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Landings of the marine shrimp *Parapenaeopsis stylifera* by multi-day trawlers in Cochin Fisheries Harbour (Photo credit: Josileen Jose)

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

India emerged as the second largest fish producer globally in 2018, with a production of 13.7 million metric tonnes of fish. Of this, 35% was from the marine sector and mostly through capture fisheries. Also, the seafood exports which had grown steadily over the years. touched 13.7 7 lakh tonnes worth 47000 crore ₹ in 2018. Several people are directly or indirectly dependant on the marine fishery resources for their livelihoods. Vast stretches of backwaters and estuaries confer a natural advantage for pursuing mariculture activities. These facts point to the need for the fisheries in the capture and culture segments, to be sustainable and well-managed. The Government of India's Blue Revolution Scheme focusses on integrated development and management of fisheries to increase fish production and productivity. A new Mariculture Policy for the country is also on the anvil. In this backdrop, articles in this issue of MFIS focus on development of an indigenous approach to prepare microalgal cultures throughout the year which is vital to marine fish larval rearing processes in hatcheries. This can ensure higher success in marine fish seed production cycles in hatcheries and meet the growing demand from mariculture units. The recent ban on wild-caught shrimp exports from India to USA linked to the non-use of Turtle Excluder Devices in shrimp trawls since July 2018 caused much concern among fishermen and seafood exporters. This issue is also explored in detail in the article on sea-turtle conservation efforts in India. Besides these, several communications pertaining to the marine fisheries sector are also included.

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Production of an indigenous micro algal concentrate from *Nannochloropsis oculata* (NANN CON): An alternate approach

Biji Xavier*, Sekar Megarajan, Ritesh Ranjan, Vamsi Balla, S. Padmaja Rani, Chinnibabu Bathina and Shubhadeep Ghosh

Visakhapatnam Regional Centre of ICAR-Central Marine Fisheries Research Institute, Visakhapatnam - 530 003, Andhra Pradesh

*E-mail: bijicmfri@gmail.com

Abstract

Nannochloropsis oculata is a marine micro algae used directly for green water larval rearing system and indirectly for rotifer culture in marine finfish hatchery. Difficulties in algal culture during summer months can be overcome by the production of microalgal concentrate which can be stored and used when required. Harvesting of micro algal biomass from the culture is considered as crucial step for the production of algal concentrate. The use of centrifugation is the effective method for harvesting microalgae and steps involved in the production of *Nannochloropsis* concentrate (NANN CON) is described in detail. Centrifugation which could accumulate a cell count of an approximately 30 billion/ml from 300 litres of *N. oculata* culture was the most efficient method as the cells in the concentrate retained shape and nutritional contents similar to cultured fresh microalgae. Chilled NANN CON preserved with 10% glycerol proved advantageous had more than 80% viable cells even after five months of storage. The preserved NANN CON is effective as feed for rotifer, algal inoculum and Green water larval rearing systems. The cost for production of NANN CON was ₹ 1158.46 per kilogram and in several aspects proved superior to other commercial products currently used.

Keywords: *Nannochloropsis oculata, rotifer, Green water*

Introduction

Nannochloropsis oculata, a marine microalgae (Eustigmatophyceae) plays an important role in seed production of marine finfishes. This small sized algae (2-5 μm) has fast multiplication rate and is rich in Chlorophyll a, Astaxanthin, Zeaxanthin, and Canthaxanthin. The algae are used directly and indirectly in marine finfish hatchery for green water larval rearing system and rotifer culture, respectively. Intermediate cultured algae are mainly used in larval rearing and mass cultured algae are used for live zooplankton (rotifer) culture. *N.oculata*, being a temperate waters species, mass production of microalgae in outdoor culture systems is difficult during the summer months in tropical countries like India. However, larval rearing for most of the marine finfishes peak during this period. Difficulties in algal culture during summer months is a major bottleneck in the year-round marine finfish larval production cycles. Microalgal concentrate is an alternative approach to ensure all-time availability of sufficient quantities of microalgae for larval rearing and zooplankton culture. These are prepared with added preservatives to be used at the required time. Different methods used to prepare algal concentrates include 1) coagulation, 2) flocculation, 3) flotation, 4) centrifugation and 5) filtration. Among these, centrifugation proved to be the most efficient method with >90% harvesting efficiency. Centrifuged micro-algal concentrates retained shape and nutritional contents as that of fresh cultured microalgae and can be used for green-water larval culture, rotifer culture and even as inoculums for further *Nannochloropsis* culture. Importantly, with optimum centrifugation time and speed, the shape of cells is maintained which helps the cells to maintain its viability during storage.

Major advantage of NANN CON over commercial products is that more than 80% of the cells in the concentrate are viable even after five months of storage in glycerol under chilled conditions. This cell can be used as inoculum for scaling up the algal culture. Additionally, the cells of the prepared concentrate remains suspended in water column for longer time similar to fresh cultured nanno cells, which helps to maintain the water quality in rotifer culture and larval culture tanks based on its use. In many of the commercially available *Nannochloropsis* concentrates, viable cells are not maintained and most of the cells settle slowly, which quickly degrades the water quality in the culture environment.

Steps involved in preparation of NANN CON

Seawater treatment: Sea water is filtered mechanically through sand filter, followed by UV filtration and finally treated with ozone for complete sterilization. A residual ozone concentration of 0.1 - 2.0 mgL^{-1} for a period of 1 - 30 minutes, is required to be maintained for complete disinfection. It is advisable to maintain nil ozone in the sea water before the inoculation of *N. oculata*.

Preparation of intermediate culture of *Nannochloropsis oculata*: 'Conway' or 'Walne's medium is used for the preparation of culture medium in the indoor culture of *N. oculata*.

The optimum environmental parameters for *N. oculata* culture include temperature: 18-24°C; salinity: 20-24 gL^{-1}; light intensity: 2,500-5,000 lux; photoperiod: 24 hours and pH: 8.0-8.5.

