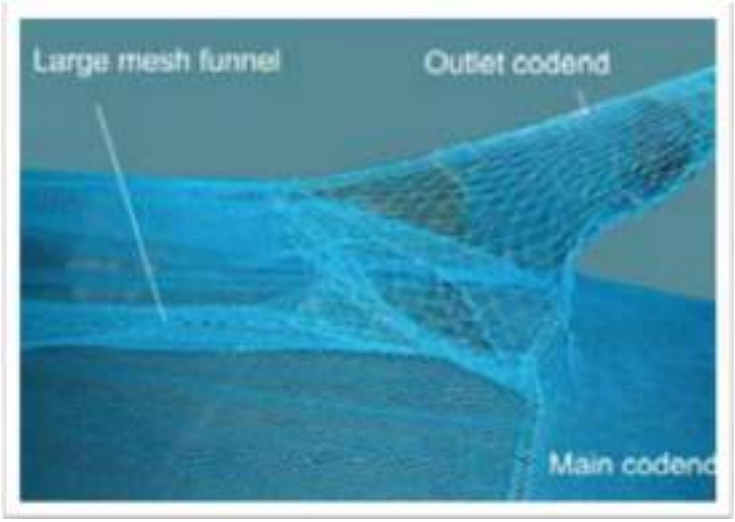
By-catch Reduction Devices (BRD)



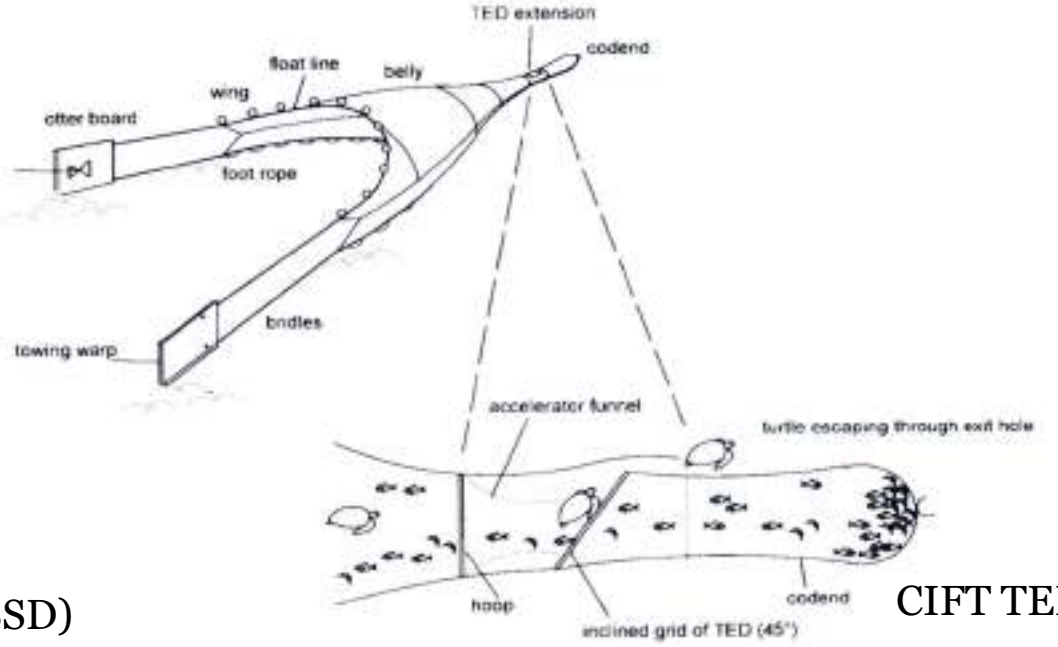
Bigeye in trawl codend



Juvenile Fish Excluder cum Shrimp Sorting Device (JFE-SSD)

