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MFiS

Marine Fisheries Information Service Technical & Extension Series

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Marine Fisheries Information Service Technical & Extension Series

The Marine Fisheries Information Service, Technical & Extension Series (MFIS) is a quarterly publication of ICAR-Central Marine Fisheries Research Institute disseminating latest research information on marine fisheries and mariculture in India. Research based technical articles, reporting significant new information, knowledge and understanding of marine fisheries and ecosystems as well as new concepts/technologies in marine fish nutrition, hatchery and larval rearing, fish pathology, fish health management, application of genetics in fish conservation and farming, sea farming technologies, seafood trade and fisheries governance are published. To see all issues since 1978, visit:

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Tomato hind caught in the Hooks and line fishery
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Marine Fisheries Information Service Technical and Extension Series envisages dissemination of information on marine fishery resources based on research results to the planners, industry and fish farmers and transfer of technology from laboratory to the field.

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From the Editorial Board

Warm greetings to all our esteemed readers

Marine fisheries of India are complex multi-species fishery assemblages typical of a tropical ecosystem and support the livelihoods of several million people, directly and indirectly. The marine fish exports, especially the shrimps significantly contribute to the export earnings and thereby the Indian economy. India is the world leader in the shrimp seafood supply chain but also has immense scope to offer diversified seafood tapped from its vast EEZ of 2.02 million square kilometres. To effectively capture the potential in domestic and international markets, it has to align its capture and culture fisheries policies with sustainability and traceability features, powered by science-based fisheries management practices. Optimal utilization of resources, adoption of new technologies and capacity building in the sector effectively tapping into the various government initiatives can transform the fisheries sector in India. The articles in this issue of MFIS focus on some of the recent efforts and outcomes of such approaches.

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Brief Communication

Steering toward sustainability: Proposed Minimum Legal Size for 50 marine species

Rajan Kumar*, Vinaya Kumar Vase, K. Mohammed Koya, Dash Swatipriyanka Sen, Dash Gyanaranjan, Rajesh Pradhan, Shikha Rahangdale, Abdul Azeez and P. S. Swathi Lekshmi
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The marine fisheries sector in Gujarat is undergoing rapid advancements, with notable improvements in fishing technology, expansion into new fishing grounds, and targeting of previously untapped resources. The industry is primarily led by a mechanized fleet—trawlers at the forefront—followed by dolnetters, gillnetters, and motorized fleets (both inboard and outboard). However, declining catch rates of commercially valuable fish species have pushed fishermen to harvest smaller-sized fish, posing a serious threat to the long-term sustainability of fish stocks. One effective tool to combat growth overfishing is the implementation of minimum legal size (MLS) regulations. MLS helps reduce juvenile exploitation, protects reproductive groups, and enables fish to grow, ultimately improving market value. The criteria for determining MLS in Gujarat are based on the methodology of Mohamed *et al.* (2014) (Table 1), focusing on the species' growth, biological, and reproductive traits. For resilient stocks, the minimum size at maturity (MSM) is proposed to combat growth overfishing, while the size at first maturity (LM_{50}/WM_{50}) is applied to depleted or rebuilding stocks, ensuring fish have a chance to spawn before being caught, thus reducing recruitment overfishing.

Based on an elaborate study and primary data collected by the research team of Veraval Research Station of ICAR-CMFRI, a minimum legal size for 50 commercially important resources were proposed to combat the overfishing in the region. The criteria for determining Minimum Legal Size (MLS) were based on several key factors, including time-series moving average trends, species growth or condition, exploitation rates, and reproductive strategies. For commercially exploited species such as *T. lepturus, N. japonicus, P. layardi, E. affinis, M. cordyla, C. hippurus, O. biauritus, P. diacanthus*, and *J. glaucus*, the Minimum Size at Maturity (MSM) was selected as the MLS benchmark. In contrast, the size at first maturity (LM_{50}) was used as the MLS criterion for species like *S. laticaudus, P. candidus*, and various shellfishes including *S. crassicornis, P. stylifera, M. affinis, P. semisulcatus,* and *U. duvaucelii*. A detailed breakdown of the MLS for these commercially significant species in the region can be found in Table 2.

Table 1. Decision Logic criteria used to define the MLS for marine fish stocks (adopted from Mohamed *et al.,* 2014).

Criteria	Explanation	Logic
SSD	Size at sexual differentiation into male and female	This metric can be applied to prevent juvenile exploitation and mitigate growth overfishing in stocks that exhibit high abundance, strong reproductive capacity, and demonstrate resilience to intense fishing pressure without significant reductions in biomass.
MSM	Minimum size at maturity or size of the smallest mature fish	This metric can be utilized to prevent growth overfishing in stocks that exhibit moderate resilience to fishing pressure.
LM_{50}/WM_{50}	Length/Weight at first maturity or size at which 50% of the fishes are mature	Employed as a metric to fully prevent growth overfishing while partially mitigating recruitment overfishing, this approach is applicable in scenarios where the stock is either depleted or in the process of rebuilding.
SCM	Size at complete maturity or size at which 100% of the fish are mature	This metric can be employed to prevent recruitment overfishing by setting a maximum legal size for capture. It is particularly relevant for fish species that attain large sizes and exhibit slow growth rates, with seasonal applicability.

Table 2. Minimum Legal Size (MLS) of 45 commercially important marine resources along Gujarat coast.

Species Name	Common Name	Vernacular Name	Recommended MLS (mm/g)	Decision Logic
Rastrelliger kanagurta	Indian Mackerel	Malabar Bhangda	140 TL	MSM
Harpodon nehereus	Bombay duck	Bhumla	185 TL	MSM
Coilia dussumieri	Golden anchovy	Mandeli	115 TL	MSM
Euthynnus affinis	Little tuna	Gedra	377 TL	MSM
Megalaspis cordyla	Horse mackerel	Bhangda	261 TL	MSM
Trichiurus lepturus	Ribbonfish	Baga	448 TL	MSM
Thunnus tonggol	Longtail tuna	Sherva	480 TL	MSM
Thunnus albacares	Yellowfin tuna	Veer gedra	500 FL	MSM
Katsuwonus pelamis	Skipjack tuna	Nani gedra	350 FL	MSM
Coryphaena hippurus	Dolphin fish	Apnus	545 TL	MSM
Scomberomorus commerson	King seer	Surmai	500 FL	MSM
Scomberomorus guttatus	Spotted seer	Surmai	370 FL	LM_{50}
Rachycentron canadum	King fish	Sakra	610 FL	LM_{50}
Decapterus russelli	Indian scad	Pira bhangda	110 TL	MSM
Nemipterus japonicus	Threadfin bream (yellow)	Ranimachla	125 TL	MSM
Nemipterus randalli	Threadfin bream (red)	Ranimachla	100 TL	MSM
Lactarius lactarius	White fish	Katali	100 TL	MSM
Saurida tumbil	Greater lizardfish	Bhungar	170 TL	MSM
Saurida undosquamis	Brushtooth Lizardfish	Bhungar	100 TL	MSM
Protonibea diacanthus	Black spotted croaker	Ghol	700 TL	MSM
Otolithoides biauritus	Bronze croaker	Koth	660 TL	MSM
Otolithes cuvieri	Lesser tiger toothed croaker	Dhoma	160TL	MSM
Otolithes ruber	Tiger toothed croaker	Dhoma	170 TL	MSM
Johnius glaucus	Pale spotfin croaker	Dhoma	148 TL	MSM
Johnius dussumieri	Sin croaker	Dhoma	110 TL	MSM
Pampus candidus	Silver pomfret	Vichudo/Paplet	133 SL	MSM
Parastromateus niger	Black pomfret	Halvo	170 TL	MSM
Epinephelus diacanthus	Spiny cheek grouper	Whekli	180 TL	MSM
Priacanthus hamrur	Bull's eye	Dorali	140 TL	MSM
Cynoglossus macrostomus	Malabar sole	Jib	90 TL	MSM
Plicofollis layardi	Thinspine sea catfish	Khagi	291 TL	MSM

Species Name	Common Name	Vernacular Name	Recommended MLS (mm/g)	Decision Logic
Leptomelanosoma indicum	Indian threadfin	Dara	530 FL	MSM
Pomadasys argenteus	Silver grunt	Karkara	250 TL	MSM

Species Name	Common Name	Vernacular Name	Recommended MLS (mm/g)	Decision Logic
Congresox talabonoides	Indian Pike conger	Wam	950 TL	MSM
Scoliodon laticaudus	Spadenose shark	Sandho	376 TL	LM_{50}
Brevitrygon imbricata	Scaly whipray	Warkhol patari	140 DW	MSM
Solenocera crassicornis	Coastal mud-prawn	Lal kolmi	63 TL	MSM
Parapenaeopsis stylifera	Kiddi prawn	Kolmi	65 TL	MSM
Metapenaeus affinis	Jinga prawn	Medium jinga	102 TL	MSM
Metapenaeus monoceros	Speckled prawn	Kapsi jinga	105 TL	MSM
Metapenaeus dobsoni	Flower tail prawn	Flower jinga	60 TL	MSM
Penaeus semisulcatus	Green tiger prawn	Patta jumbo	120 TL	MSM
Portunus sanguinolentus	Spotted crab	Karchala	74 CW	MSM
Portunus pelagicus	Blue crab	Karchala	90 CW	MSM
Charybdis feriata	Cross crab	Karchala	66 CW	MSM
Panulirus polyphagus	Mud spiny lobster	Teetan	300 g	WM_{50}
Panulirus homarus	Scalloped spiny lobster	Teetan	200 g	WM_{50}
Uroteuthis (photololigo) duvaucelii	Indian squid	Narsinga	107 DML	MSM
Uroteuthis (photololigo) singhalensis	Long barrel squid	Narsinga	83 DML	MSM
Sepia pharaonis	Pharaoh cuttlefish	Makul	110 DML	MSM

Abbreviations: TL – Total Length; FL – Fork length; CW – Carapace Width of Crabs; DML – Dorsal Mantle Length of Cephalopods; DW – Disc Width of Rays; LM_{50} – Length at which 50% of the fishes are mature; MSM – Minimum Size at Maturity or size of the smallest mature fish; WM_{50} – Weight at first maturity or the weight of the animal where 50% of the fishes are mature.

The proposed MLS could be adopted by the state of Gujarat as a regulatory measure to ensure long-term sustainability of the marine fisheries of Gujarat. However, considering the multi-species and multi-gear nature of the fisheries and possible minor decline in catch rates for a few years during the initial period of its adoption could be a challenge in its adoption and implementation. A landing site or coastal district wise awareness campaigns among fishers regarding need and long-term benefits of MLS implementation prior to its adoption and implementation should allow smoother adoption and implementation. Further, the officials of implementing agency, Department of Fisheries (DoF), Gujarat should be trained in sampling and estimating the proportion of catches below MLS to ensure effective implementation during the post-adoption phase of proposed MLS. Post-adoption study on the economic impact and changes in biomass and size structure of the resources is recommended to quantify the effect of the regulatory measure as a part of management strategy evaluation (MSE). The multi-disciplinary team of ICAR-CMFRI in a participatory mode with fishers and officials of DoF should conduct awareness programs and the impact study.

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Mohamed, K.S. *et al*., 2014. *Mar. Fish. Infor. Serv., T & E Ser.,* 220: 3 - 7

Brief Communication

Significance of Green tiger shrimp fishery in Palk Bay, Tamil Nadu

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The Green tiger shrimp, *Penaeus semisulcatus* De Haan, 1844, is an important commercial penaeid shrimp in capture fisheries and culture practices due to its large size and fast growth rate. It is known as '*Mandapam flower* or *Flower shrimp*' in the international market. *P. semisulcatus* contributes over three-fourths of the shrimp landings in Palk Bay and the Gulf of Mannar. Palk Bay (9° 55′ to 10° 45′ N and 78° 58′ to 79° 55′ E), situated in Tamil Nadu on the southeast coast of India, has a coastline of approximately 296 km spanning from Point Calimere in the north to Dhanushkodi in the south. The coastline comprises five revenue districts: Nagapattinam (58 km), Thiruvarur (19 km), Thanjavur (29 km), Pudukkottai (49 km), and Ramanathapuram (141 km). Palk Bay's muddy bottom and seagrass ecosystem supports shrimp fishery, particularly *P. semisulcatus.* It is extensively distributed in the Indo-West Pacific region, the Red Sea, eastern and southeastern Africa, Japan, Korea, the Malay Archipelago, and northern Australia. In India, it is distributed on both the east and west coasts, forming a fishery in the Palk Bay and Gulf of Mannar with its abundance gradually reducing south to north on the east coast. On the west coast, it forms a fishery only along the Gujarat coast, from October to November.