Stock culture of microalgae (10%) is inoculated into seawater with culture medium (Conway). This is maintained for 3 days with optimum aeration (Fig.1). The culture in growing phase / log phase is selected for the preparation of *N. oculata* concentrate by centrifugation (Fig.2). At this time, cell count should reach 30-40 million / ml if culture is healthy. Additionally, the cell count could be enhanced upto 80 million / ml if the culture is supported with pure CO_2.

Preparation of NANN CON: Industrial centrifuge, which holds more volume of culture, is used for this step. The culture is transferred into centrifugation bottle and centrifuged at the maximum speed of 4000 rpm for 30 minutes. The supernatant is decanted and the precipitated concentrate is collected without damaging the cells. Using this method, centrifugation of 300 litres of *N. oculata* culture can accumulate a cell count of an approximately 30 billion/ml. The concentrate with 5 - 20% inclusion of glycerol is amenable to preservation by both, chilling and freezing. Glycerol at 10% inclusion performs better with chilling and 20% inclusion performs well with freezing.

Cell viability test: Viability of the harvested and preserved cells is tested using 'Evans Blue' stain. Ruptured cells appear blue, since Evans Blue solution diffuses into the protoplasm region and stain the cells blue (Fig.6).

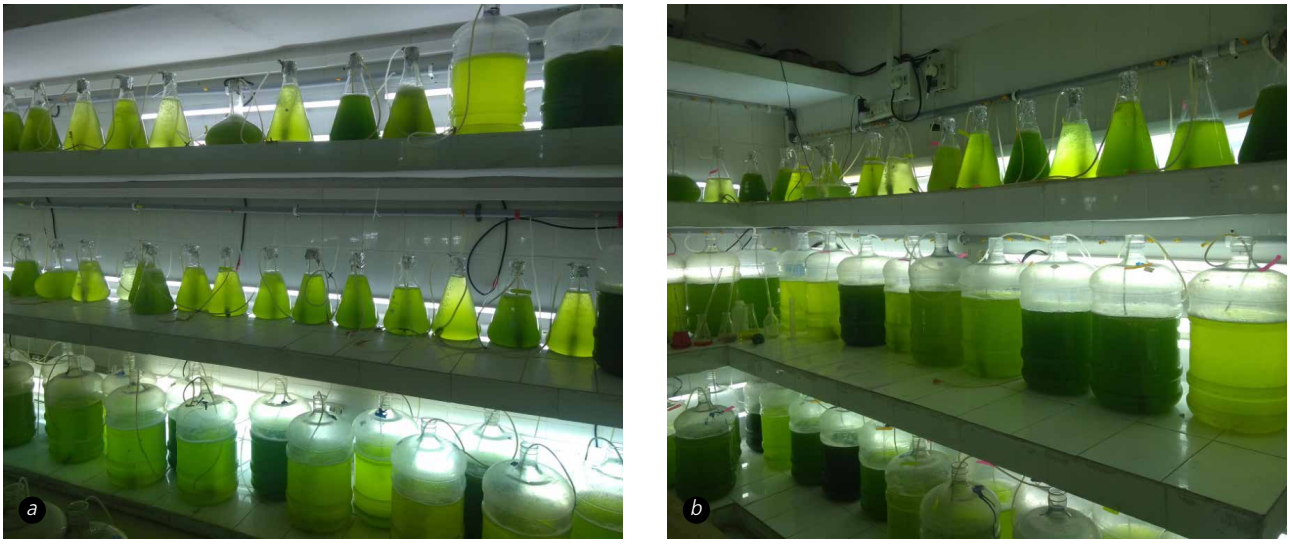

Fig.1. Stock (a) and Intermediate (b) culture of *Nannochloropsis oculata*

Fig. 2. Intermediate culture of *N. oculata* before centrifugation

Fig.3. Intermediate culture of *N.oculata* after centrifugation

Fig.4. NANN CON concentrate

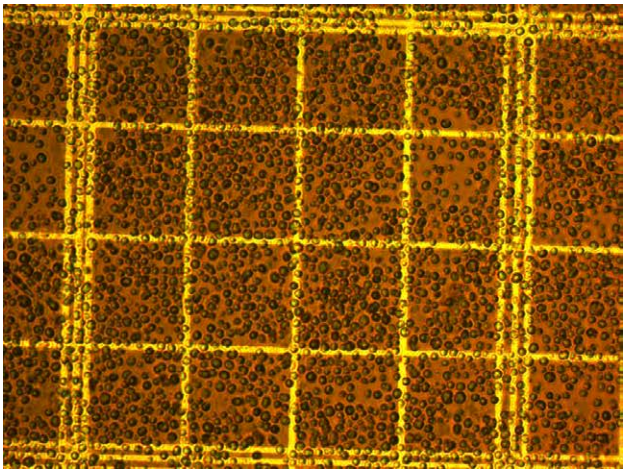

Fig.5. Concentrated *N. oculata* cells after dilution (20X)