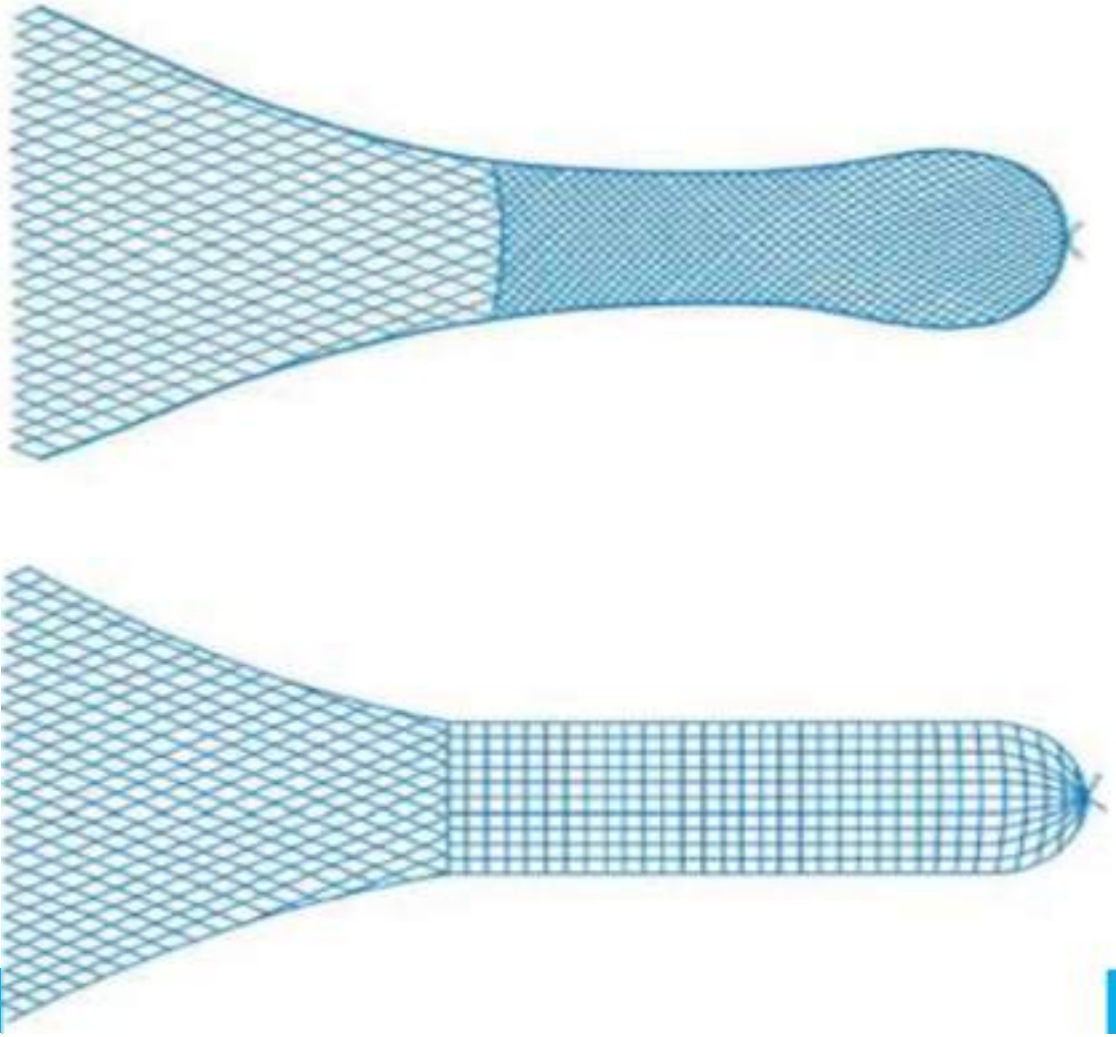


Sieve net BRD



CIFT TED

Square Mesh Codend

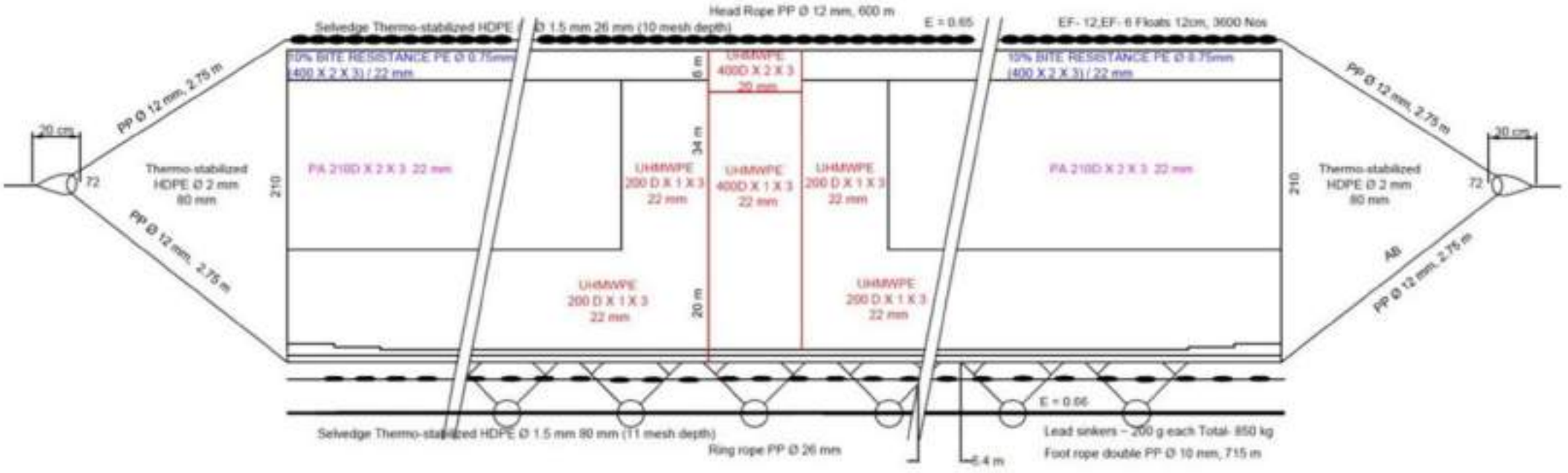


- Traditionally codends are made of diamond shaped meshes, which tend to close during the fishing process and hence make the release of untargeted species in the codend very difficult.
- Use of square mesh codends significantly reduces the bycatch often comprising of the juveniles of commercially important species.
- Good filtration and reduction in the drag are other benefits of the technology. No significant economic loss is incurred since the escapees are the juveniles which often fetch very less value in the market.

Marine mammal interaction during fishing causes depredation, loss of catch, damage to the fishing gear and sometimes entanglement and mortality