P. semisulcatus is a carnivorous species that primarily feeds on smaller molluscs, crustaceans, and polychaetes. In addition to these, the diet included digested matter, unidentified sand particles, foraminiferans and traces of fish scales, remains of echinoderms, cirripeds, algae, seagrass, seaweed, diatoms, mysids, and radiolarians. The spawning season is most active during the post-monsoon and monsoon periods, with a minor peak during the pre-monsoon period. Males mature earlier than females, and they do not have specific seasons or cyclic changes. Females were consistently present in larger numbers.

Habitat and ecology

Nursery grounds and distribution

Juvenile Green tiger shrimp primarily inhabit shallow waters because these areas provide the ideal environment for early life stages. The shallows are typically nutrient-rich, supporting the availability of food and other essential resources. Muddy bottoms, offer a stable substrate for the shrimp to anchor themselves and hide from predators. Abundance of organic matter, which serves as food and shelter for the juvenile shrimp. Seagrass beds are vital for the juvenile Green tiger shrimp as a nursery ground where shrimp can grow safely. Seagrass beds are also critical for the health of the ecosystem because they maintain water quality and offer food sources such as detritus and small invertebrates. Adult *P. semisulcatus* shrimps prefer sandy areas available up to 130 m depth.

Fishery

Mechanised fishing crafts with an overall length (OAL) of 13.0–25.0 m, equipped with 110–240 hp engines, operate bottom trawls in the Palk Bay for shrimp fishing. The fishing grounds are located between Sri Lanka and India at 5-13 m depth. Fishing is permitted three days a week: Monday, Wednesday, and Saturday by the Tamil Nadu Fisheries Department. The department issues tokens at 6 am on the morning of the fishing days. Fishing begins at 6 am and ends the next day at 6 am. The power of the engines may vary according to the size of the craft and gear, and the length of the trawl net also varies from 30-32 m. The cod end mesh size used is 25 mm. Each haul lasts for 3 hours, and there are 6 hauls for a single-day fishing operation The number of hauls depends on the season and the quantity of catch. Fishing is year-round, except for the monsoon trawl ban. The crew members involved in fishing varies from 5 to 6 people. Eight fish landing centres in Palk Bay operate trawls with 1538 trawl units engaged in shrimp fishing, 996 in the Ramanathapuram district, 375 in the Pudukottai district, and 167 in the Thanjavur district.

Motorised FRP (fibre-reinforced plastic) boats with OAL of 11-14 m operates mini-trawls. The boats use sails and wind energy to operate mini-trawls, while the motor facilitates reaching the fishing grounds. The fishing typically commences at 3 pm and concludes at 3 am the next day, operating at depths ranging from 3 to 5 m, usually within a radius of 3 nautical miles. The cod end measures 18 mm. The net is operated from one of the boat's lateral sides depending on the wind direction. Outrigger poles are used to spread the net's opening. The dragging may commence for 1 hour at a 1 km/hr speed. Fishing operations continue throughout the year, except the trawl ban period. Fifty fishing villages in Palk Bay are involved in mini-trawl fishing. There are 1239 mini-trawl units engaged in shrimp fishing, with 546

Green tiger shrimp landings from the mechanised trawl in Palk Bay

Green tiger shrimp landings from the mini trawl in Palk Bay

Green tiger shrimp landings by trammel net in Palk Bay

units located in the Ramanathapuram district, 323 in the Pudukottai district, and 370 in the Thanjavur district.

Motorised FRP boats with OAL of 11-14 m also operate the disco net, also known as the trammel net. These nets operate throughout the year, peaking during the monsoon trawl ban period when the mini-trawls are not in operation. Two crews engage in fishing in a single boat at a depth of 5-7 m within the territorial waters. The fishing begins at 2 pm in the evening, and by 3 am the following morning, the net is brought to the shore with the catch. The outer and inner mesh sizes of the gear are 120 and 34 mm, respectively. Thirteen fishing villages in Palk Bay are operating disco gill nets for shrimp fishing. There are 1007 disco gillnet units engaged in shrimp fishing in Palk Bay, with 52 of these units located in the Ramanathapuram district, 630 in the Pudukottai district, 170 in the Thanjavur district, and 155 in the Thiruvarur district.

Species composition

In total, twenty-two species constitute the shrimp landings in Palk Bay. *P. semisulcatus* contributed 57.6% followed by *P. indicus* (8.9%), *P. monodon* (8.3%), and *P. merguiensis* (5.9%). Surprisingly, when Palk Bay is taken as a single unit for study, the top three landed species were *P. semisulcatus*, *P. indicus*, and *P. monodon* whereas when the same ecosystem is studied region-wise, the top three shrimps were considerably changed. This inference plays a crucial role in planning the management of this regional fishery. Apart from these penaeid shrimps, finfish, cephalopods, molluscs, crustaceans, sponges, bivalves, seagrass, and seaweeds are also part of the bycatch in bottom trawls, with the crustaceans being dominant. Mini-trawls capture fish, crustaceans, cephalopods, molluscs, bivalves, and seagrass, with seagrass dominating the bycatch. *P. semisulcatus* and *P. pelagicus* are the major constituents of the mini-trawl catch. The disco gill net does not register a substantial catch since it is selective. Few shrimps, cephalopods, crabs, and fish are encountered in the catches of the disco gill net, and shrimp (*P. indicus, P. semisulcatus, P. monodon, and P. merguiensis*) are the major constituents among them.

Catch and effort

The average annual landings of *P. semisulcatus* in Palk Bay was 6286±1108 t from 2007 to 2022. The species alone made

up 61% of the penaeid shrimp caught in the area. The average landings of *P. semisulcatus* from single-day mechanised bottom trawl was 5043±954 t, 894±333 t from mini-trawl and 283±300 t from disco gill nets. The percentage, catch per hour, catch per unit effort and size range of *P. semisulcatus* caught in different gears are given in Table 1.

Population parameters and stock status

It was observed from the Thompson and Bell bioeconomic model, that increasing fishing pressure to F = 1.4 and F = 1.6 for males and females, respectively, would achieve MSY, but cannot result in a higher financial return. In contrast, reducing current fishing effort (F = 0.8) for males and increasing (F = 1.2) for females results in maximum economic yield. SB/SB_0 or SPR by both Thompson and Bell and LB-SPR analysis indicated the stock to be healthy and sustainable (Thompson and Bell SPR 24.83% for males and 32.08% for females and LB-SPR 0.21 for males and 0.31 for females).

Trade and processing

The shrimps were auctioned collectively on the shore (closed auctions, in which the quoted price is known only to auctioneers). The highest bidder wins the auction. The

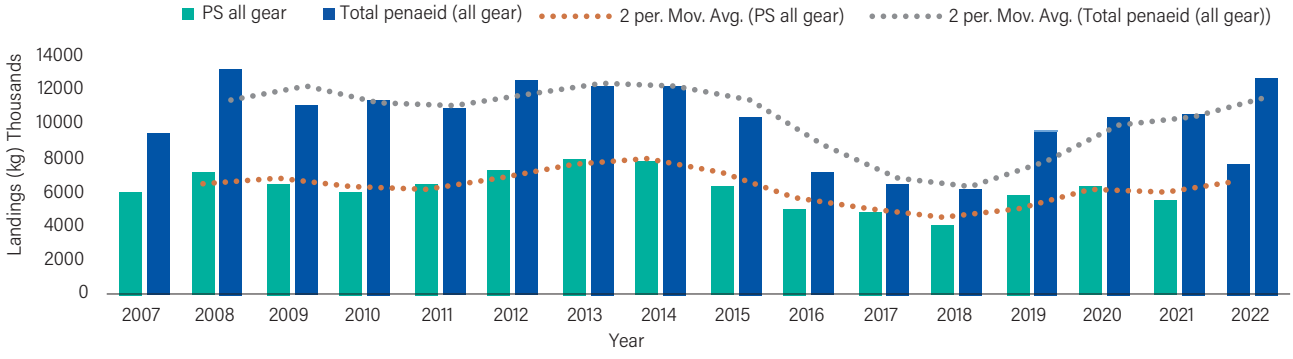


Fig. 1. Temporal change in the landings of *Penaeus semisulcatus* (PS) and penaeid shrimp in Palk Bay from 2007 to 2022

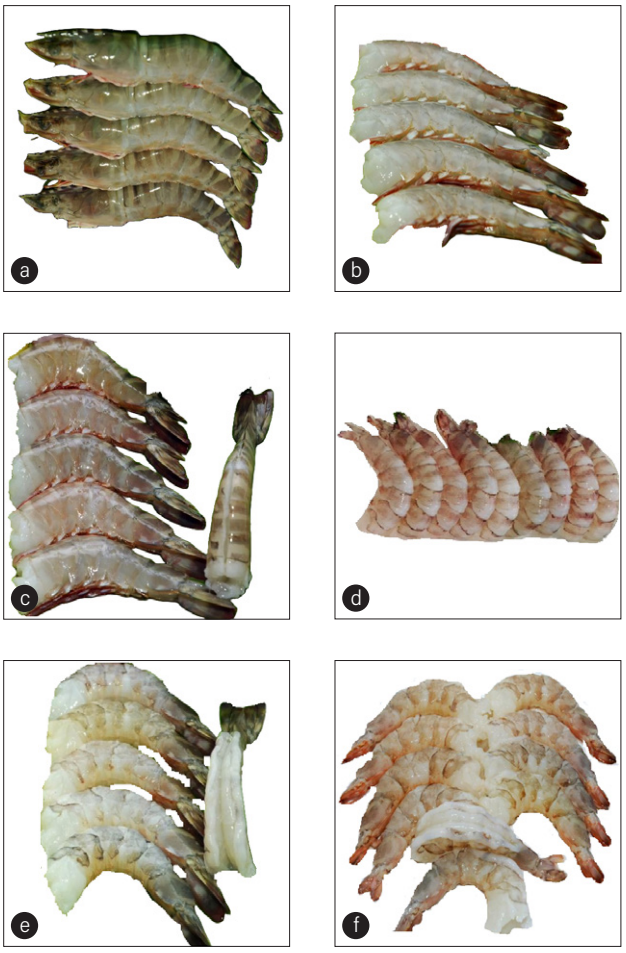
Table 1. Details of the landing of *P. semisulcatus* in Palk Bay

Gear	C/h (kg/h)	C/unit (kg/u)	% in total penaeid shrimp landings	Size range (mm)
Mech. bottom trawl	1.9±0.5	30.7±6.6	57	51-251
Mini-trawl	1.2±0.21	8.4±1.09	98.7	50-172
Disco gill net	0.05±0.04	0.57±0.49	74.1	59-190