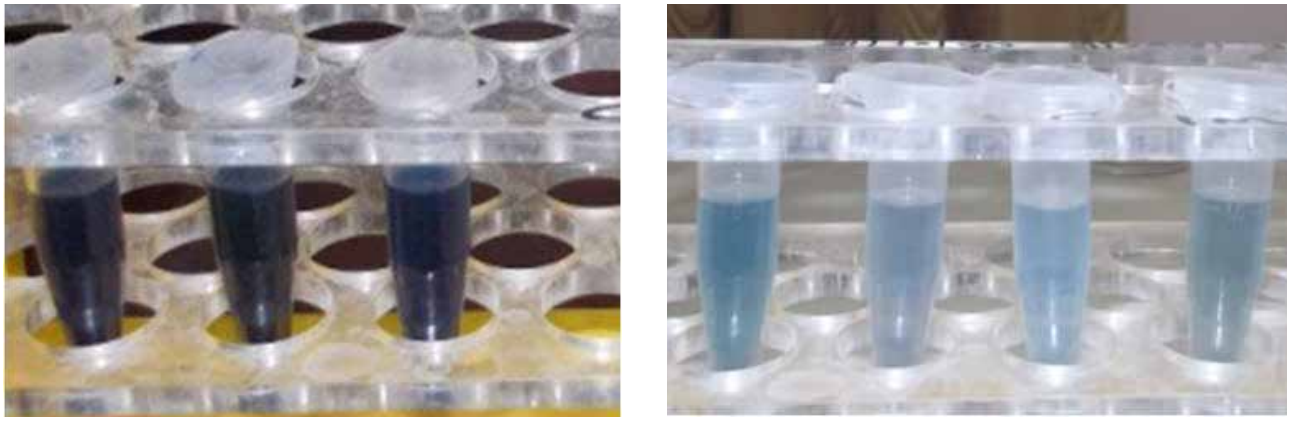

Fig.6. Diluted *N. oculata* cells from concentrate with Evan's Blue stain applied and after staining process completed (on the right)

Application of *Nannochloropsis* concentrates: NANN CON is used in fish hatcheries as feed for rotifer, as algal inoculum and in Green water larval rearing systems. For rotifer (*Brachionus plicatilis*) culture, using NANN CON (preserved in 10% glycerol) as feed resulted in a maximum of 1040 rotifers / ml at the concentration $3x10^6$ *Nannochloropsis* cells / ml as indicated in Fig.7.

As inoculum for further *N. oculata* culture the preserved NANN CON (0 to 20% of glycerol in chilling) is diluted with sterilized sea water to obtain a cell count of

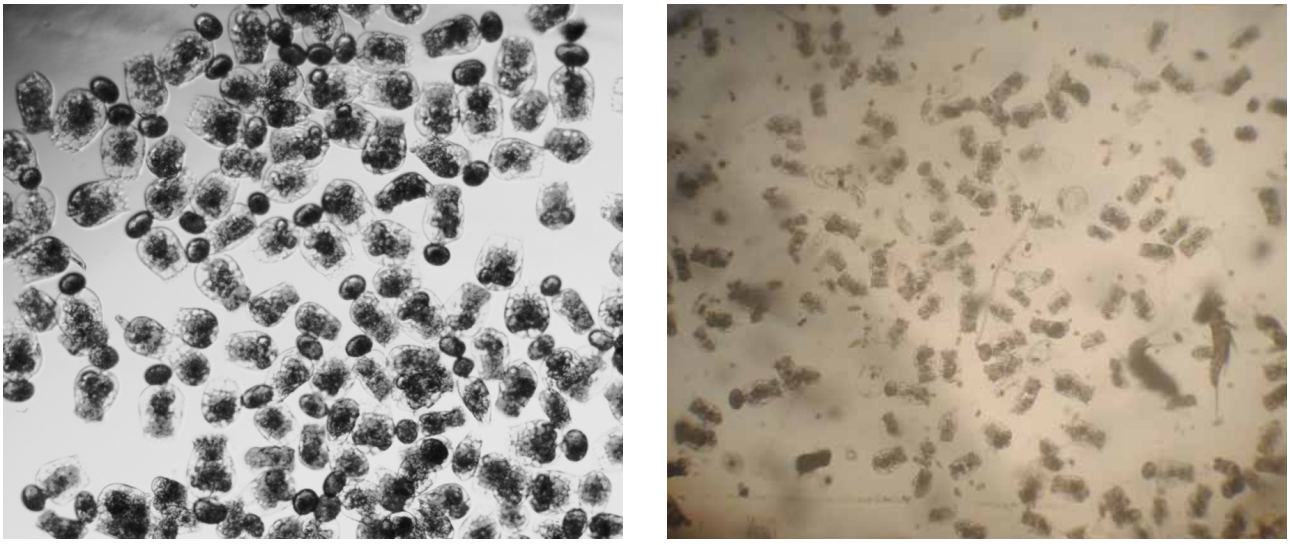

Fig.7. Rotifer cultured on NANN CON for marine finfish larval rearing

1x 10^6/ml. A 10% of inoculum is added into 10 ml of culture medium containing Conway medium. The culture is maintained at optimum environmental condition for the stock culture development. At the end of third day of inoculation, the cell count reached 12 x 10^6 cells/ml in culture with chilled cells preserved in 10% glycerol and the same stock is used for further development. The glycerol preserved NANN CON can be diluted and also used as direct inoculum to prepare intermediate culture.

In the Green water system for marine finfish larval rearing, an approximately 3.5 g of NANN CON added to 1 cubic metre water volume, maintained the *Nannochloropsis* concentration of 1 lakh cells/ml in suspended condition and also maintained the water quality during the period of larval rearing.

Economics for production of NANN CON: Product development is dependent on the economic viability of the product and therefore, the cost of production for producing 1 kg of NANN CON is calculated. The cost (fixed and variable) involved is presented in Table1. The cost of producing NANN CON using centrifugation method is ₹1158.46 per kg with a cell count of approximately 30 billion/ml.