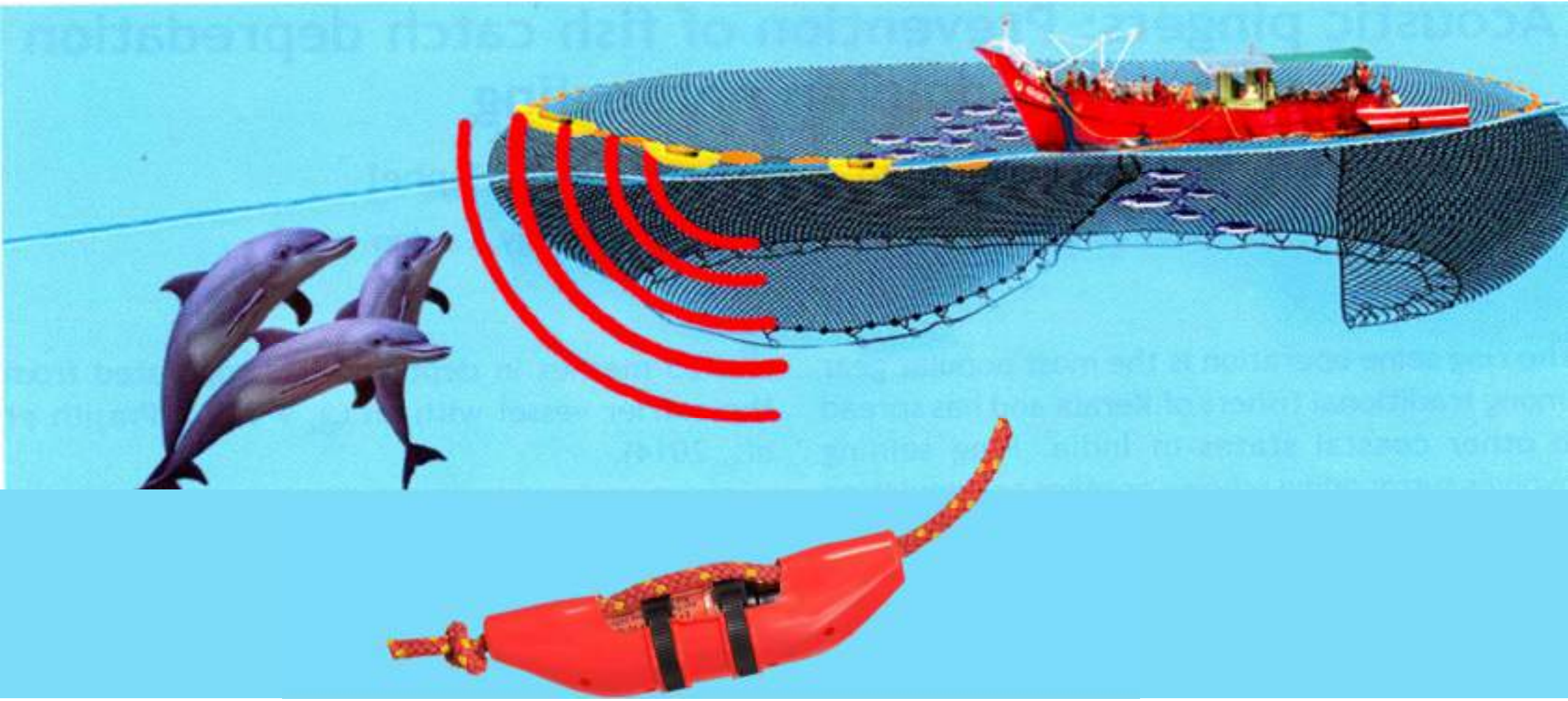
Gear damage due to cetacean attack

Damaged area being replaced by fresh piece of webbing



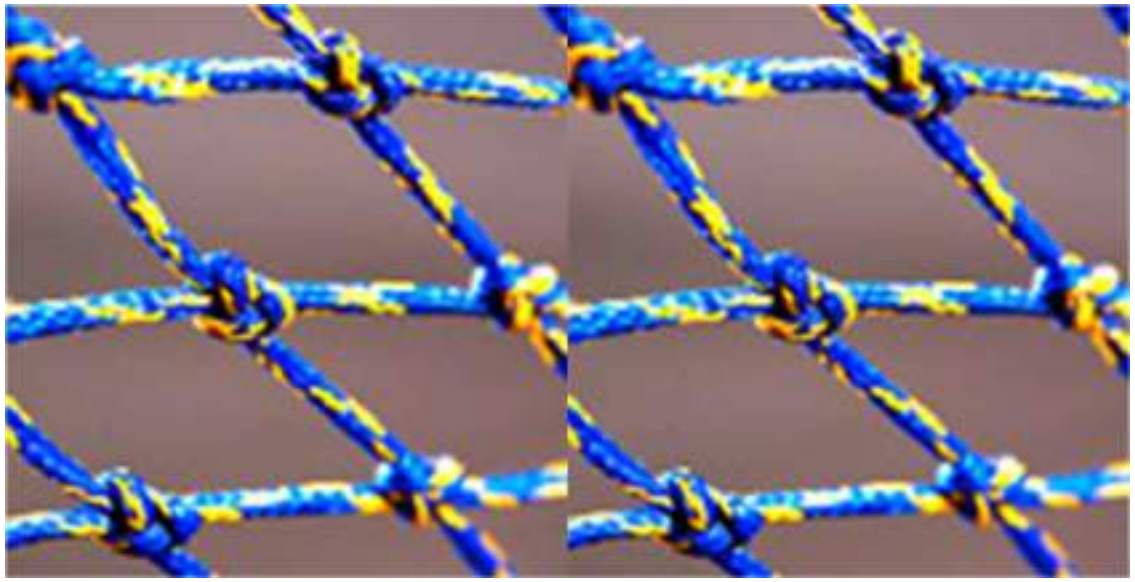
Concept and design of a new ring seine gear

Acoustic pingers to save dolphins and fish catch



High strength HDPE for gillnet (Sapphire)