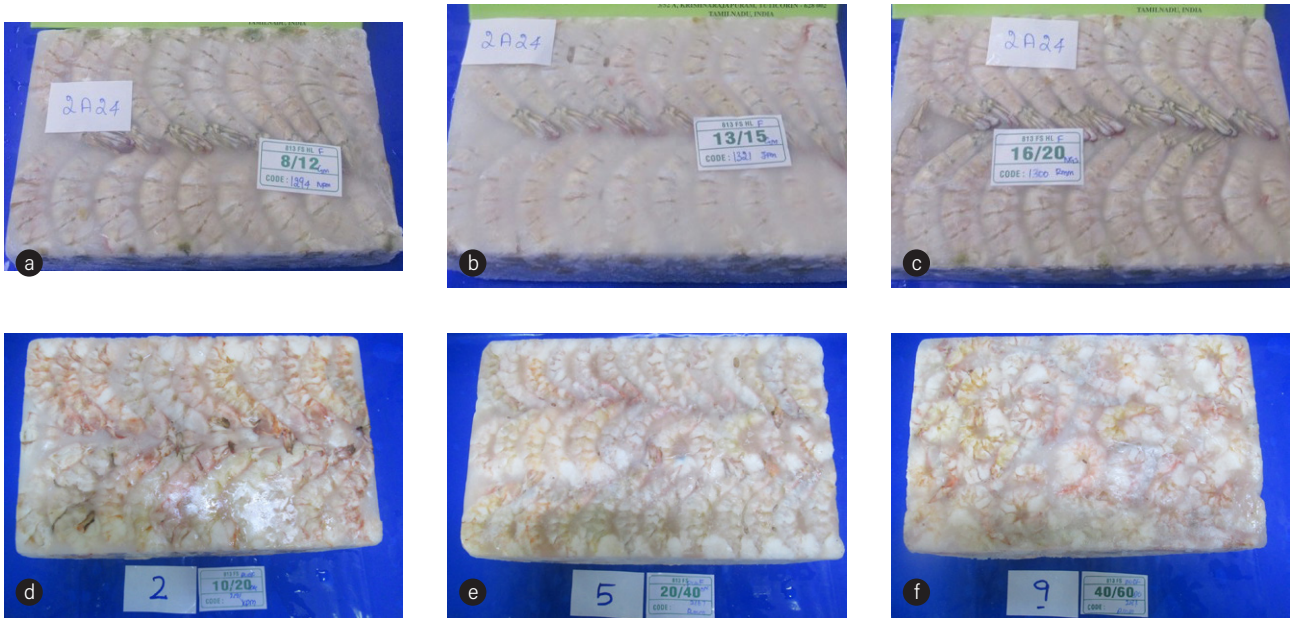
Table 2. Life history parameters estimated for *P. semisulcatus* from Palk Bay

Parameters	Male	Female
L_∞	229.3 mm	270.4 mm
K	1.24 y^{-1}	1.14 y^{-1}
Z	5.301 y^{-1}	5.474 y^{-1}
M	2.214 y^{-1}	2.002 y^{-1}
F	3.087 y^{-1}	3.265 y^{-1}
E	0.582	0.634
MSY	1594.1 t	6437.5 t
Potential yield	2557 t	11206 t

auction price ranged from ₹180 to ₹900 depending on the size grade. The species were sourced by the processing companies in Thoothukudi. The processed Green tiger shrimp include HON (head-on), HL (headless), HL-EZP (headless easy peel), PUD (peeled undeveined), PD-TON (peeled, deveined tail-on), and PD (peeled, deveined). The final packing is carried out according to the grades. *P. semisulcatus* is exported under various labels to eighteen countries, namely Japan, the USA, China, Vietnam, Belgium, France, Germany, Greece, Ireland, the Netherlands, Spain, the United Kingdom, Hong Kong, Saudi Arabia, Dubai, Qatar, Canada, and Kuwait. Major exports from Tamil Nadu were to Japan, the USA, and European countries. There was a steady decline in India's exports of *P. semisulcatus* from 2015-16 (4410 t) to 2022–23 (2260 t). The average annual export of *P. semisulcatus* was 3532±746 t, with a value of 30.9±9.3 million US dollars.



Varieties of processed green tiger shrimps from Palk Bay. A. HON – head-on, B. HL – headless, C. HL-EZP – headless easy peel, D. PUD – peeled undeveined, E. PD-TON – peeled deveined tail – on, F. PD- peeled deveined.



Some of the grade-wise packing of green tiger shrimp. A. HL (8/12), B. HL (13/15), C. HL (16/20), D. PUDF (10/20), E. PUDF (20/40), F. PUDF (40/60)

Brands of Palk Bay green tiger shrimp exported.

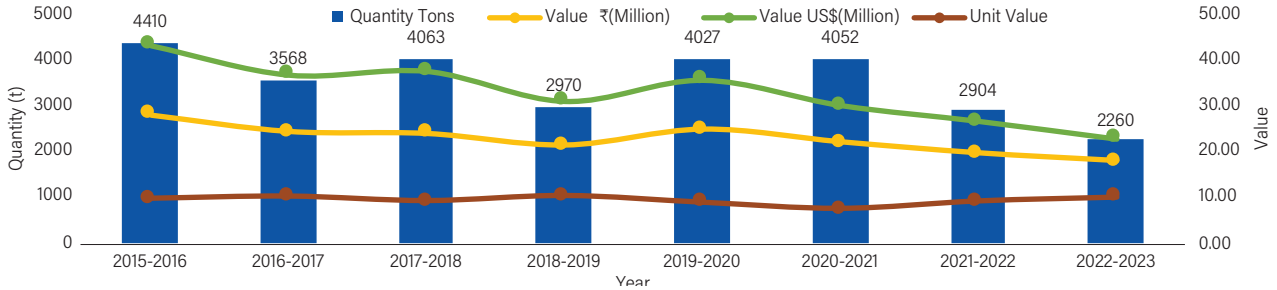


Fig. 2. Export of *Penaeus semisulcatus* from India to other countries

Fishery enhancement programme

The Green tiger shrimp fishery in Palk Bay at the present level is healthy and sustainable (Rajkumar, 2024); however, considering the importance of this fishery for the livelihood of this region, ICAR-CMFRI is implementing a sea ranching programme through the project entitled "Sea ranching of Green tiger shrimp (*Penaeus semisulcatus*) Post Larvae (PL) in Palk Bay and Gulf of Mannar, Tamil Nadu" with funding support from the PMMSY as a proactive measure. The project aims to release 200 million shrimp seeds in the Gulf of Mannar and Palk Bay during 2022-2026.

Conclusion & Recommendations

To ensure the long-term sustainability of the Green tiger shrimp fishery, a seasonal ban on shrimp fishing should be imposed during the peak breeding season, regardless of the gear used. This ban will help protect shrimp during their critical reproductive period. Shallow, muddy areas with seagrass beds and bays are vital for the survival, growth, and reproduction of Green tiger shrimp. These habitats provide essential shelter, abundant food, protection from predators, and optimal growth conditions, forming the foundation of the shrimp's life cycle from juvenile to adult. The preservation of these environments is crucial for maintaining healthy shrimp populations. Without them, the survival and productivity of the shrimp fishery could be jeopardized. Additionally, artificial propagation in protected waters could serve as a viable alternative for enhancing shrimp stocks and supporting fishery sustainability.

Palk Bay is the primary spawning ground for *P. semisulcatus*, and fishing during the spawning season reduces reproductive output. Overexploitation of a spawning stock will most likely decrease reproductive output, becoming a limiting factor for fishery production. Based on these findings, we recommend imposing a seasonal ban on shrimp fishing in Palk Bay during peak breeding season, irrespective of the gear, through a fleet cut-off to use the resource sustainably. The muddy bottom and seagrass beds encourage *P. semisulcatus* recruitment to sustain fishing pressure in Palk Bay. The intense fishing pressure on juveniles by mini-trawl and adults by mechanised trawlers has affected the spawning stock/spawning potential ratio. Even though the resource is sustainable, appropriate management measures to avoid overfishing are required. The peak spawning periods should be declared as closed seasons to maintain biologically sustainable levels (SSB_{20-30}) of Spawning Stock Biomass.

Brief Communication

Coastal shrimp biology during trawl ban: Observations from 2023-2024

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The trawl ban period in Kerala during June - July, witnesses bustling activity in different fish landing centres. Ring seines and gillnets are mostly operated in dugout/rigged canoes. Among the crustaceans, *Metapenaeus dobsoni* and *Penaeus indicus* are primarily caught during this period. This study explores the biology of these shrimp in 2023 and 2024. By analysing the size range, maturity, fecundity, and stomach contents of the shrimp species captured during June & July, the study offers insights into their reproductive cycles and feeding habits during the monsoon trawl ban

Fish landing centres across the Thrissur, Ernakulam, and Alappuzha districts were monitored during June and July 2023 and 2024. The specific centres included Thotapally and Arthunkal in Alappuzha District, Chellanam in Ernakulam District, and Azhikode, Chettuva, Aatupuram, Thattumkadavu and Chavakkad in Thrissur District. These centres were visited at weekly/fortnightly intervals.

The most abundant species landed was *M. dobsoni* followed by *P. indicus*. *Penaeus monodon* and *Metapenaeus affinis*

(a) Fishing boats at Thotapally harbour, Alappuzha District (b) Boat to set sail from Aatupuram fish landing centre in Thrissur District (c) Boats sailing from Chetuva fish landing centre, Thrissur District

Table 1. Estimated fecundity of the coastal shrimps

Species	Total Length (mm)	Weight (g)	Fecundity
M. dobsoni	82-112	3.69-10.96	11057-56005
P. indicus	144-190	21.11-63.08	11653-226980
M. affinis	113-135	11.17-18.96	18700-29879
P. monodon	244	138	254749

Penaeid shrimp *M. dobsoni* and *P. indicus* landing

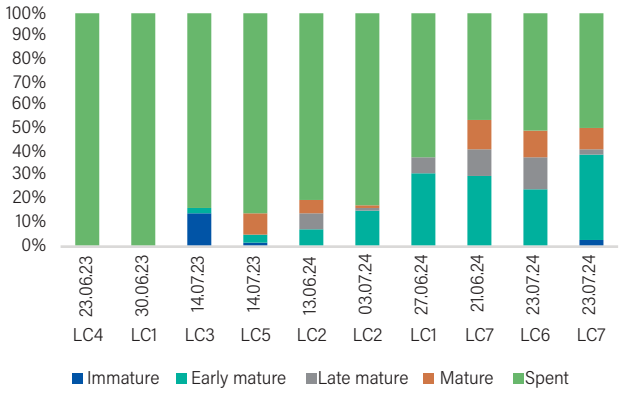

Fig. 1. Maturity stages in *M. dobsoni* from different landing centres
LC1: Chellanam; LC2: Thotapally; LC3: Azheekode; LC4: Company padi; LC5: Thattumkadavu; LC6: Aatupuram; LC7: Chavakad