Fig.8. Green water rearing system with *N.oculata* for finfish larval rearing and in close-up (on right)

Table 1. Economics of culturing *Nannochloropsis oculata* for NANN CON preparation

Items	Qty.	Unit	Unit cost (₹)	Total cost (₹)	Economic life	Yearly depreciation	Daily depreciation	Depreciation based on usage
Equipments								
Dry oven	1	unit	50000	50000	20	2500	6.84	0.28
Weighing balance	1	unit	150000	150000	20	7500	20.55	0.85
Air blower	2	unit	12000	24000	10	2400	6.57	5.26
Ozone generator/Autoclave	1	unit	90000	90000	10	9000	24.65	1.03
Compound microscope	1	unit	30000	30000	20	1500	4.11	0.00
Haemocytometer	1	unit	1500	1500	10	150	0.41	0.00
Gas stove and cylinder	1	unit	2000	2000	10	200	0.55	0.00
Centrifuge and accessories	1	unit	350000	350000	20	17500	47.94	23.97
Refrigerator	1	unit	15000	15000	20	750	2.05	0.00
Lux meter	1	unit	10000	10000	20	500	1.37	0.00
Refractometer	1	unit	5000	5000	5	1000	2.74	0.00
Air conditioner	1	unit	30000	30000	10	3000	8.22	6.57
UV lamp	1	unit	7000	7000	10	700	1.92	0.00
Distillation unit	1	Unit	350000	350000	15	23333	63.93	0.00
Subtotal (Rs)				1114500		70033	191.85	37.96
Culture materials								
Test tubes 15ml	10	pcs	16	160	3	53.33	0.15	0.00
Conical flask 100ml	10	pcs	85	850	3	283.33	0.78	0.00
250ml	10	pcs	130	1300	3	433.33	1.19	2.56
3000ml	15	pcs	1485	22275	3	7425	20.34	6.10
Carbouy 20 L	15	pcs	150	2250	3	750	2.05	1.02
Reagent bottles 1000ml	3	pcs	700	2100	10	210	0.57	0.00
Spatula	10	pcs	80	800	10	80	0.22	0.00
Tissue paper	1	unit	75	75	100days	0	0.75	0.00
Glass pipette: 10ml	2	pcs	180	360	3	120	0.33	0.00
5ml	2	pcs	160	320	3	106.67	0.29	0.00
1ml	2	pcs	150	300	3	100	0.27	0.00
Pipette bulb	3	pcs	20	60	5	12	0.00	0.00
Air hose	15	m	60	900	3	300	0.82	6.57
Air stone	15	stone	25	375	2	187.5	0.51	4.11
Air valve	15	pcs	4	60	3	20	0.05	0.00
Florescent lights	3	units	250	750	2	375	1.03	4.10
Aluminium foil	20	m	5	100	3days	0	20.0	0.00
Pasture pipette	10	pcs	2	20	2	10	0.00	0.00

Items	Qty.	Unit	Unit cost (₹)	Total cost (₹)	Economic life	Yearly depreciation	Daily depreciation	Depreciation based on usage
Glass slide	10	pcs	3	30	3	10	0.00	0.00
Coverslip	10	pcs	1	10	3	3.33	0.00	0.00
Plastic brush	5	pcs	40	200	60days	0	3.33	0.00
Plastic tub (100 litres)	2	units	1000	2000	5	400	1.09	0.00
Water storage tank:300 litres	2	units	2500	5000	10	500	1.37	0.00
Sanitizer	1	bottle	40	40	30days	0	1.33	0.00
Broom	1	pc	80	80	90days	0	0.89	0.00
Bucket	2	pcs	110	220	2	110	0.30	0.00
Funnel	1	pc	90	90	5	18	0.05	0.00
Mug	1	pc	50	50	5	10	0.03	0.00
Subtotal				40775		11517.49	57.74	24.46
Total				1155275		81550	249.59	62.42

Cost (₹) of producing 1kg *Nannochloropsis oculata* concentrate (NANN CON)

Item		Quantity	Cost (₹)
	Equipments	-	37.96
Depreciation:	Culture Materials	-	24.46
Inoculum @ ₹360/100 ml		1.0 ml	3.6
Culture (Conway) medium @ ₹0.27/ ml		480 ml	129.6
Gas: CO_2		-	50
Electricity @ ₹4/ unit		115.71	462.84
Labour @ ₹300/day		(1.5 day)	450
Total operating cost			1158.46

Status of sea turtle conservation in India and the way forward

R. Jeyabaskaran* and V. Kripa
ICAR-Central Marine Fisheries Research Institute, Kochi - 682 018, Kerala

*E-mail: jbcmfri@gmail.com

Abstract

Sea turtles play an important role in maintaining the balance of the food web in the marine ecosystem. It is reported that the unintentional capture of turtles in shrimp trawls is the most important factor leading to the mortality of sea turtles. Globally, several conservation measures are in place for conserving populations of the iconic sea turtles. This includes India where several identified turtle nesting sites are protected through appropriate restrictions on fishing and other anthropogenic activities. The history of conservation of sea turtles in India and recent linking use of Turtle Excluder Device (TED) in shrimp trawls to shrimp imports by the USA, is discussed.

Keywords: *Sea turtles, conservation, Turtle Excluder Device, shrimp trawls*

Introduction

Five species of marine turtles viz., Olive Ridley turtle (*Lepidochelys olivacea*), Loggerhead turtle (*Caretta caretta*), Leather back turtle (*Dermochelys coriacea*), Hawksbill turtle (*Eretmochelys imbricata*) and Green turtle (*Chelonia mydas*) are known to inhabit the Indian coastal waters. Government of India has given high priority to conserve the sea turtles and all the five species are protected as they are placed in Schedule I of the Indian Wildlife (Protection) Act 1972 as per the Amendments made to the Schedule in September 1977. Sea turtles are venerated in Hindu mythology and those accidentally caught are usually released back into the sea by the local fishermen. In South India, majority of the coastal people believed that turtles are bad omens and cannot be brought into the house. Likewise, turtle meat consumption is forbidden among muslims while only certain christian and tribal communities in India are not averse to consuming their eggs and meat. Thus, socio-religious importance for turtles in India goes a long way in the implementation of conservation measures.