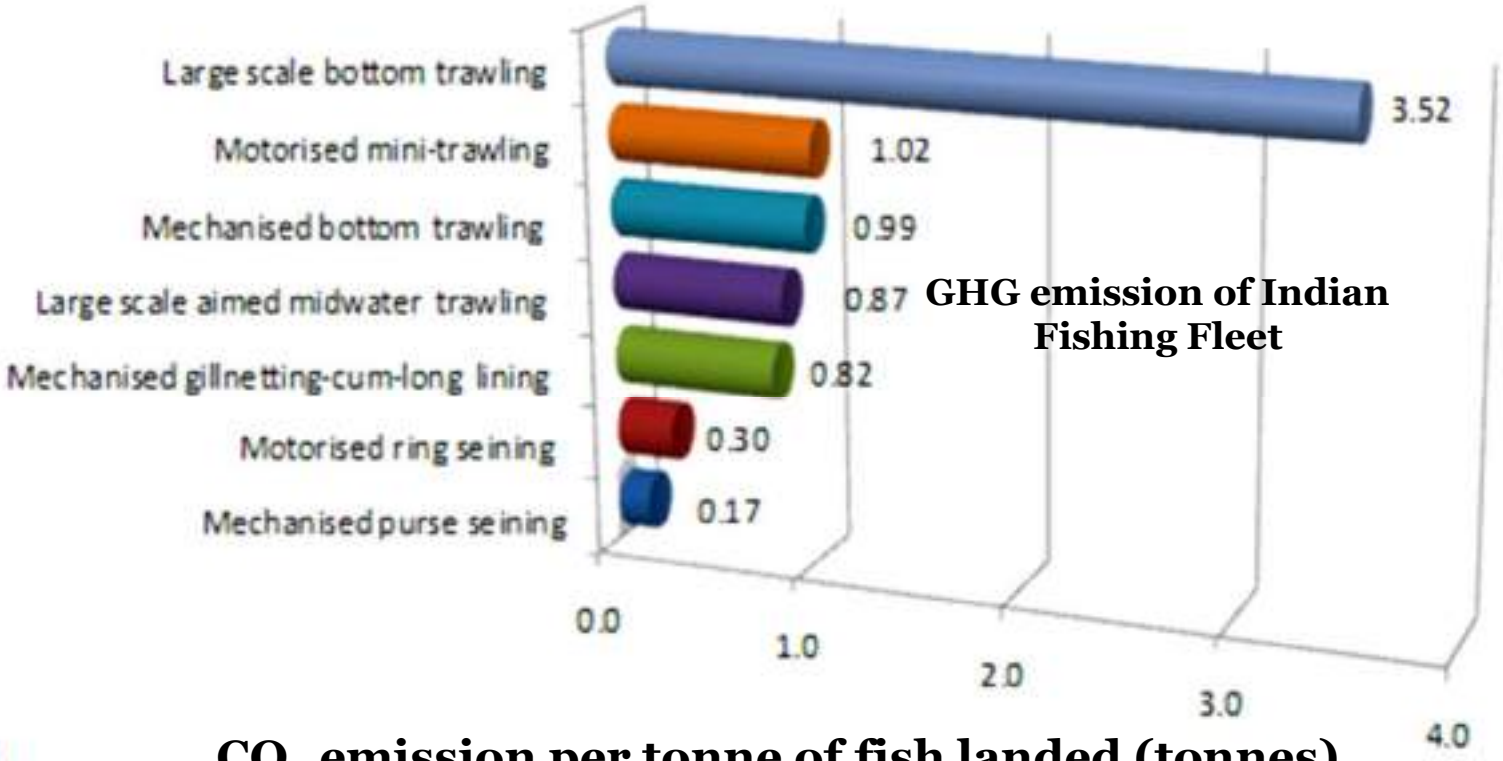
- Reduce fuel consumption by improved resistance to wear and tear
- Combines highest knot breaking strength and excellent abrasion resistance
- Braided twine : Compact Construction restricts mud penetration and provides less drag



INCREASING ENERGY USE IN FISHING

- Modern fishing is one of the most energy intensive methods of food production.
- Motorised and mechanised fishing are dependent on fossil fuels which are non-renewable and limited.
- FAO Code of Conduct for Responsible Fisheries (FAO, 1995) highlights the need for efficient use of energy in the fisheries sector.
- The upper safety limit for atmospheric CO_2 is 350 parts per million (ppm). Atmospheric CO_2 levels have stayed higher than 350 ppm since early 1988.
- Atmospheric CO_2 in October 2023– 418.87 ppm (Scripps UCSD, 2021)

- World consumes 40 billion litres of fuel for fishing
- Releases about 179 million tonnes of CO_2-equivalent (CO_2-eq) GHGs to the atmosphere
- 2.2 kg CO_2-eq per kg of landed fish (Parker et al., 2018)



(Vivekanandan, 2013)

Engine Power regulations

- An all India survey conducted by CIFT (2014) shows that at present the engine horse power of all types of mechanised fishing boats exceed the prescribed limit based on speed/ length ratio.
- Hence fuel consumption has drastically increased and this increases the carbon emission by the fishing units.
- High power engines requires larger fuel tanks which in turn increases the displacement of the vessel which calls for higher investment/ bigger berthing facilities
- This has affected the profitability of the units.