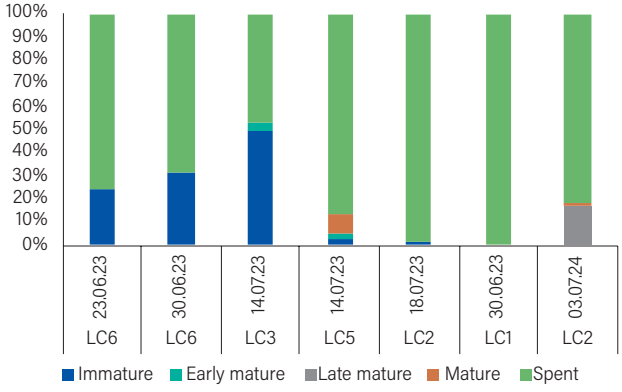

Fig. 2. Maturity stages in *P. indicus* from different landing centres

Late maturing and mature *M. dobsoni* from the landings

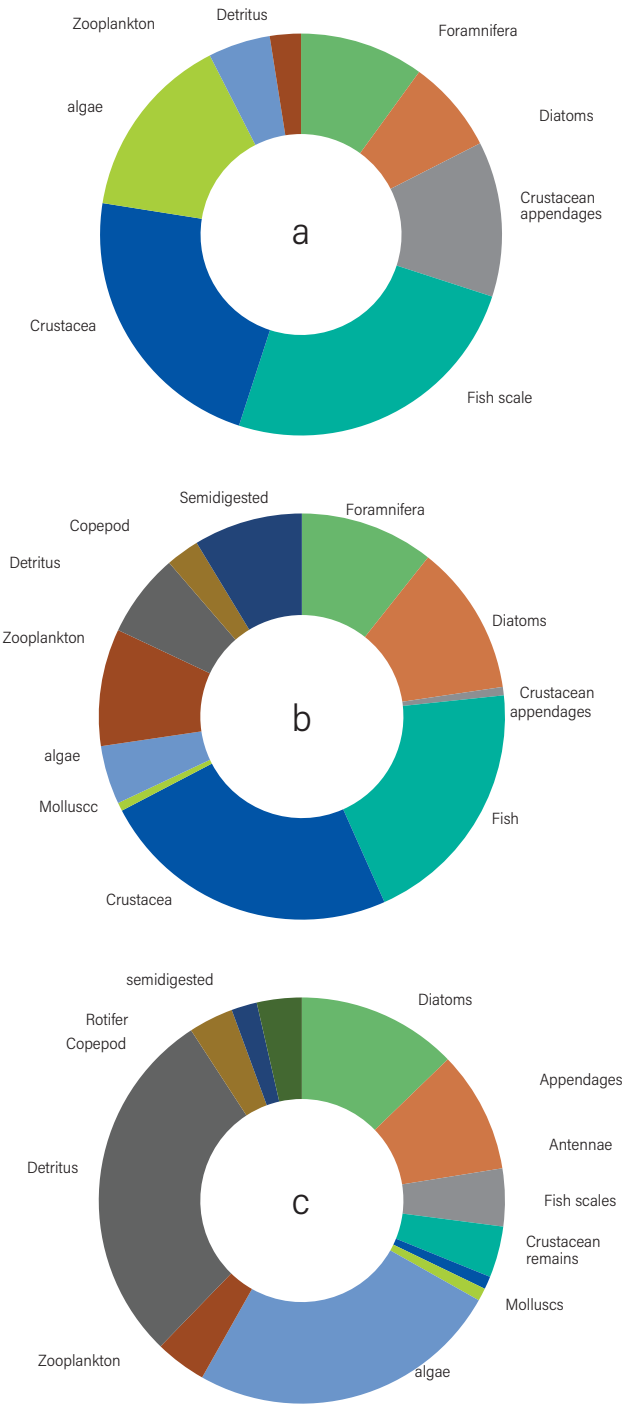

Fig. 3. Gut content in (a) *P. monodon*; (b) *P. indicus*; (c) *M. dobsoni*

were observed only in July and in limited numbers. The specimens were mostly in the spent stage, suggesting an active reproductive season for the species during this period. Fecundity estimates were derived from the late-maturing and mature individuals.

The gut contents of *M. dobsoni*, *P. indicus*, and *P. monodon* were analysed. In *P. indicus* and *P. monodon*, crustacean remains were the predominant component of the diet whereas, *M. dobsoni* had detritus as dominant component. Additionally, foraminiferans were found in the guts of *P. indicus* and *Penaeus monodon.*

Brief Communication

The fishery for Tomato hind along Coromandel Coast of Tamil Nadu

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C*ephalopholis sonnerati* (Valenciennes, 1828) is a protogynous grouper of the family Serranidae, widely distributed in the Indo-Pacific and abundant in reefs and areas with rocky substratum. It is commonly called as Tomato hind and locally known as *thakkalimeen* (tomato fish) in Tamil Nadu due to the brilliant red colouration of the fresh fishes. A group of fishers from Karaikal, Nagapattinam, Tharangambadi and Kaveripattinam of Tamil Nadu have been exclusively involved in targeted fishing of Tomato hind. The present study summarizes the observations from these parts of Coromandel Coast (CC) along Tamil Nadu during 2017 to 2022. The landings data, marketing and utilization of the fish were gathered from field visits and personal inquiry with fishers and traders associated with the fishery at Karaikal, Nagapattinam, Tharangambadi and Kaveripattinam Field Landing Centres (FLC). The Tomato hind was not targeted until 2004 as the fishers and traders were unaware about the availability of *Cephalopholis sonnerati* in the rocky substratum off Karaikal until discovered by a group of twenty fishers operating fibre boats of 9-11m overall length (OAL) fitted with outboard motor, doing hook and line fishing. All fish catches that were landed at Nagapattinam FLC shifted to Karaikal FLC after its construction in 2006. The ground is located within 50 to 70 km away from Karaikal FLC at depth of 70 to 120 m. The substratum is rocky and hence other mechanised vessels are unable to fish there. If the Tomato hind catch is poor, they operate gillnet within 2-3 km from the shore for other fishes such as lesser sardines (*Sardinella albella, S. gibbosa*) and scads (*Selaroides leptolepis*, *Decapterus* spp.) that may be available.

Fibre boats of 9, 10, and 12 m OAL fitted with outboard motors (10, 12, 24 hp) are involved in Tomato hind fishing. Each boat has 4 to 6 persons to operate 100 to 300 hooks and lines. Some fishers operate 1 or 2 long lines bearing 90 hooks. The hooks of nos. 7, 8 and 12 are tied to nylon fishing lines (0.25 to 5 mm) of 100-150 m length. Sliced *Loligo singhalensis*, *Selaroides leptolepis*, *Sardinella albella*, *Decapterus kurroides* etc. are used as bait. Presently, 150 units from Karaikal, 8-10 from Tharangambadi, 4 from Nagapattinam and 5 from Kaveripattinam are involved in Tomato hind fishery. The landing of *C. sonnerati* along CC was compared for 6 years from 2017. The catch increased to 350 t in 2018 from 272 t in (2017) and then reached an all-time low of 87 t in 2020. Later it showed an abrupt increase and the highest landing of 822 t in was recorded in 2022.

Even though hook and line fishing targets *Cephalopholis sonnerati*, other groupers and some carangids caught as bycatch include *Epinephelus coioides, E. areolatus, Rachycentron canadum, Scomberomorus commerson, Caranx ignobilis* and *C. sexfasciatus.* (Table 1). The boats set sail by 3 pm with actual fishing restricted to the day time between 6 am and 6 pm during the next two days. The boats return and land the catches by 6 am of 4th day. Each boat carries ice and baits procured from local markets. The landings are auctioned to traders from Kanyakumari, Nagapattinam and Chennai. The net profit from each trip is shared among

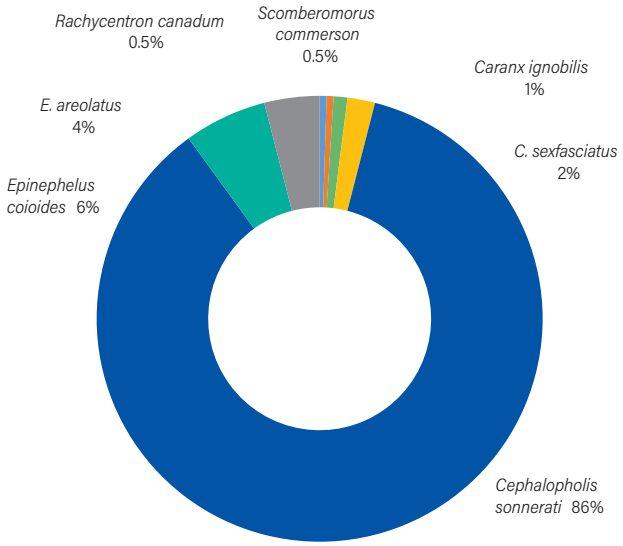

Fig. 2. Species composition of the catch

fishers in such a way that five shares go to the fishers, 2 for the engine operators, 1 for the gear operators and half for the boat owner. The economic analysis indicates an estimated profit of ₹31000 per fisher per trip (Table 2).

The crafts carry ice to the fishing grounds and store the catch in the hull as soon as possible. There is no gutting or drying of the fish onboard or at landing centres as it has good demand as fresh/iced form both in export and domestic markets. Fish of above 400 g weight are auctioned to traders from Kanykumari and Chennai, and exported to China, Dubai, U.K. and Oman. The rest are usually marketed either within Tamil Nadu or Puducherry (Thiruchirapilly, Chennai, Nagapattinam, Karaikal) or transported to Kerala in ice. At present there are no restrictions on catch, fishing trips or other efforts imposed on Tomato hind landings in the Coramandel Coast. Even though the catch trend in the region showed an increasing trend, an assessment of *C. sonnerati* fishery has not been done to determine the stock health status. Biological studies to determine gonad maturity, fecundity and spawning season are also needed to understand spawning aggregation of Tomato hind in the region as the unique reproductive nature of the species limits applicability of existing conventional management measures. Catch quota, seasonal closure, and MLS may be required to ensure a sustainable harvest of Tomato hind based on observations of this study which is a baseline information.

Table 1. Size composition of fishes caught in the hooks and line fishery

Scientific name	Length range (mm)	Weight range (g)
Cephalopholis sonnerati	200-500	260-4000
Epinephelus coioides	250-570	250-1500
E. areolatus	210-420	200-900
Rachycentron canadum	550-840	3500-13000w
Scomberomorus commerson	400-680	2500-8000
Caranx ignobilis	250-670	500-12000
C. sexfasciatus	240-540	500-1500

Table 2. Economic analysis of Tomato hind fishery

Particulars	Values in Rupees
1. Initial investment	
i. Craft	325000.0
ii. Engine	68000.0
iii. Gear and accessories	15000.0
iv. Battery/ Generator	7000.0
Total	415000.0
2. Fixed cost	
a. Depreciation	
1. Craft and engine (20%)	74.9
2. Battery/ Generator (10%)	2.5
b. Interest on investment	304.3
c. Repair and maintenance	553.3
Total	935.0
3. Operating cost	
I . Fuel	9000.0
ii. Crew wages	52279.4
iii. Food	2500.0
iv. Ice	900.0
v. Bait	3500.0
Total	68179.4
4. Total cost (2+3)	69114.4
5. Gross Revenue (Catch sale price)	337500.0
6. net operating income (5-3)	269320.6
7. Net profit (5-4)	268385.6
8. profit margin (7/5) *100	79.5
9. Annual days of operation	150.0
Average catch (kg)	750.0
Manpower	5.0
10. Productivity measures	
a. Labour productivity (kg)	150.0
b. Remuneration (₹)	31574.8
c. Fuel efficiency (kg/l)	8.3

Brief Communication

Abandoned and Derelict FRP Fishing Vessels (ADFV) in North Kerala – An urgent need for a National Policy

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Over the past five decades, the marine fisheries sector has evolved much in capacity, vessel transitions, areas covered, time spent at sea and catch. The advent of Fibre Reinforced Plastic (FRP) for boat construction has been an urging force in fisheries, particularly in the marine fisheries sector. This technological shift, marked by the motorization period of marine fisheries, has significantly revolutionized the fisheries industry especially the small-scale fisheries, contributing much of its success to the widespread adoption of FRP fishing vessels. Initiated in the 1970s, Indian government-supported schemes aimed at enhancing marine fisheries, led to the extensive introduction of motorised boats in Indian waters. By 1980-90's, these boats were urged to use Fibre Reinforced Polymer to a larger extent, laying a crucial transitional-historical step-up in the fisheries industry. Presently, India has a total of 1,66,333 fishing crafts in the marine fisheries sector, of which, 42,985 (25.8%) are mechanized, 97,659 (58.7%) are motorized, and 25,689 (15.4%) are non-motorized (ReALCRaft 2024). Notably, many of the motorized and non-motorized fishing vessels, supporting the small-scale fisheries primarily rely on FRP boats, highlighting their pivotal role in the sector. The popularity of FRP boats can be attributed to several advantages over traditional

FRP fishing vessels in a fish landing centre

Derelict fishing vessels

materials like wood, steel etc. These advantages include being lightweight, easy to handle, more fuel-efficiency, long durability, resistant to corrosion and weathering, easy mouldability in any sizes and shapes, low maintenance, and less prone to rotting etc. Moreover, the cost-effectiveness of FRP construction further strongly solidifies its position as the supreme material of choice in the fishing vessel industry. The widespread adoption of FRP boats has not only revolutionized the fishing industry in India but has also played a pivotal role in supporting sustainable and efficient practices in marine fisheries.

It is estimated that the lifespan of FRP fishing boats is influenced by various factors such as material quality, manufacturing processes, fishing activities, and maintenance. Generally, it is observed that the FRP boats last for 15 to 20 years in Indian waters may be due to the proper maintenance on a regular basis. In India, the peak of motorization in the 1980-1990 through BoBP programs and post Tsunami rehabilitation programs, addition to the government programs for conversion/new boats and subsidies; which all led to an upsurge in FRP fishing boats. As the time passed, these boats, now reaching the end of their operational lifespan, present a challenge in terms of disposal.