The Government of India constituted an Expert Scientific Panel (ESP) on 10 July 1998 to conduct a study on the distribution of sea turtles, their incidental mortalities in fishing nets, use of TED in fishing waters, etc. which submitted its report in March 2000. Two important recommendations made by ESP were: (i) declaration of mass nesting areas as marine sanctuaries, and (ii) mandatory implementation of turtle excluder devices (TEDs) in all mechanized trawlers operating in areas of mass nesting where incidental mortalities have been recorded, in order to bring down incidental catch and mortality of sea turtles. It identified both the areas and the period as follows:

I. Entire coast of Odisha during the period from November to April,
II. Coast of Midnapore District in West Bengal during December-March,
III. Coast of Srikakulam, Vizianagaram, Visakhapatnam and East Godavari districts in Andhra Pradesh during November-April,
IV. Coast of Nagapattinam, Turticorin, Ramanathapuram and Tirunelveli districts in Tamil Nadu during December-April,

V. Coast of Puducherry, excluding areas off the coast of Mahe, Karaikal and Yanam, during December-April, and
VI. Coast of Kollam and Trivandrum districts in Kerala, during December-March.

Marine Product Export Development Authority (MPEDA) was entrusted with the responsibility of the development and promotion of TED designed by ICAR-Central Institute of Fisheries Technology (CIFT).

Laws that govern marine turtle conservation in India include

1. Wildlife (Protection) Act - 1972
2. Ratification of the CITES - 1976
3. Ratification of Bon Convention - 1981
4. Environment (Protection) Act - 1986
5. The Biological Diversity Act, 2002
6. The Wildlife Protection Amendment Act- 2002
7. The Marine Fishing Policy, 2004
8. Marine Fisheries (Regulation and Management) Bill, 2009
9. Coastal Regulation Zone Notification, 2011
10. State Fisheries Policies and Laws

Conservation and Management measures on East Coast of India

West Bengal: Marine Fishing Regulatory Act was implemented in the year 1993. Fishing craft fitted with more than 30 hp engine are allowed to operate beyond 18 km. Trawl net of standard mesh size fitted with turtle excluder devices is mandatory. Incidental catch of Olive ridley was reported in the gillnet fishing at Digha the months of December-February. Fishermen used to release it immediately due to the strict legal action taken by the forest department. In 1982, the West Bengal Government enforced the Indian Wild Life Act, 1972 (Amendment, October '77).

Odisha: The Green sea turtle has been reported to occur during summer in the outer channel (river mouth area) of the Chilka lake, a brackish waterbody. The mass nesting beach (rookery) along the Chilika coast is at Rushikulya which is located in southern Odisha. Half of the world's Olive Ridley turtle population and 90% of India's turtle population lives in this state. Every year between October and April, three major nesting sites:- the Nasi Islands in Gahirmatha, the Devi river mouth and the Rushikulya river mouth in Odisha becomes the nesting ground for Olive Ridley Turtles. The coastal belt was also notified as the Gahirmatha (Marine) Wildlife Sanctuary in 1997, in order to protect the Olive Ridley sea turtles. Bhitarkanika gained the status of a wildlife sanctuary in 1975 and national park in 1998, due to its ecological significance. For the protection and conservation of Olive Ridley turtles, there has been a ban on fishing for a period of seven months (November 1 - May 31) every year, applicable to a 20-kilometre radius from the coast and enforced by the forest department to protect the endangered turtles, under the Orissa (Odisha) Marine Fishing Regulation Act, 1982 and Marine Fishing Rules, 1983. All these restrictions amount to a loss of ₹1000 million to the fishing industry and to the fishermen involved in fishing. The state fisheries department offers affected families subsidised rice rations for up to six months as a form of compensation. Odisha government has also proposed to enhance the livelihood support assistance from ₹ 5000 to ₹ 7500 to each fishermen family during the ban period. In Odisha, it is legally mandated that trawlers use TEDs. Odisha government also promotes turtle tourism which in turn could help conserve Olive Ridley turtles. It is reported that during 2017-18 around 11.10 lakh Olive Ridley turtles emerged from the sea to lay eggs along Odisha coast. The '*Operation Oliva*' mission launched by the Indian Coast Guard and the 'Sea Turtle Research Centre' near the Ghati Central Nursery in the Khalikote forest range of Ganjam district set up the Odisha government for the conservation of Olive Ridley turtles are other initiatives.

Andhra Pradesh: Mypadu a fishing village in Nellore district is one of the sporadic nesting sites with less than 10 nestings of Olive Ridley turtles. The state government is promoting tourism in the beach. Trammel net ('Disco net') used to catch shrimp particularly *Penaeus indicus* by the artisanal fishermen occasionally trapped juvenile Olive Ridleys and caused much damage to the nets. Presently, fishermen are avoiding the place where turtles are found and entangled juvenile turtles are also immediately released back to the sea to prevent damage to nets. ICAR-Central Marine Fisheries Research Institute (CMFRI) which extensively studied the trawl by-catch in Andhra Pradesh during December 2013 to December 2014 reported that bycatch of turtles in trawl net was $< 0.5\%$.

As per the Andhra Pradesh Marine Fishing Regulation Act, 1994 trawlers are mandated to use TED and the shrimp trawlers fishing without Turtle Excluder Device (TED) shall be liable for confiscation of entire catch

and impose a fine of ₹ 2500. Andhra Pradesh Forest Department and NTPC Ltd jointly initiated the 'Sea turtle Conservation Project' under the 'Corporate Social Responsibility and Sustainable Development Initiative'. Community Based Sea Turtle Protection and Conservation Programme has been taking place for the past 21 years jointly by Andhra Pradesh Forest Department and Visakha Society for Protection and Care of Animals to protect and conserve the sea turtles. Village level sea turtle protection committees are constituted at each Nesting Beach Zone for the protection of nesting turtles, nests, eggs and hatchlings.