Dimensions and maximum allowable engine horse power for different length classes of trawlers

Sl. No	Length (m)	Breadth (m)	Depth (m)	Maximum allowable main engine horse power (MCR)
i.	Up to 15.00	Up to 4.70	2.40	**140***
ii.	15.00 – 17.50	4.60 – 5.20	2.40 – 3.00	**200***
iii.	17.50 – 20.00	5.20 – 5.50	2.65 – 3.10	**250***
iv.	> 20.00	> 5.25	>3.0	**> 250****

*Permitted for operation beyond the specified area vide G.O. (P) 29/86/F&PD dated 14.03.1986
**Operation on beyond territorial waters

Dimensions and maximum allowable engine horse power for different length classes of purse seiners

Sl. No.	Length (m)	Breadth (m)	Depth (m)	Maximum allowable main engine horse power (MCR)
i.	Up to 15.00	Up to 4.60	2.40	**190***
ii.	15.00 – 20.00	4.60 – 5.50	2.40 – 3.20	**240***
iii.	> 20.00	> 5.25	> 3.00	**>240***
*Operation on beyond territorial waters				

Dimensions and maximum allowable engine horse power for different length classes of gillnetters

Sl. No.	Length (m)	Breadth (m)	Depth (m)	Maximum allowable main engine horse power (MCR)
i.	Up to 15.00	Up to 4.60	Up to 2.40	**Up to 90***
ii.	15.00 – 20.00	4.60 – 5.50	2.40 – 3.20	**140***
iii.	> 20.00	> 5.25	> 3.00	**> 140****
*Permitted for operation beyond the specified area vide G.O. (P) 29/86/F&PD dated 14.03.1986 **Operation on beyond territorial waters				

Dimensions and maximum allowable engine horse power for different length classes of ring seiners

Sl. No.	Length (m)	Breadth (m)	Depth (m)	Maximum allowable main engine horse power (MCR)
i.	Anchovy < 15.0	Up to 5.0	Up to 2.50	**25**
ii.	Sardine/ Mackerel Up to 17.5	Up to 5.5	Up to 2.50	**65**
iii.	17.5 – 20.00	Up to 6.0	Up to 3.0	**250***
iv.	> 20.00	> 5.25	> 3.00	**> 250****
*Permitted for operation beyond the specified area vide G.O. (P) 29/86/F&PD dated 14.03.1986 **Operation on beyond territorial waters				

Dimensions and maximum allowable engine horse power for different length classes of long liner-cum-trawlers

Sl. No.	Length (m)	Breadth (m)	Depth (m)	Maximum allowable main engine horse power (MCR)
i.	Up to 15.00	Up to 4.70	2.40	**140***
ii.	15.00-17.50	4.60 – 5.20	2.40 – 3.00	**200***
iii.	17.5 – 20.00	5.20 – 5.50	2.65 – 3.10	**250***
iv.	> 20.00	> 5.25	> 3.00	**> 250****
*Permitted for operation beyond the specified area vide G.O. (P) 29/86/F&PD dated 14.03.1986 **Operation on beyond territorial waters				

Fishing using artificial lights

- Light fishing is the technique of aggregating fish by artificial light; lights attached to structure above water or suspended underwater.
- Using light attraction spawning adults or as juveniles of fishes are easily captured
- Only surface light is allowed for artisanal fishing.
- The Govt. of India has banned light fishing.

Abandoned, Lost or otherwise Discarded Fishing Gear (ALDFG)

- Approximately, 6% of all fishing nets, 19% of all traps and pots, and 29% of all fishing lines are estimated to be lost around the world each year (Richardson et al., 2019).
  - Plastic debris constituted contributes to 60-70% of marine litter
  - Fishing related debris constitute 30-40% of marine plastic debris.

Impacts of ALDFG

- continued catching of target and non-target species (such as turtles, seabirds and marine mammals)
- alterations to the benthic environment
- navigational hazards
- beach debris/litter
- introduction of synthetic material into the marine food web
- introduction of alien species transported by ALDFG
- a variety of costs related to clean-up operations