The global concerns over the disposal of FRP boats are alarmingly increasing, with an increasing trend of discarding them on beaches, estuarine stretches as well as within the water bodies as well as non-scientific disposal activities like burning are observed locally. These activities lead to the release of significant quantities of potentially toxic metals, leading to potential risk to the environment as well as public health. This also aids in discarding of derelict or abandoning of fishing gears and other marine debris on beaches and in coastal waters. These, improper discarding of non-seaworthy vessels has several impacts, including risks of causing environmental harm due to the prolonged release of toxic chemicals from FRP coating into the sediment and water indicating need for national policies to address abandoned, lost, or discarded fishing gears and vessels. In India, National Action Plan On Marine Plastic Litter From Sea-based Sources (https://digital.gpmarinelitter.org/action-plan/11010) (2024), UN led Global Partnership for preventing and reducing marine plastic litter from sea-based sources viz; Glo Litter partnership (https://glolitter.imo.org/) is being implemented. Ways to implement regulations addressing coastal pollution caused by abandoned FRP fishing crafts, are urgently needed as abandoned fishing boats are very common sight in harbours, beaches, coastal-intertidal areas in Kerala. These boats are often discarded as they may be in damaged/ non-repairable condition, expiration of license period, seized for violation of laws, disputes among the shareholders etc. Besides, FRP boats are mostly owned by small-scale fishers who may not have the resources, finance or knowledge to dispose of their boats properly. Discarded FRP boats range in sizes from 3-22 m overall length (OAL) in North Kerala, and other fishing boats like trawlers are also seen abandoned or unused for long time in the landing centres in water and land. Surveys conducted by ICAR-CMFRI along the coastal areas have documented a notable rise in the prevalence of abandoned and derelict FRP fishing vessels and fishing gears, reaching to 12-23 FRP boats/km^2, often affecting navigation, berthing and occupying operational space. Though there are no direct SOPs regarding the vessel disposal, the responsibility of fishing vessels during operation and post-life lies with the vessel owner, similar to vehicles on land. This results in deliberate dumping of boats in coastal environments. Kerala has a fishing vessel license based on life span of period of 12 years for FRP fishing vessels with wheel house (request based extension upto 15 years from 2022), and 18 years for those FRP vessels without wheelhouse (request based extension up to 21 years from 2022); license and registration is not renewed after this period currently in Kerala, and fishing vessels whose licences have expired are not entitled to operate. As there is strict enforcement of this rule in land and sea, with frequent on-board inspections, most of these fishing vessels contribute to the increased anonymous dumping in the coastal waters. Lack of infrastructure and inadequate regulations, especially concerning the small-scale fishers lacking financial aid for proper disposal magnify the problem. Recycling FRP boats is challenging due to the difficulty in breaking down the composite materials. Programs like *Swachhta Abhiyaan, Suchitwa Sagaram- Sundara Teeram, Swachh Sagar-Surakshit Sagar*, Clean Coast Safe Sea, coastal clean-up campaigns, etc. are, model program to

Abandoned and derelict FRP fishing vessels in coastal regions of North Kerala

address marine debris and pollution issues which needs to implemented widely and improvised. Stakeholder meetings conducted by Calicut Regional Station of ICAR-CMFRI and District Fisheries Management Council sessions in Northern Kerala have consistently highlighted similar concerns among the participants on the open discards of FRP fishing vessels. Recommendations to address the concerns due to ADFV in the marine fisheries sector, based on observations from North Kerala are listed below.

Table 1. Mitigational suggestions/recommendations for proper management of FRP boats discarding in public spaces

No.	Critical Steps	Interventions	Suggestion for implementation agencies/Institutions/ Departments
1	General. New dedicated rule in addressing marine pollution	Addressing major concerns by source prevention, debris filtration implementation etc. Options for polluters responsibility and pays.	National policy implementation at local scales, Local Governments
2	Guidance and policy development on disposal of fishing crafts and gears	National working group. Proper guidance for FRP usage, prompt disposal and recycling. Methodologies as well as other crafts and gears. User responsibility programs and strict implementation of the formulated policies specifically addressing the disposal of non- operational FRP fishing vessels.	FSI, ICAR-CMFRI, ICAR-CIFT, NCCR, Department of Fisheries
3	Establish recycling Infrastructure	Dedicated dumping yards of fishing vessels. Develop recycling facilities for processing FRP materials. Proper guidance and support to the fisher for the development of efficient FRP recycling.	Department of Fisheries
4	Traceability	Replacement registration should ensure on the older boats which are disposed properly in designated areas. Real craft to include the image depository of fishing boats. Develop collecting yards.	Department of Fisheries
5	Enhancement in monitoring and enforcement	Monitor and enforce proper disposal practices for FRP fishing vessels. Initiate strict implementation of penalties for improper disposal and irresponsible practices.	Department of Fisheries and citizen reporting mechanisms
6	Promote sustainable fishing and post harvest practices	Encourage for the use of eco-friendly materials in new vessel constructions. More awareness among the fishers about the ecological impact of FRP pollution so as to support and promote sustainable good fishing practices and disposal.	Department of Fisheries and organisations in relevant fields, stakeholder organisations, like boat owners, etc
7	Research	More research to innovate and recommend alternatives to FRP and sustainable disposal mechanism for FRP .	ICAR-CIFT, CIPET, other research organisations
8	Polluter Pay principle	Initial collection of tax for new boat registration including charges of disposal and and fine for violation of marine pollution prevention laws.	Department of Fisheries
9	Mass awareness programs	Provide incentives or subsidies for fishermen to collect marine debris as well as to promote the recycling of old vessels, thus promoting recycling in the economy. Conduct awareness campaigns and educational programs on the environmental consequences of FRP pollution. Distribute extension pamphlets among the fisher communities on proper disposal methods and to show the importance of responsible waste management. Organise frequent clean-up drives and swachhata activities in coastal ecosytems, in beaches, with public participation, mainly targeting abandoned FRP vessels as well as other marine debris.	Department of fisheries, all fisheries/ ocean related government and non government organization
	Local community engagement	The local communities should be involved in mitigating open discards, clean-up efforts of their particular area, thus creating a responsibility for the environment. More community-driven initiatives to be established for the proper disposal of FRP materials.	Department of Fisheries and other organisation involved in pollution and marine pollution management
	Financial support	Provide financial support or subsidies for transitioning to eco-friendly materials and recycling initiatives. Funding schemes to have responsible disposal practices among fishers.	Department of Fisheries
	International collaboration	Engage in collaborative efforts with international organizations/ countries to exchange best practices and knowledge and expertise sharing in managing, mitigation of pollution. Actively participate in global meets aimed at addressing marine pollution, and or undertake bilateral programmes and global programmes like GloLitter, IMO, etc. for sustainable solutions on a broader scale.	Department of fisheries, Central Institute of Petrochemicals Engineering & Technology (CIPET), ICAR-Central Institute of Fisheries Technology (CIFT), ICAR-CMFRI and Fishery Survey of India (FSI)

Ensuring the proper disposal and recycling of FRP boats through comprehensive laws, inspections, and initiatives to minimize open discards; prioritizing research and initiatives for FRP recycling, establishing dumping-breaking yards, and initiating buyback or credit programs to fishers are some measures that may be considered.

Brief Communication

Empowering the Mavilan tribes of Kasaragod, Kerala: A success story in cage farming

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The Mavilan tribe, one of Kerala's many indigenous tribal communities known for their unique customs and traditions, resides mainly in the hilly and forested areas of the northern Kasaragod district, contributes significantly to the region's rich cultural heritage. Their residing areas include Manjeshwaram, Kanhangad, and parts of the Sullia region neighboring Karnataka. They mostly depend on agricultural labour and forest-based activities for their livelihood. Despite their rich cultural heritage, they are facing socio-economic challenges such as limited access to healthcare, education and land rights. Recognizing the need to preserve their heritage while improving their quality of life, a targeted initiative was undertaken to empower the Mavilan tribes through cage farming. This initiative, under the Tribal Sub-Plan (TSP) program by the Calicut Regional Station of ICAR-CMFRI, introduced marine fish cage culture to the Mavilan tribal families of Kasaragod district.

The Cage farming initiative

Mavilan tribes of Kurichikunnu colony of Pariyaram Grama Panchayath, Bekal, Kasaragod, were selected to participate in the cage culture initiative in 2019, aimed to empower the community through aquaculture. Based on the information provided by the local Pallikkara Grama Panchayat of Kasaragod district, 22 beneficiaries (14 males and 8 females) were selected. Three tribal Self-Help Groups were formed, Navodaya SHG-10 beneficiaries (6 males and 4 females); Sangamithra SHG- 7 beneficiaries (5 males and 2 females); Udhayam SHG- 5 beneficiaries (3 males and 2 females) to facilitate joint efforts in aquaculture and ensure active participation of the tribal community. Prior to this, most of the selected persons were engaged in labour-intensive occupations such as painting and masonry, while a few women participated in local, government employment schemes such as MGNREGA programmes and none had any earlier experience in aquaculture. The selected groups were provided with technical training, farm inputs, and on-site training and demonstrations to enable them to undertake cage culture activities. The Calicut Regional Station of ICAR-CMFRI initiated these efforts by offering a comprehensive "Hands-on training and on-field demonstration programmes on cage culture of marine fishes". The training-cum-demonstration included:

Theoretical knowledge

Lectures were delivered on key aspects of aquaculture such as site selection, species selection, feed management, water quality management, disease management, stocking of fingerlings, and integrated multi-trophic aquaculture techniques.

Hands-on training

Practical sessions on cage fabrication, installation, and maintenance were also provided to all beneficiaries.

Lecture on cage farming to TSP beneficiaries

Fabrication of cage frame

Preparation of floatation system for cages

Attaching floats to cage frame by beneficiary

Fabrication of PVC ballast

Field exposure

A visit to a local cage farming site in Payyanur, Kannur, was organized for selected beneficiaries to gain more knowledge on cage farming culture practices. The combination of hands-on training, demonstrations, and exposure visits helped enhance the technical capacity of the beneficiaries, preparing them for sustainable cage aquaculture practices.

These initiatives enabled participants to gain practical and theoretical knowledge on:

- Selecting suitable sites for cage culture.
- Identifying appropriate fish species and acclimatizing them for farming.
- Setting up and managing cages, including feeding and disease control.

Implementation

The Bekal River (12°24′23.76″N, 75°1′58.908″E) near the Kurichikunnu tribal colony was identified as an ideal location for cage farming, meeting criteria like suitable water depth (3 meters) and clean water, free from industrial or domestic waste.The program introduced grow-out culture of marine finfishes in galvanized iron (GI) cages. Five units of 4x4x3m cages were fabricated and installed, along with an 8-meter-long catwalk for easy access. Inputs provided included fingerlings of Asian seabass (*Lates calcarifer*) and Pearlspot (*Etroplus suratensis*), high-quality floating pellet feed, infrastructure such as cages, GI catwalk, nets, hapa, floats, and anchors and equipments such as freezer and weighing balances. Initially, five cages (4x4x3m, 48 m^3) were used, with Asian seabass fingerlings (8-10 cm; 600 individuals) stocked in three cages and Pearlspot fingerlings (3-4 cm; 2000 individuals) in the rest. The fingerlings were transported from Kumta, Karnataka, in insulated trucks and they were stocked after acclimatisation.

Fishes were fed with nutrilla floating pellet feed (45% protein and 10% crude fat). During the culture period, the fishes were fed with pellet feed initially at 12 percent of the body weight, then reduced to 3 percent of the body

weight as the culture progressed. In case of seabass, low-value fishes were also provided along with the pellet feed. After 8-9 months of culture, seabass reached an average weight of 1-1.5 kg individual weight, while Pearlspot attained 200-250 g. A 48 m^3 cage stocked with 600 numbers of seabass yielded a gross revenue of ₹1.8 lakhs and a net profit of ₹86,200, achieving an internal rate of return (IRR) of 88.5% and a benefit-cost ratio (BCR) of 2.29 (Table 1). A 48 m^3 cage with 2000 numbers of Pearlspot generated ₹1.75 lakhs in gross revenue and ₹55,900 in net profit. The IRR was 86.9%, and the BCR was 4.25. Pearlspot commanded a high market price (₹500-600/kg locally). The initiative proved economically beneficial, especially through partial harvests, providing significant support to the Mavilan tribal community.