Tamil Nadu: According to the Tamil Nadu Marine Fisheries Regulation Act of 1983 (Tamil Nadu Act: 8 of 1983), fishing by mechanized fishing vessels, motorized country craft and those using mechanized fishing techniques within a 5 nautical mile (nmi) radius around the identified potential nesting and breeding sites of sea turtles is prohibited. In Tamil Nadu, the Olive Ridley nests between December and April along the Chennai-Kancheepuram coastline. In January 2015, a newspaper report on 35 sea turtles washed ashore along the Chennai - Pulicat coast was considered a *suo motu* PIL by the Madras High Court, directing the Secretary to Government, Fisheries Department and the Commissioner of Fisheries, to take action against erring fishermen and ensure safe living of sea animals including sea turtles. Accordingly, on September 30, 2015, the Tamil Nadu Fisheries Department amended the state's Marine Fishing Regulation Rules, 1983 and included the following clause: "(d) No trawl net shall be used without fixing Turtle Excluder Device (TED). In September 2016, the Tamil Nadu government announced the" prohibition of fishing by any kind of fishing vessels in a radius of five nmi [approximately nine km] around potential nesting and breeding sites of sea turtles, called as the Tamil Nadu Marine Fishing Regulation (Amendment) Act, 2016. Following this, Department of Fisheries issued a government order (GO) in September 2016, identifying over a 100 potential Olive Ridley nesting sites and prohibiting fishing using any mechanised or motorised crafts within five nmi of these sites for four months (January to April). Forest department has also set up turtle hatchery in Chennai coast for implementing conservation measures involving NGOs and students.

Puducherry: The coastline of Puducherry is used as a migratory route by Olive Ridley turtles and the stretch between Nallavadu and Moorthykuppam in Puducherry and the Arasalar beach in Karaikal have been identified as important nesting sites. In 2018, Puducherry forest department personnel and several volunteers managed to collect 11500 eggs, the highest in the last 15 years and around 7000 turtle hatchlings were released in November.

Conservation and management measures on West Coast of India

Kerala: Kuzhupilly beach located in the Vypeen island of Ernakulam district has several areas of backwaters where three species of Terrapins i.e Leith's softshell turtle *Nilssonia leithii*, Indian black turtle *Melanochelys trijuga coronata* and Indian soft-shelled turtle *Lissemys punctata punctata* are are reported to occur. However, sea turtles are not at all sighted in Cochin backwaters. The number of turtles nesting along the Kerala coast is also very less. Sea wall covers about 70% of the state's coastline and activities related to sand mining prevalent along the coast are the reasons that keep the turtles away. The Social Forestry Wing of the Kerala Forests and Wildlife Department is developing a site-specific action plan for its turtle conservation initiative launched under the title 'Green Partnership Programme'. Kerala also pioneers in community-based turtle conservation efforts in the country.

Karnataka: The state forest department initiated the sea turtle conservation efforts following the sea turtle workshop organized by ICAR-CMFRI in the year 1984. Olive ridley, green and hawksbill turtles are reported to occur in the Karnataka but, only the first species has been reported to nest sporadically along Karanataka coast.

As per the Karnataka Marine Fishing Regulation Act, 1986; mechanized boats (up to 50 feet length) are allowed to operate beyond 6 km and deep-sea vessels (of 50 feet length and above) are required to operate beyond 20 km. Assessment of trawl bycatch by the Mangalore Research Centre of ICAR-CMFRI recorded 116 species of finfishes, 31 species of gastropods, 4 species of bivalves, 7 species of cephalopods, 13 species of shrimps, 3 species of stomatopods, 21 species of crabs, 3 species of lobsters and juveniles of unidentified sharks and rays were recorded but none of the sea turtle species.

Goa: According to the Goa, Daman and Diu Marine Fishing Regulation Act, 1980 (amended in 1989), mechanized fishing vessels are allowed beyond 5 km. The Forest

Department of Goa along with involvement of locals started the Turtle Conservation Programme in 1996. Only Olive Ridleys nest along Goa coast between November and April with identified nestings in Mandrem, Morjim, Agonda and Galgibaga beaches of Goa. Ecotourism is highly promoted where Forest department, NGOs and local people create special Eco-huts for tourists to watch this natural phenomenon from a distance. Recently, the Goa Coastal Zone Management Authority's (GCZMA) ordered demolition of 171 structures built in the No-Development Zones at beaches which have turtle nesting sites. So far, incidental catches of sea turtles have not been reported since the turtle population is very small and only sporadic stranding of sea turtles has been reported.

Maharashtra: As per the Maharashtra Marine Fishing Regulation Act 1981, operation of trawl net by mechanized fishing vessels is prohibited from the seashore to 5 fathoms and 10 fathoms depth zone in specified areas. Fishing by mechanized fishing vessels of any type with more than 6 cylinder engines is prohibited within the territorial waters of Maharashtra up to 22 km and operation of trawl gear by mechanized fishing vessels is prohibited between 6 pm and 6 am.

The nesting season of Olive Ridley turtles is from October to March with reports of sporadic nesting along the entire coast. There are some reports of nesting of green turtle also. Main nestings of Olive Ridleys in Maharashtra occur in Sindhudurg and Ratnagiri districts. In Velas, a tiny village on the northernmost boundary of Ratnagiri district the locals started turtle conservation since 2002. The annual Turtle Festival attracts around 3000 tourists a year giving new income opportunities for the villagers. Monitoring of turtle nesting in 39 locations across 4 districts of Maharashtra is being done since 2002. The Maharashtra forest department and Wildlife Conservation and Animal Welfare Association (WCAWA) have jointly announced reward ₹5000 for giving information about incidents of egg laying and incentives for release of threatened and endangered species of turtles. Sea turtles included in the Wildlife Protection Act, 1972 and killing or destroying their eggs is a criminal offence that can be fined upto ₹24,000 and 7 years of imprisonment. The 'Turtle treatment and transit centre' at Dahanu beach on an average, rescues, treats and rehabilitates over 60 turtles including Olive Ridley, Green Sea Turtles, Hawksbills and Loggerheads every year besides undertaking awareness programs for turtle conservation along the beach.