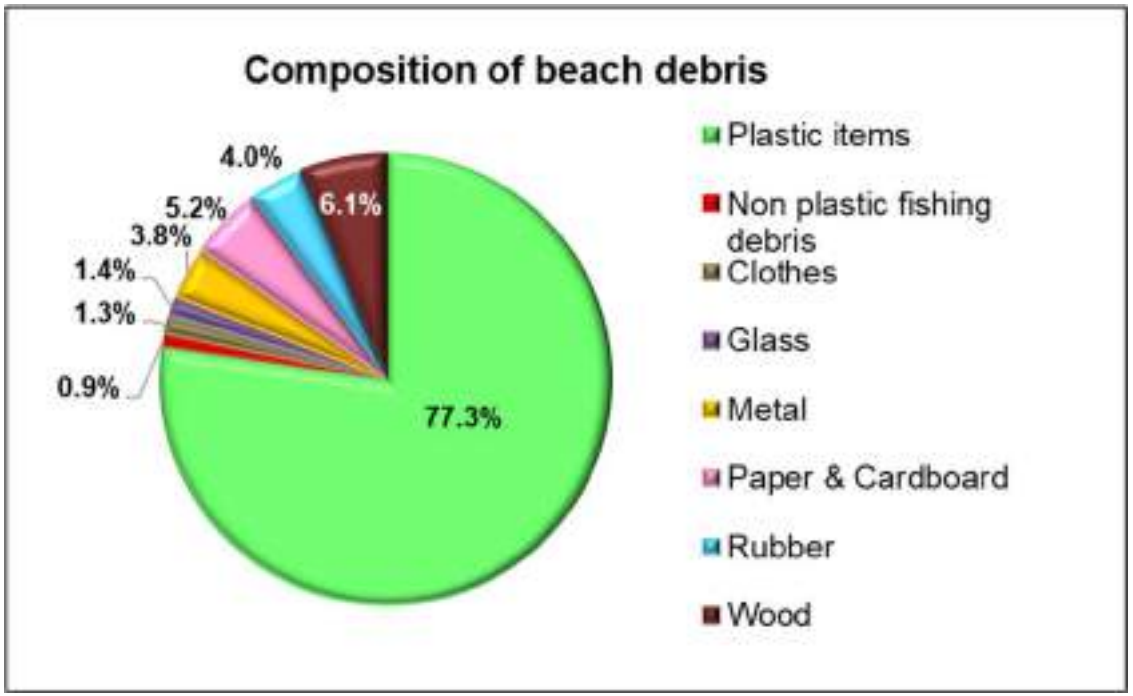
ALDFG mitigation

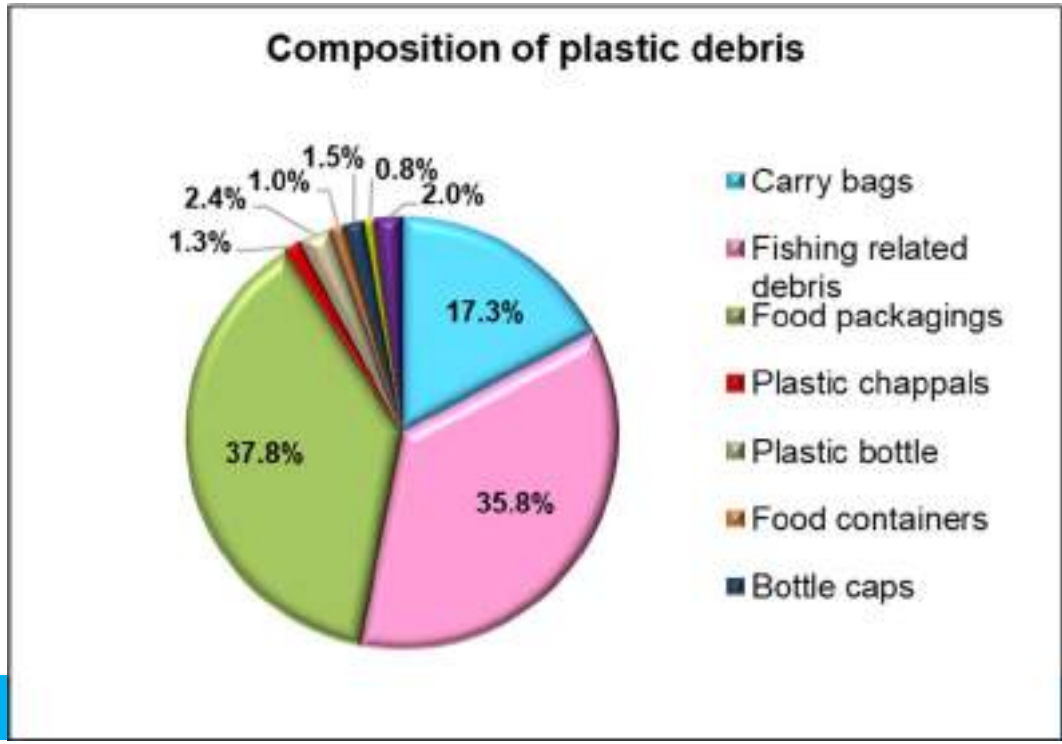
- Gear marking (Voluntary Guidelines on the Marking of Fishing Gear, FAO, 2019)
- Bio degradable materials in synthetic gears
- Optimising size of gears
- Awareness creation among fishermen
- Collection for recycling

MARINE PLASTIC POLLUTION

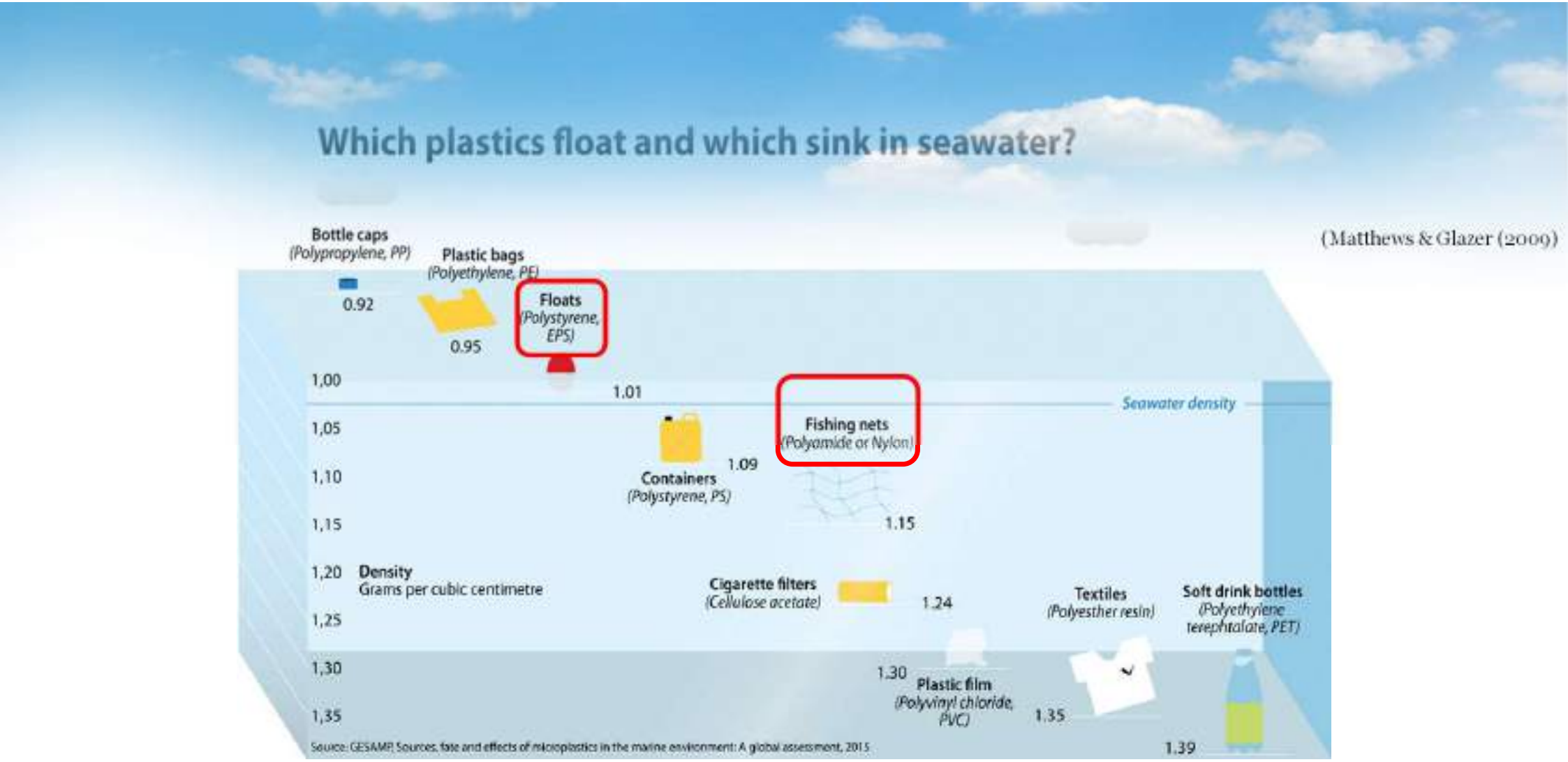
- Over 300 million tons of plastic are produced every year for use in a wide variety of applications.
- At least 8 million tons of plastic end up in our oceans every year, and make up 80% of all marine debris from surface waters to deep-sea sediments.
- Marine species ingest or are entangled by plastic debris, which causes severe injuries and deaths.
- Plastic pollution threatens food safety and quality, human health, coastal tourism, and contributes to climate change.