Galvanized iron (GI) cages at Bekal

Fabrication of GI catwalk

Table 1. Economic performance of Seabass cage culture

Particulars	Amount (₹)
I. Capital Investment	
1. Cost of cage frame (1.25-inch B class pipe)	30,000.00
2. Cost of nets	30,000.00
3. Cost of floats (8 numbers for each cage)	10,000.00
4. Mooring (20 kg GI anchors- 2 nos.) & installation	5,000.00
Total fixed cost (1+2+3+4)	75,000.00
5. Depreciation (20%)	15,000.00
6. Interest on fixed capital (12%)	9,000.00
Annual Fixed cost (5+6) (A)	24,000.00
II. Operating costs	
7. Seed (Cost of 600 seabass seeds @ ₹35/seed)	21,000.00
8. Feed (low-value fish) 1500 kg@ 20/kg and 60 kg pellet feed	37,200.00
9. Labour 2 hours/day @ ₹1200/month for 8 months	9,600.00
10. Harvesting & Miscellaneous Expenses	2,000.00
Total operating cost (B)	69,800.00
Total cost (A+B)	93,800.00
III. Returns	
11. Production	400 kg
12. Gross revenue @ ₹400/kg for 450 kg	1,80,000
13. Net profit	86,200
14. Cost/ kg of fish (₹)	234
15. Price/ kg of fish (₹)	450
16. NPV	1,99,410
17. BCR	2.29
18. IRR	88.5%

Fish seed transportation acclimatization and stocking

Harvest of seabass from cages by Mavilan tribes of Kasaragod

Harvest of Pearlspot

Table 2. Economic performance of Pearlspot cage culture

Particulars	Amount (₹)
I. Capital Investment	
1. Cost of cage frame (1.25 inch B class pipe)	30,000.00
2. Cost of nets	30,000.00
3. Cost of floats (8 numbers for each cage)	10,000.00
4. Mooring (20 kg GI anchors- 2 nos.) & installation	5,000.00
Total fixed cost (1+2+3+4)	75,000.00
5. Depreciation (20%)	15,000.00
6. Interest on fixed capital (12%)	9,000.00
Annual Fixed cost (5+6) (A)	24,000.00
II. Operating costs	
7. Seed (Cost of 2000 Pearlspot seeds @ ₹10/seed & Transportation charges)	20,000.00
8. Feed (pellet feed) 500 kg	63,500.00
9. Labour 2 hours/day @ ₹1200/month for 8 months	9,600.00
10. Harvesting & Miscellaneous Expenses	2,000.00
Total operating cost (7+8+9) (B)	95,100.00
Total cost (A+B)	1,19,100.00
III. Returns	
11. Production (89 % survival)	350 kg
12. Gross revenue @ ₹500/kg for 350 kg	1,75,000
13. Net profit	55,900
14. Cost/ kg of fish (₹)	340
15. Price/ kg of fish (₹)	500
16. Operating ratio	0.54
17. NPV	1,71,967
18. BCR	4.25
19. IRR	86.9%

A harvest mela was also organized through which ICAR-CMFRI actively supported the Mavilan tribal community by empowering them to market their produce through social media platforms, local restaurants, and wholesale distributors. Empowering the Mavilan tribal community in aquaculture required addressing a range of socio-economic, environmental, and technical challenges.

Challenges addressed when implementing the programme included

Technical knowledge gap: Training was provided to bridge the gap in aquaculture skills such as site selection, cage fabrication, species selection, cage installation, feed management, water quality management, disease control, and cage maintenance.

Financial barriers: The initiative provided financial support in a phased manner, starting with 100% coverage in the initial years and gradually reducing assistance to encourage self-reliance.

Cultural and traditional hesitancy: Awareness programmes and consistent engagement helped address resistance to adopting new practices.

Infrastructure limitations: Support included supply of cages, nets, seeds, feed, and storage equipment.

Market access: Assistance was provided to connect the Mavilans with wholesalers, restaurants, and local markets, ensuring fair prices for their produce.

The project significantly improved the living standards of the participating tribal families involved by enabling construction of new houses or renovation of existing houses, purchase of household items like refrigerators, televisions, and mobile phones and investment in children's education and clearing existing debts. During the first four years of fish farming, beneficiaries received comprehensive support from ICAR-CMFRI, including both technical guidance and financial assistance. In subsequent farming seasons, this support transitioned to technical guidance alone. The Mavilan tribes gradually transitioned to self-reliant cage farmers, with some families adding more cage units independently.

Harvest Mela

The successful demonstration of high-value marine finfish culture in low-cost estuarine cages significantly improved livelihoods and empowered the Mavilan tribes of Kasaragod to sustain cage culture independently without financial aid. This success story highlights how targeted interventions can empower marginalized communities while ensuring sustainable development.This model of integrating aquaculture with tribal upliftment can serve as a blueprint for similar communities across India, combining economic viability with cultural preservation.

Brief Communication

Pre-budget policy recommendations: A proposal from ICAR-CMFRI

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The marine fisheries sector is a cornerstone of Kerala's coastal economy, contributing significantly to employment, food security, and export earnings. However, the sector faces multifaceted challenges, including extreme weather events, insufficient financial safety nets, low adoption of modern technology, and a lack of market transparency. To address these challenges and ensure sustainable economic growth, ICAR-Central Marine Fisheries Research Institute (CMFRI) put forth critical policy suggestions in the pre-budget consultation meeting chaired by Shri. K.N. Balagopal, the Hon'ble Finance Minister, Government of Kerala on December 6, 2024, in virtual mode. The meeting was attended by heads and representatives of various research organizations based in Kerala. The proposals put forth by ICAR-CMFRI mainly aim to promote fisher safety, financial inclusion, technological advancements, and mariculture development while fostering a resilient marine economy. This article outlines the detailed inputs provided for consideration in the upcoming state budget.

Ensuring safety and security of marine fishers

The frequency and severity of extreme weather events along Kerala's coastline have escalated in recent years posing life-threatening risks to marine fishers who venture into the sea. Prioritizing safety and security is essential to safeguard livelihoods and ensure sustainable fishing operations.

Recommendations: Allocate greater budgetary resources to provide fishers with affordable and subsidized access to onboard life-saving equipment such as life jackets, lifebuoys, flares, and medical kits. Support investments to improve access to modern communication and navigation tools such as Very High Frequency (VHF) radios, Automatic Identification Systems (AIS), satellite phones, and transponders. These tools will enable timely communication during emergencies and help locate vessels in distress.

Expanding insurance coverage for fishers and fishing vessels

Fishing activities involve inherent risks, necessitating appropriate institutional mechanisms such as insurance to address individual risks. However, insurance coverage, particularly vessel/gear insurance, remains limited among Kerala's fishers due to high premiums, inadequate loss

coverage, delays in claim settlements, and unsuitable insurance products. Enhancing insurance coverage will help fishers mitigate financial risks and recover quickly from unexpected damages or accidents, contributing to long-term economic stability.

Recommendations: Introduce insurance schemes with affordable premiums for aquafarming and fishing vessels with simplified terms and conditions. Expand coverage to include partial losses to fishing vessels, to ensure greater adoption and acceptance of insurance products among stakeholders.

Enhancing disaster assistance for coastal communities

Coastal fisher households face recurring damages to their homes and immovable assets due to cyclones, storm surges, and flooding. Existing disaster relief funds are often insufficient to address the recurring challenges. Given this, strengthening disaster assistance mechanisms are the need of the hour and can protect vulnerable populations from the impacts of climate change.

Recommendations: Enhance budget allocations for disaster assistance funds to adequately compensate for losses and damages incurred by coastal-dwelling fishers. Streamline procedures to ensure timely disbursal of disaster assistance to affected communities.

Promoting financial inclusion through institutional credit

Access to affordable institutional credit remains a challenge for many fishers in Kerala, thereby limiting their ability to invest in modern fishing equipment, gear, or alternative livelihood opportunities. Improved access to institutional credit will enable fishers to adopt modern technologies, diversify income sources, and boost productivity.

Recommendations: Increase allocations for institutional credit schemes, particularly the Kisan Credit Card (KCC), tailored for fishers. Allocate resources to create awareness about the benefits of the KCC scheme and simplify the procedures for availing credit among marine fishing communities.

Promoting fish farmer producer organisations/ companies

Fish Farmer Producer Organisations/Companies (FFPOs/Cs) play a pivotal role in creating value chain efficiencies. FFPOs enable collective action among fish farmers to integrate harvest, processing, marketing, and sales. Development of FFFPOs/Cs is identified as a strategic activity under the flagship scheme the Pradhan Mantri Matsya Sampada Yojana (PMMSY) to economically empower fish farmers and fishers and to enhance their bargaining power.

Recommendations: Allocate greater funds for promoting FFPOs and FFPCs which can bring about greater vertical integration of harvest and post-harvest operations, including marketing and sale of processed fish products.

Promoting mariculture and ornamental fish farming

Mariculture operations such as cage farming and ornamental fish farming have been found to have promising potential in Kerala and can be promoted with a favorable policy environment and through greater funding support. ICAR-Central Marine Fisheries Research Institute (CMFRI) has been involved in research activities including sea farming, coastal mariculture, the development of hatchery technologies for commercially viable marine fish species, and more than 25 marine ornamental fish species. By promoting coastal cage farming and ornamental fish farming, Kerala can leverage its vast coastal resources to boost fish production, generate employment, and increase fisher incomes.

Recommendations: Provide budgetary allocations and policy incentives to promote coastal cage farming and ornamental fish farming.

Modernizing marine fish markets through e-auction platforms

The current marine fish marketing system in Kerala faces challenges related to transparency, price realization, and operational efficiency. Digitizing fish markets through e-auction platforms can revolutionize the sector by ensuring fair pricing and reducing intermediaries.

Recommendations: Establish e-auction platforms in marine fish landing centers to ensure efficiency, transparency, and fair pricing. Develop necessary infrastructure and provide training to stakeholders for the smooth adoption of e-auction systems.

Role of ICAR-CMFRI

ICAR-CMFRI is committed to supporting the proposed initiatives by providing technical guidance on mariculture, cage farming, and other relevant areas within its scientific expertise. The institute can conduct capacity-building programs and skill development initiatives for fishers and stakeholders while offering policy guidance and scientific inputs to monitor the success of the implemented measures.

Brief Communication

Cage culture of Maze rabbitfish

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Maze rabbitfish, *Siganus vermiculatus* is considered as promising species for coastal cage and pond farming due to its herbivorous feeding habit and ability to feed low on the aquatic food chain. The Karwar Regional Station was successful in breeding and seed production of maze rabbitfish, *S. vermiculatus* in captive condition. To popularize the cage farming of maze rabbitfish, thousand numbers of hatchery produced *S. vermiculatus* fingerlings (Total length 3.63±0.088 cm and body weight 2.46±0.03 g), were supplied to the Mangrove Foundation, Maharashtra, on 22nd December 2023. This was used in the demonstration of *S. vermiculatus* farming in cages as a livelihood option for self-help group beneficiaries in Tank Village, Sindhudurg District, Maharashtra. The fish seeds were stocked in 4 x 4 x 2 m cages installed in the creek (Salinity 25 ppt). Commercial feed containing 32% crude protein & 8% crude fat was given during the rearing period of 7 months. *S. vermiculatus* attained a total length (24.33±0.88 cm) and body weight (235.0±9.65 g) with the observed specific growth rate (2.16±0.303) as indicated in Figure 1.

The *S. vermiculatus* harvested from the cages totally weighed 103 kg and was sold in the local market at ₹300 per kg. The successful first harvest of Maze Rabbitfish using hatchery supplied fingerlings by ICAR-CMFRI, Karwar has fostered interest among the local fisherfolk to take up farming of this species.