Gujarat: Nesting grounds of Green and Olive Ridely turtles were recorded from Jamnagar, Junagadh, Amreli, Bhavnagar and Valsad districts. In Kachh, only nests of Olive Ridley were recorded. The nesting season of the Olive Ridley begins in June and ends in early November, while green turtles nest between July and January. Gujarat state forest department is implementing sea turtle hatchery management management programme for the past 20 years. It has set up five hatcheries in Madhavpur (Porbandar) and Okha Madhi (Jamnagar) where eggs are collected and brought to an enclosure to ensure their hatching.

Sea turtle menace in Lakshadweep: In Lakshadweep Islands, especially in Agatti, Kadmat and Kalpeni Islands, Green sea turtles (*Chelonia mydas*) population is in higher densities than anywhere else in India. This high congregation of turtles has resulted in over-grazing of seagrass and loss of seagrass habitats in the Islands. The severe consequences of seagrass overgrazing include loss of seagrass meadows, biodiversity loss, reduction in productivity, erosion of intertidal area, siltation, creation of turbid plume of silt particles, death of corals due to sedimentation and poor molluscan diversity. Fishing is the primary occupation here, dominated by pole-and-line fishing for the pelagic skipjack tuna using bait fish which are mainly distributed in the seagrass beds of the lagoon. Because of the disappearance of seagrass which are the natural habitats of baitfish, there is scarcity of bait fishes and fishermen are not happy as it is adversely affecting their livelihoods. Explosion of sea turtle population is changing seagrass dominated lagoon ecosystem into algal rich habitats. The increase of green turtle population in Lakshadweep is the result of protective measures taken by the Indian government. So, there is an urgent need to conserve the seagrass ecosystem and their associated fishes and fisheries as well as management of sea turtle population within the limits necessary to protect the livelihood of people in Lakshadweep.

Shrimp fisheries in India and US Shrimp Import Ban - 2018

Sea turtles are highly migratory across the oceans and particularly vulnerable to incidental capture, leading to their global population declining rapidly. In 1981, the US National Marine Fisheries Service (NMFS) developed a unique separator trawl design called the Turtle Excluder Device (TED), which claimed to reduce

the turtle mortality during shrimp trawling by up to 97 per cent. In 1987, it was mandatory for all shrimp trawlers in the United States of America (USA) to use TEDs. The US fishermen demanded their government to make TED mandatory for foreign shrimpers as well since they did not incur extra costs to install and use TEDs and were getting larger catch without the mandatory TEDS. It led to the enactment of the Section 609 of Endangered Species Act (Public Law 101-162) by the US Congress in 1989, requiring the US government to certify that all shrimp imported to the country was caught with methods that protected marine turtles from incidental drowning in shrimp trawling nets. In May 1996, the USA made it mandatory for countries exporting shrimp to the US to set in place a marine turtle conservation program comparable to that of the US and imposed a ban on importing shrimp from countries not certified as using TEDs. However, this ban on imports did not apply to shrimps produced through aquaculture.

Commercially important shrimps from India are largely constituted by two groups namely penaeids mainly belonging to the family Penaeidae and non-penaeid shrimps belonging to Palaemonidae, Hippolytidae and Sergestidae. The US has banned import of wild caught shrimp from India on May 2018, after the US Department of State found the fishing practices followed in India were non-compliant with US regulations to protect sea turtles. Wild-caught shrimp constitutes around 11 per cent of the ₹1500-crore shrimp export to the US from India.

In the main land of India, fishing take place by numerous fishing crafts and landings of marine fish at 1265 centres situated along 6100 km long coast line. India is taking utmost care in protecting the sea turtles but it is a herculean task. Generally, sea turtles live in coastal waters up to 5 nautical miles. Almost all the coastal states of India implemented the trawl fishing ban within the 5 nautical miles under the 'Fishing Regulation Act'. Apart from these, yearly fishing ban for the period of 60 days also followed by coastal states. It is reported that each sea turtle feeds 1.5 kg of seafood per day. Olive Ridley turtles mainly feed on fishes, shrimps, crabs, jellyfish and molluscs. Every year, more than 6 lakhs Olive Ridleys are nesting on the eastern coast of India, which is half of the world's population. It is estimated that more than 600 tons of seafood per day are consumed by the Olive Ridley turtles in India. The coastal resources of India is very much utilized for the conservation of world's sea turtle population and therefore, the US import ban on shrimps from India is untenable. Appropriate actions that will prove the regulatory mechanisms to conserve sea turtles in India are comparable to those in the USA will have to be done. Based on this, following recomendations are made

Recommendations

- The TED developed/ modified by ICAR-CIFT is not acceptable by the US expert team. Therefore, suitably modified TEDs can be explored.
- TED should be fit in all shrimp trawlers operating on the east coast of India during the turtle nesting season. Yearly renewal of trawler license should be based on fitting of TEDs.
- The trawl fishers in Thiruvananthapuram and Kollam district of Kerala coast should be mandated to fit TEDs. Due to the very low intensity of turtle nesting further north of west coast of India does not warrant the use of TEDs.
- Continuous monitoring of sea turtle incidental catches in fishing gears is mandatory as per US Sec. 609. Hence, regular by-catch monitoring programme should be intiated all along the coast in India.
- Action must be taken to supply adequate number of TEDs to fishers who should also be trained to use them.
- Awareness programme on sea turtle conservation and demonstration of TEDS among fishers is important. The misconception that the trawler fitted with TED considerably reduces their catches should be changed by proper demonstration.
- Translocation of sea turtles eggs and hatchling from thickly/healthy populated areas such as Lakshadweep to areas where the sea turtles have disappeared due to various reasons is an option.
- Incentive schemes should be announced to protect the endangered sea turtle species such as Leatherhead and Loggerhead turtles.