Fishing Related Plastic debris recorded from beaches of Kerala, India





(Source Damaris et al., 2020)



Majority of ALDFG are underwater (60.1%), remaining 24.6% on shorelines and 15.3% floating at sea

Plastics from Boat building materials

- **Fiberglass Reinforced Plastic (FRP)** used as a boat building material since 1940 and widely used for the construction of small size fishing boats (FRP and Sheathed boats).

- In 2016, the London Convention and London Protocol (LC/LP), discussed and identified **end-of-life FRP boat as a marine debris (unavailability of recycling/reuse)**

- End-of-life FRP fishing boats cause a deleterious impact on the ecosystem after being **abandoned/discarded in the environment.**

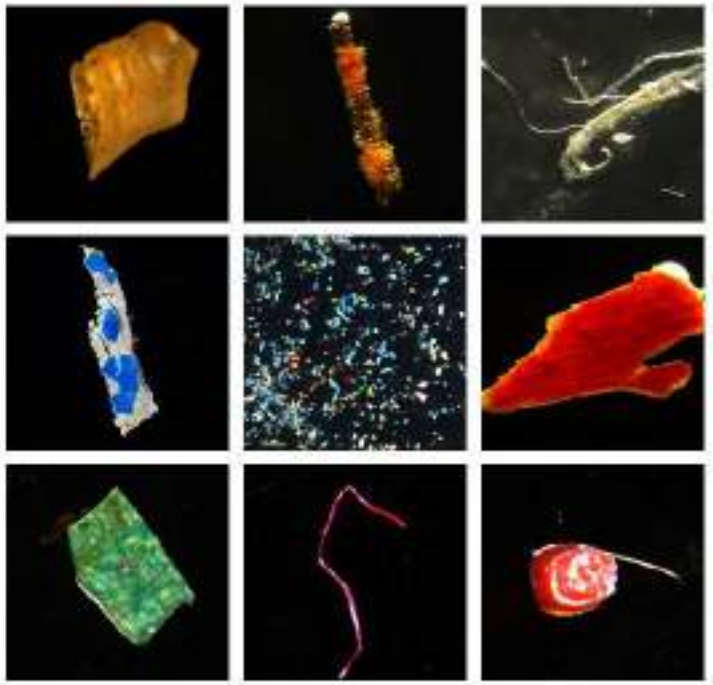
a. Away from landing centres, b. backyard burning, c. sunken in water , sunken in sand

- The coastal zones of Kerala are impacted with an escalating intensity of disposal.
- CIFTs study- an average of **29 boats/km** were identified from the selected fish landing centres (15 centres).

- More than **90%** of the abandoned boats were **FRP sheathed** over marine plywood/wood, with a life expectancy of less than 10 years.

Weathering of plastics in marine environment

Photodegradation and other weathering processes at the marine environment led to fragmentation, increasing micro-and nano plastic abundance which causes ecological, social and economic impacts.



Guidelines

- FRP recycling units – more research and infrastructure
- Reuse – construction activities – shredded and powdered; (In kiln – use as an energy source)
- Phasing out of sheathed boat
- Subsidies for fishing boats with recyclable materials
- Standards must be formulated for construction of FRP fishing boats

Recycling plastic waste collected by fishermen from the sea

Fishermen removed 25 tonnes of plastic from the sea, including 10 tonnes of plastic bags and bottles in the first 10 months.