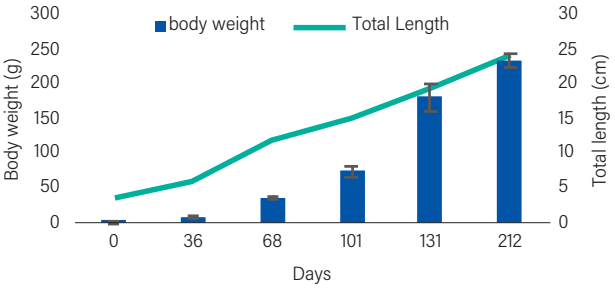

Fig. 1. Growth performance of maze rabbitfish during the cage farming demonstration

Brief Communication

Social impact assessment of bio-invasion of *Mytella strigata* in Ennore-Pulicat wetland ecosystem

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Ennore creek in Tamil Nadu has been supporting the livelihood of many fishing families in neighboring villages, who bore the brunt of the bio-invasion of alien mussel species, *Mytella strigata* or Charru Mussels. There were numerous studies and efforts to monitor introduced species and to study their ecological effects on native species and biodiversity, ecosystem processes, and functioning. Social aspects that related to the invasive species specifically to people and human society, however, are less studied. In this context, a field visit was made to the Ennore Creek of Kosasthalai River on 29th August, 2024. Further, the second visit was made to the affected sites along the coast of 23 kms from Ennore to Pazhaverkadu on 3rd September 2024. These field studies were undertaken with the aim of assessing the social impact of invasive mussels, externalities and the mitigative measures as perceived by the fishing communities. During the field visits, stakeholder meetings, focus group discussions and personal interviews were held with key informants and progressive fishers, using semi-structured questionnaires. The parameters covered during the focus group discussions were; major livelihood ventures in the locale, number of people involved and average monthly income, the immediate negative consequences as experienced by the fishers in their daily walks of life, the valuable native fishery resources wiped out due to this alien invasion, health issues encountered if any, decline in number of fishing days or fishing hours per day, migration of fishers and fisherwomen to other non-fishery occupations and any ITKs in practice for mitigating the impact of this alien species. The socio economic impact on livelihood of fishers was studied with information collected from Senjiamman Nagar, a tribal dominated fishing village. The major livelihood ventures of the 120 fisher families with a population of 480 was documented (Table 1) In Senjiamman Nagar, the income from the previous day fishing reported by an active fisher with a crew size of 3 reported a catch of 3.5 kg of lady fish (Elops) which was sold at ₹400/ kg and small caranx which was sold for ₹250/-, generating a total revenue of ₹1650/-, though the fishing days per month was found to be 15 days, in which both male and female were involved, and the fishing trip is from 6 am to 5 pm in a fishing day. Depending on the resources spotted, they use the nets *viz*, gill nets/ cast net or go for hand picking. From

Table 1. Details of Economic activities/livelihood ventures

Economic activities/ livelihood ventures	Number of people involved		Approximate per capita income
	Male	Female	
Fishing	120	120	₹500/- per day for 15 days in a month
Sea cage farming of ICAR-CMFRI	25	25	₹20,000/- to 24,000/- per family as annual income from the 6 sea cages; for 50 families
Daily wage labour (during rainy season-2 to 3 months)	20	20	₹240-320/- per day
MGNREGS	-	30	₹380/- per day (approx. 80 days in a year)

the focused group discussion with a group of 11 respondents from a cluster of three villages *viz.,* Nadur Madhakuppam, Kottaikuppam and Aranikuppam, it was observed that they go for fishing on rotation basis, once in 6 days on rotation basis among the three villages, and the mean fishing days in a year was reported as 60 days. It could be observed that, in a decade, their fishing days have reduced from 200 days earlier to 60 days at present. It was reported that about 50% of fishers from these three fishing villages have migrated to other non-fishery livelihoods or daily wage earnings.

Monitoring of *Mytella strigata* was done regularly in Ennore Creek. It was found attached to protective walls, bridges, pillars, and artificial structures, forming dense mats, covering the benthic layer, altering the benthic community structure, changing the sediment composition and outcompeting native green mussel *Perna viridis* and rock oyster *Crassostrea madrasensis.* Samples were collected from 9 different sites of Ennore Creek i.e.,

1. VNC Bridge Conveyer Belt,
2. Kattu Bridge,
3. Jalli Kuzhi Bridge,
4. Subaar Aazham Bridge,
5. Puliyamaram Conveyer Belt,
6. Karukkumaram Bridge,
7. Kandachedi Bridge,
8. Kattupalli Bridge,
9. Hot water discharge point.

Among these stations, the native oyster *Crassostrea madrasensis* and the Windowpane oyster *Placuna placenta* were observed only in the VNC Bridge conveyer belt area. Another native species of Green mussel *Perna viridis* is present only in Pulicat Lake. It is wholly vanished in the Ennore Creek area. The density of Charru mussel was higher in the Puliyamaram Conveyer Belt area (688 numbers per square meter area). The abundance of mussels was high in intertidal shallow areas and along the bridges. Most of the Ennore Creek area depth is less than 1 feet. Hence, the fishing boat movement is very much affected. The maximum depth of the creek is 2.70 metres. The abundance of Charru mussels' presence is much less in deeper regions.

Negative externalities as perceived by the fishers were recorded. It could be understood that the valuable fishery resources wiped out due to this alien invasion were; clam, Green mussels, White shrimp (earlier it constitutes 90% of the catch), Tiger shrimp, mullets, and Mud crabs. Diversified livelihood avenues such as handpicking of shrimps and crab fattening too were also hampered. Earlier the fishers used to do crab fattening by releasing the crabs in ponds for 20 days, which used to fetch from ₹300/- per kg for the un-fattened crab to ₹1500/- per kg for fattened ones. Presently, crab fattening has vanished due to the reported high mortality, due to domination of this alien species .

Majority of the fisherwomen, who were in the vending of shrimps, fish, crabs and green mussels have moved out

Infested sites in the Ennore wetlands

of fisheries into non-fisheries occupations as daily wage labourers. Mainly the creek is the bed of shrimps, the resources take shelter in the creek for breeding, then move to sea; presently, the creek water has been polluted to a greater extent, both due to the invasion and industrial pollution, affecting the passage and flow of water, which ultimately affects the flow of resources, and its breeding. Hot water discharged from thermal plant also leads to resource depletion. Reduction in the taste of fish caught from the creek was reported by about 20 per cent of fishers and consumers. Other negative externalities include physical damages to the fishing gears, physical injuries such as injuries in the foot as the fishers used to get into the creek for fishing (injuries are cured by self-stitching of wounds and cuts with ordinary twines used for stitching clothes), and injuries in the palms on manual hand picking of shrimps. Health issues encountered if any could not be ascertained due to this alien invasion, as it has not been tried for edible purpose so far, for the reasons such as the meager meat content and, its suitability for edible purposes is yet be ascertained.

Mitigative measures for invasive *Charru* Mussel management as perceived by the local fishing communities was also recorded. They felt that frequent deepening of the Ennore creek should be done to facilitate boat movement. They said that fishing is their primary main source of livelihood, which is drastically affected due to the depth of the creek has been reduced to a minimum of 1 feet. Manual removal of invasive mussels is possible on all the bridges crossing the Ennore Creek and the base of the electric transmission towers. The deepening of the midway (central portion) of the creek should be done by mechanical methods. The mussel growth in the intertidal shallow area can be removed manually, in order to prevent shore erosion. Most fishermen are interested in doing this job as it will provide them with an additional source of income. A village-level invasive mussel management committee can be set up to organize the eradication process, which will rely on the efforts of local fishermen. Manual removal, while labor-intensive, is highly effective in removing both live and dead mussels, thus restoring the natural state of the waterbody. This method involves techniques such as scraping and digging to extract the mussels from their habitat. The shells of Charru mussel, dredged out can be tried/ experimented as raw materials for the nearby lime and poultry industryat

Field visits and sample collection from infested sites

Meat content in the Green (left) and Charru mussel (right)

Processing of the shells of Green mussel for poultry feed and lime industries

Sunnambukualm near Gummidipoondi. They procure clam shell/ green mussel shell powder for poultry industry and for lime industry. Though for the past 40 years clam and green mussel shells were used, it was observed that the present day raw materials also consist of the shells of Charru mussels (though they are unaware about the presence of Charru mussel shells too along with other raw materials). Hence, it can be dredged and the raw materials can be diverted to the lime industry after assessing its suitability for this industry. Due to meagre meat content (average of 2.0 g only), and for the reasons yet to be found out, Charru mussels have not been tried as food; its suitability for edible purposes may be ascertained. Any processing methodology for making it edible may be explored.

The native edible green mussel *Perna viridis* population has vanished due to the invasive mussels. Replenishment of green mussels' stock is much needed to restore Ennore Creek and Pulicat Lake. ICAR-CMFRI has hatchery and culture technology for green mussels. Many Kerala fishermen were trained by ICAR-CMFRI, and they are culturing on their own. Development of research on the effect of deepening of water bodies and removal of invasive mussels on fisheries would contribute to better management. The invasive mussels should be subsequently monitored for three consecutive years. Future directions of research and research areas proposed are;

- Investigate the impact of eradication of *Mytella strigata* and restoration of fishery in Ennore Creek,
- Socio-economic impact assessment of invasion of alien mussels on fishermen's livelihood in Ennore-Pulicat wetlands, and
- Biological control of invasive mussels by the sea ranging of gastropods and bivalves.

From social perspectives, in-depth studies are required on database on socio-economic indicators of marine fisherfolk, sector-wise livelihood status of sea-going and creek-dependent fisherfolk, document on category-wise quantum of welfare measures and corporate social responsibility-benefits realized from the industries, impacts of selected livelihood improvement programmes, and policies for sustainable livelihoods.

Brief Communication

Ranching for resilience and sustainability: Enhancing the Yellow-foot clam fishery in Ashtamudi Lake

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Captive broodstock maturation and hatchery seed production of Yellow-foot clam has been standardized in ICAR-CMFRI. Broodstock of *Paphia malabarica* collected from the Ashtamudi Lake matured under controlled hatchery environment. After two months of rearing in the hatchery, the clams spawned volitionally. Larvae were reared in FRP tanks with optimal water quality conditions (30-35 ppt salinity, 7.8-8.2 pH, and 28-31°C temperature). The larvae settled as spat on the 11th day post-hatch and were transferred to a micro-nursery system for further growth. After 50 days, the clam seeds reached a size of 3-5 mm and were oxygen-packed for transportation to the Ashtamudi Lake for ranching.

In October 2024, resource mapping surveys conducted by ICAR-CMFRI identified the spat fall of *P. malabarica* in Ashtamudi Lake, signalling a natural replenishment of the clam population. The spat fall was predominantly observed in the high-salinity zones of the Lake. To augment this natural process,3 million clam seeds were ranched on 17th December, 2024, by releasing the hatchery-produced clam seed of *P. malabarica* into the Lake. To facilitate the growth and survival of the clam seed, it was ranched during the closed season of clam fishing. The event demonstrated a collaborative effort among key stakeholders in the sector, fishermen of the area and members of scientific community and state fisheries officials. Dr. K. K. Appukuttan (Retd) who formerly headed the Molluscan Fisheries Division in ICAR-CMFRI was present for the clam-ranching programme in Ashtamudi Lake.

This initiative was designed to enhance natural clam stock in the estuary and ensure sustainability, reflecting the collective commitment of fishery managers and scientific communities to the conservation and enhancement of molluscan resources.The ranching program is a technology

demonstration to explore the feasibility of large-scale implementation. While releasing 3 million seeds may not significantly impact overall production, it demonstrates the potential of ranching in closed or semi-enclosed systems like lakes, rivers, and backwaters, where such practices have shown success in the past. The initiative also highlights ICAR-CMFRI's capability to scale up seed production to 100 million or more, encompassing oysters, clams, and mussels. This effort underscores the importance of stakeholder collaboration and scientific intervention in supporting sustainable fisheries to significantly enhance economic opportunities for local communities.