G20 Report on Actions Against Marine Plastic Litter

- In the recently concluded G20 summit about 50% of the participating countries have indicated initiatives to restrict microplastics in personal care products and in promoting the collection of end-of life fishing gears and creating a value chain opportunity for abandoned, lost, and discarded fishing gear (ALDFG)

- The efforts for prevention and reduction in plastic waste generation is gaining huge impetus as 73% of the countries levy charges/ taxes on single use plastics while 63% have completely banned SUPs. Further, 77% of the countries have established frameworks to encourage sustainable and circular product designs and 83% reported having policies to promote plastic alternatives

Recommendations on Gear Marking

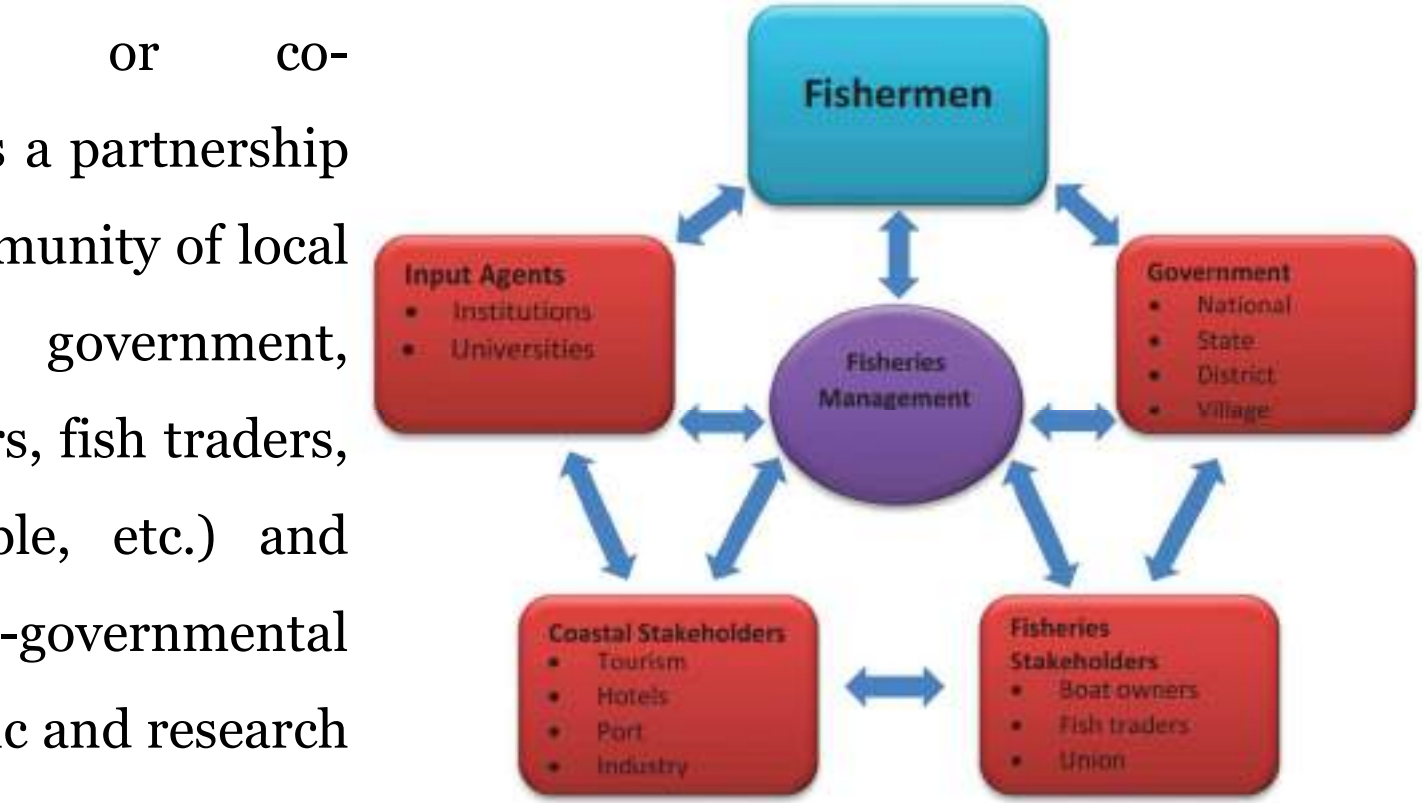
- Creation of awareness among fishermen on the International requirements and the use of gear marking system
- Providing gear manufacturers with clear guidelines on the marking of gear and accessories
- It must be made mandatory that all registered fishing vessels should operate only marked gears
- The specification details of each gear available onboard a vessel is to be entered in the log book and details of operation to be recorded
- Considering that a large section of artisanal fishers of India factoring the cost of marking into the cost of gear will be difficult for the fishers to bear
- Prevention of defaults is also to be ensured through proper monitoring
- A unique identification code that can be machine read for each gear being operated from registered fishing vessels can be used for gear marking

F. V. Sagar Harita

Novel features	Advantages
Bulbous bow	Reduces resistance and improves fuel efficiency
Larger fuel tank (14000 l capacity)	For greater endurance at sea
RSW tank (4 -5 m^3)	Quick and better quality fish preservation
Solar panels (20 m^2–2 kw)	Navigational lighting, wheel house equipment, galley use
Underwater sensor	To monitor trawl gear
Hydraulic long line winch	Reduce labour
Split trawl winch	To save deck space
Gill net drum	Reduce labour
FRP Cabin and wheel house	For reducing the weight 8%
Hydraulic derrick	For easy handling of weight onboard
Freezer-cold store- RSW tank in a row	For easy handling of catch
Reduced wheel house height	For increased stability
Efficient propulsion system	Increased thrust
Bilge keel	To reduce rolling

Marine fisheries management model

Participatory management or co-management can be defined as a partnership arrangement in which the community of local resource users (fishermen), government, other stakeholders (boat owners, fish traders, boat builders, business people, etc.) and external input agents (non-governmental organizations (NGOs), academic and research institutions) share the responsibility and authority for the management of the fishery.



Mohamed et al, 2014


Thank You