Kaleidoscope

Stranding of Whale sharks along north Andhra Pradesh coast

Stranded whale shark at Thantadi, Anakapalli district

Rhincodon typus Smith, 1828, commonly known as whale shark, is found in tropical and temperate waters, except the Mediterranean Sea. It is most commonly seen in deeper water but also in shallow areas near estuaries and river mouths. The whale shark is the largest fish on earth and is an epipelagic, planktivorous fish with late maturation and low number of

A caracass of Whale shark at Donkuru, Srikakulam district

pups. Due to its life history, the species is protected under different national and international legislation. The species is listed in the "Endangered" category in the IUCN RED List and is also included in Appendices I and II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS) and Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In India, the species has been protected under Schedule I of the Indian Wildlife (Protection) Act, 1972, since May 2001, and currently it is also included in Schedule I of the Indian Wildlife Protection and Amendment Act, 2022. Though not targeted, Whale sharks are occasionally caught/damaged in coastal fisheries unintentionally. Whale sharks are the most common elasmobranch protected species landed as incidental catch in Andhra Pradesh. Reports of stranding/incidental catch of the species are available from several locations in the state, namely, Kakinada, Visakhapatnam and Srikakulam, with the gillnets being the most common fishing gear in which the animals get entangled. Most recently, on April 13, 2024, a whale shark of total length 9.1 m and weight 2.5 tons (approx.) was entangled in a traditional fishing net, shoreseine (locally known as Dharivala), operated at Thantadi (17.524386 and 83.062544) in Anakapalli district. Fishermen tried to release the animals back to the sea. However, it died and got stranded on the beach. Earlier, a carcass of whale shark of 6 m length and weight 2 tons (approx.) was observed at Donkuru (19.056232 and 84.749548) in the Srikakulam district of Andhra Pradesh on 27.02.24. As per fishermen's view, the animal got entangled in a gillnet operated at a depth of 35 m, died, and was stranded on the beach. Though it is impossible to totally avoid accidental entanglement of whale sharks in fishing gear, advisories can be made based on seasonal and temporal distribution or presence of these animals, in and near fishing grounds, which can be a guide for fishermen to reduce bycatch of these majestic animals.

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Bryde's whale sighting in coastal waters of Karnataka

Balaenoptera edeni (Anderson, 1879) is a widely distributed tropical marine mammal species belonging to the family Balaenopteridae. They are found in tropical, subtropical, and warm temperate waters worldwide, where temperature ranges between 16°C and 23°C. Bryde's whales inhabit all oceans between 40° south and 40° north. Some populations migrate seasonally, moving away from the equator in summer and returning toward it in winter. In contrast, other populations are residents and remain in the same area year-round without migrating. They are considered one of the "great whales," a group that also includes, Blue Whales and Humpback Whales. Originally, *B. edeni* and B*. brydei* were classified as separate species (Wada *et al.,* 2003). However, recent scientific consensus recognizes Bryde's whale as a single species with two subspecies (Ren *et al.,* 2022). Bryde's Whales are distributed across the Indian Ocean, but sightings in Indian waters are uncommon (Sathasivam, 2004) and often documented through stranding reports. Under the Marine Mammal Stock Assessment in India (MMSAI) project we started the marine mammal survey of the Karnataka coast on 13th December 2023 from Mangalore coast. The survey was conducted using a 22m OAL commercial fishing vessel with four research crew members on board, following a linear transect methodology for visual survey. Surveys were conducted following six predefined line transects each of 12 nautical miles (NM) in length, situated at an interval of 24 NM throughout the Karnataka coast. On December 16th, around 16:30 IST, while conducting the sixth and final transect along the coast of Karwar, Karnataka (Latitude: 14° 52.922' N, Longitude: 73° 53.705' E), we observed a whale blow on the starboard side of the boat. Upon closer observation, we identified a pod of three whales (two adults and one sub-adult). The observation was

made 12 NM from the coast at a depth of 28-30 m. The adult whales were approximately 10-11 m in length, while the sub-adult measured around 6-7 m. The whales were identified as Bryde's whales (*Balaenoptera edeni*) based on their counter-shaded coloration, which transitions from smoky grey on the dorsal side to white on the ventral side. Identification was further confirmed by the presence of three prominent ridges running from the anterior blowholes along the dorsal surface of the head, as well as a pointed, strongly hooked dorsal fin positioned about two-thirds of the way along the back of the. From the initial cue, the sighting was sustained for 60 minutes, observing the behaviour of the individuals. All three whales exhibited uniform breathing patterns, performing apneustic breathing to secure more time underwater. The breathing tailed a long deep dive for an average of four minutes followed by three to four instant breathings with an average time interval of 15 seconds. During each deep dive, they did not display their flukes, a characteristic commonly observed in Bryde's whales. We followed the animals through the visual observation of the whale's footprint. During our observation of about 50 minutes, the whales were showing behavioural states including slow swimming, semi-breaching, and tactile communication. All the individuals maintained a minimal distance between them while moving. Water samples were collected from the site to measure water quality and conduct plankton analysis. The water temperature at the site was measured as 29°C, salinity at 34.7 PSU, pH at 8.1, and dissolved oxygen (DO) at 5.82 mg/L. Initial analysis of the water sample revealed a clear abundance of mesozooplankton. Zooplankton density observed at the site was 3030.16 nos/m^3, with appendicularia as the dominant group comprising of 1521.44 nos/m^3.

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Saving the Widenose guitarfish: a success story

In a commendable act of conservation, the critically endangered Widenose guitarfish (*Glaucostegus obtusus*), listed under Schedule I of *The Wild Life (Protection) Amendment Act, 2022*, was successfully released back into the sea after being accidentally caught in a bottom-set gillnet. This significant effort was carried out by ICAR-CMFRI technical staff, Mr. Paulose Jacob Peter and Mr. Joby P. J., on 7th November, 2024, at Vypin, Kochi. The neonate guitarfish, measuring 23 cm, was entangled in the net and landed ashore. Recognizing its critical conservation status and its inclusion under Schedule I of the act (Amendment Act came into force in April 2023), Mr. Joby and Mr. Paulose acted swiftly. Upon confirming that the neonate was alive, they carefully released it back into its natural habitat, where it swam away unharmed.

The timing of this event aligns with the guitarfish's breeding season along the Kerala coast, which occurs from October to December. During this period, neonates, mature individuals, and pregnant females with near-term embryos are frequently encountered in shallow coastal waters, especially in sandy habitats at depths of 0–2 meters. The released neonate, a female, is particularly significant, as its survival directly supports the fragile population of this critically endangered species. With a small litter size of only 5-6 pups, each individual plays a crucial role in the species' recovery, emphasizing the importance of releasing neonates or accidentally caught individuals back into the wild. This remarkable effort underscores the importance of awareness creation among stakeholders, including fishers, vendors, traders, auctioneers, students

Released neonate of *Glaucostegus obtusus* measuring 23 cm

and government officials. By promoting awareness of conservation laws and the ecological importance of such species, accidental catches like this can lead to similar successful releases, ensuring the protection of endangered marine resources. The dedication and quick action taken in this instance, set a precedent for responsible conservation practices and highlights how informed individuals can make a significant difference in the survival of critically endangered species.

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Observations of rarely recorded deep-water Snappers

Etelis coruscans

Pristipomoides zonatus

Deep-water fish species, particularly those belonging to the Lutjanidae family, are rare in the fisheries landings as they are only caught rarely, due to the very few fishing boats operating in their deep habitats they frequent. Any landings recorded therefore provide valuable insights into their distribution, biology, and potential ecological significance. During routine sampling at the Cochin Fisheries Harbour (9.9391°N, 76.2627°E) in April 2023, an unusual catch comprising three individuals of deep-water longtail red snapper (*Etelis coruscans*) and a single specimen of oblique-banded snapper (*Pristipomoides zonatus*) was recorded. These were recorded from a hook and line operation at a depth range of 130-200 meters. The catch composition also included species such as *Pristipomoides filamentosus, Aprion virescens,* and various species of Lethrinids, suggesting that the demersal fish community in this depth zone is dominated by snappers and pig-face breams. *Etelis coruscans* is a slender, pink to reddish jobfish characterized by a small head, prominent eyes, and a deeply forked caudal fin. The dorsal fin is notably incised between the spinous and soft portions. The specimens recorded in this study had total lengths of 68.6, 68.7, and 72.4 cm, indicating mature individuals. The oblique-banded snapper is distinguishable by its reddish to pink body with oblique yellow bars and yellow-tinted dorsal and caudal fins, while the other fins remain pink. A single specimen measuring 44.8 cm in total length was observed in the current catch. Both these species are distributed widely across the tropical and subtropical waters of the Indo-Pacific. These sporadic landings of *E. coruscans* and *P. zonatus* indicate the presence of these deep-water fishes on the southwest coast, which have limited deep-sea fishing activities. The long-lived and slow-growing species like *E. coruscans*, are reported to live for over 50 years. Documenting these fish occurrences will help to develop a database on deep-water fish populations.

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Spinetail mobula landed in Sasson Dock

The *Mobula mobular*, a large pelagic ray from the Mobulidae family, is widely distributed in tropical and temperate seas. Known for its distinctive wing-like pectoral fins and elongated spinetail, this species stands out among mobulids. On October 1st, 2024, during the Fortnightly Fishery observation at Sassoon Dock harbor, a pregnant female *Mobula mobular* (with a disc width of 2280 mm) was documented, incidentally caught by a multiday trawler off Mumbai. While the specimen was being cut by fishermen, an advanced female foetus was found, measuring 452 mm in disc width and weighing 1.850 kg. The foetus displayed dorsal colour pattern, including a crescent-shaped white band between the spiracles, curving forward, and two symmetrical shoulder markings against a dark background. Reports indicate that these white markings fade or vanish after birth. Data on embryo development and birth size for *Mobula mobular* are limited, with only a few recorded instances

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Bryde's whale washed ashore in Andhra Pradesh

A Bryde's whale (*Balaenoptera edeni*) was found washed ashore at Meghavaram village (18.6024° N, 84.1935° E), in Srikakulam district of Andhra Pradesh on 27th July 2024. Based on observation and morphometric measurements taken by ICAR-CMFRI survey personnel, the whale was a male, measuring 10.6 m in total length with total weight estimated to be between 3-5 tonnes. The body of the whale had multiple bruises along the right side of belly as well as some cuts in the caudal area, near the flukes as well as both sides of the belly. Based on the post-mortem study carried out by concerned officials, it was seen that the whale was in starved condition and it was thought to have been separated from its pod. The age of the whale was surmised to be 6-7 years. The carcass of the whale was buried in the same location by officials. This is a first report of this species from Andhra Pradesh and second report of stranding of this species from the region. An earlier report of stranding of a female Bryde's whale was reported from Puri, Odisha on 10th December 2021 (Dash *et al*., 2021). Sighting of Bryde's whale has been reported from the region, off the mouth of River Rushikulya, Odisha at a distance of 6 km from the shore, at a depth of 28-32 m (John *et al*., 2012).

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Unusual presence of sea cucumbers in coastal waters off Kochi, south-west coast of India

During the routine pre-monsoon sampling conducted off Kochi in the 5–40 m depth zone on 19th April 2023, an unusual presence of sea cucumbers belonging to the genus *Holothuria*, was observed. Around 60 number of specimens were found in the sediment samples and in the trawl net as accidental catch during the experimental trawling conducted along the inshore waters at 20 m depth (10° 1'34.80"N, 76° 6'27.18"E). The specimens were released back to the sea immediately after taking photographs and careful examination. They were brownish-white in colour and ranged between 30-50 mm in length. No significant relationship was discernible between the observed sea cucumber densities and sediment characteristics such as texture (77.3 % clay, 4.5% sand and 22.6% silt) and organic carbon content (2.2%). This unusual occurrence is significant as there were no previous reports of sea cucumbers from coastal waters off Kochi. Sea cucumbers belonging to the class Holothuroidea under the phylum Echinodermata, are benthic marine invertebrates found throughout the world's oceans. Their crucial role in the marine ecosystems by consuming decomposing organic matter and converting it into recyclable nutrients. Also, the feeding and excretion activities of sea cucumbers induces the alkalinity of sea water, which helps to buffer ocean acidification. In India, approximately 200 sea cucumber species are found all of which are listed in Schedule 1 of Wildlife (Protection) Act, 1972, making their collection, trade, or any form of utilization a punishable offence. Along the Indian coast, sea cucumbers are found particularly in Gulf of Mannar, Palk Bay, Andaman and Nicobar Islands, Lakshadweep and Gujarat coasts (Asha *et al.*, 2019). The coastal waters of Kerala, particularly around the districts of Thiruvananthapuram and Kollam, have also reported occurrences of sea cucumbers (Deepa & Biju Kumar, 2011).

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