An overview of elasmobranch fisheries of West Bengal in 2018

Swatipriyanka Sen*, Gyanaranjan Dash and Indranil Mukherjee
Digha Research Centre of ICAR-Central Marine Fisheries Research Institute, Ramnagar-721 441, West Bengal
*E-mail: swatipriyank1a@gmail.com

Abstract

Elasmobranch fishery of West Bengal comprises of sharks, rays, guitarfishes and skates. Due to demand in the national and international market, the fishery has gained importance though it is not a targeted resource. The catch data showed that the fishery is in a declining phase since 2016. The estimated landing of elasmobranchs (3799 tonnes) has shown a further decrease of 12.6% during 2018 in West Bengal compared to 2017. Sharks form the major portion (48%) of the elasmobranch fishery followed by rays (40%) and guitarfishes (12%) during 2108 in West Bengal. The fishery flourished more during the first (January-March) and last quarter (October-December)of the year. Maximum catch of sharks have been observed in October followed by February. The gear-wise landings of sharks showed that multiday trawlers contributed 81% of the shark landings followed by mechanized gill netters (17%) and the remaining 2% by inboard gill netters. Maximum catch of rays have been observed during June followed by January and October. The rays were mainly exploited by trawlers (76%) followed by hook and lines (15%) and gill netters (8%). Maximum catch of guitarfishes was observed during January followed by August and February. Guitarfishes are landed mostly by trawlers (91%) followed by gill nets (9%). The elasmobranch resources in West Bengal are very diverse in nature. However, there is a continuous decline in the landings which could be detrimental in future if the resources are not managed properly. Hence, it is recommended to follow good management practices to ensure long term sustainability of the resources.

***Key words**: Elasmobranchs, fishery, West Bengal, management*

Introduction

Elasmobranchs (sharks, rays, skates and guitarfishes) form one of the important commercial fisheries of West Bengal under the demersal fisheries resource group. Though not targeted by the fishermen, elasmobranchs are usually caught as by-catch in trawlers and gillnetters. However, due to increase in demand for sharks in the national and international markets, the landed sharks fetch goodmarket price. Different species of elasmobranchs landed at DighaMohana, Petuaghat, Shankarpur, Kakdwip, Namkhana, Diamond Harbour, Fraserganj fish landing centres of West Bengal are *Rhizoprionodon oligolinx, Scoliodon laticaudus, Alopias* sp., *Carcharhinus dussumieri, Galeoceredo cuvier, Carcharhinus limbatus, Chiloscyllium* sp., *Iago* sp., *Carcharhinus leucas, Sphyrna lewinii, Carcharhinus amblyrhincoides, Carcharhinus sorrah, Rhinobatos lionotus, R. annandalei, Glaucostegus granulatus, Gymnura poecilura, Pastinachus ater, Maculobatis gerrardi, Brevitryogon imbricata, Pateobatis jenkinsii, Pateobatis bleekerii, Himantura uarnak, H. undulata, H. pastinacoides, H.leoparda, Urogymnus polylepis, Aetobatus ocellatus, A. narinari, Mobula mobular, Mobula kuhlii, Rhinoptera javanica, R. jayakari, Rhina ancylostoma* and *Pristis microdon*.

The trend of estimated elasmobranch landings in West Bengal indicates a general declining trend (Fig.1). Sharks form the major portion (48%) of the elasmobranch landings followed by rays (40%) and guitarfishes (12%) during 2018 in West Bengal. The monthly composition of sharks, rays and skates in the elasmobranch landings in 2018 is shown in Fig.2. The landings are more during the first (January-March) and last quarter (October-December) of the year.

The month-wise catch indicates maximum catch in October followed by February. Among sharks, the *Carcharhinus* genus forms the dominant group contributing 78% of the total shark landing. The species composition was *Carcharhinus* sp. (50.5%), *Scoliodon laticaudus* (15.34%), *Rhizoprionodon oligolinx* (5.68%), *Carcharhinus dussumieri* (5.08%), *Carcharhinus sorrah* (0.25%), *Sphyrna lewinii* (0.17%), *Carcharhinus leucas* (0.07%). Monthwise species composition of sharks landed is shown in Fig.3. Other sharks observed in the landings were *Chiloscyllium* sp. (15.6%), *Iago* sp. (7.2%) and *Alopias* sp. (0.02%) (Fig.3). The gear-wise landings of sharks showed that multiday trawlers contributed 81% of the shark landings followed by mechanized gill netters (17%) and the remaining 2% by inboard gill netters.

The monthly landings of rays indicated maximum in June followed by January and October (Fig.2). The rays landing were mainly contributed by *Himantura* sp. (97.18%). A minor quantity was also contributed by *Mobula* sp. (2.19%) followed by *Aetobatos* sp. (0.27%)

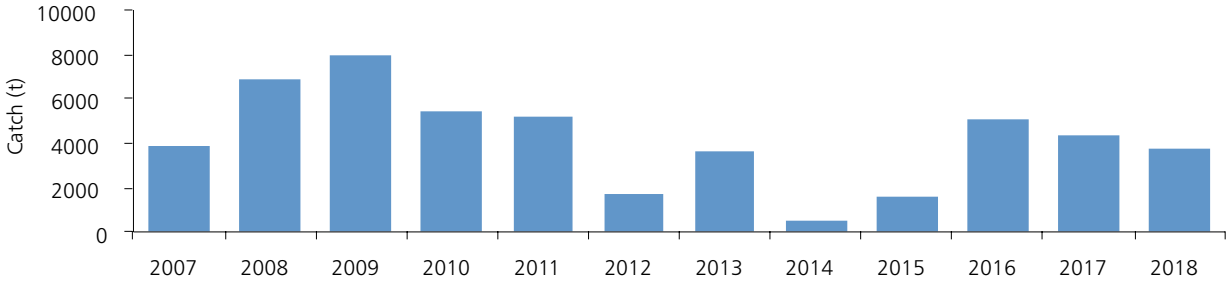

Fig. 1. Historic trend of elasmobranch landings in West Bengal during 2007-18

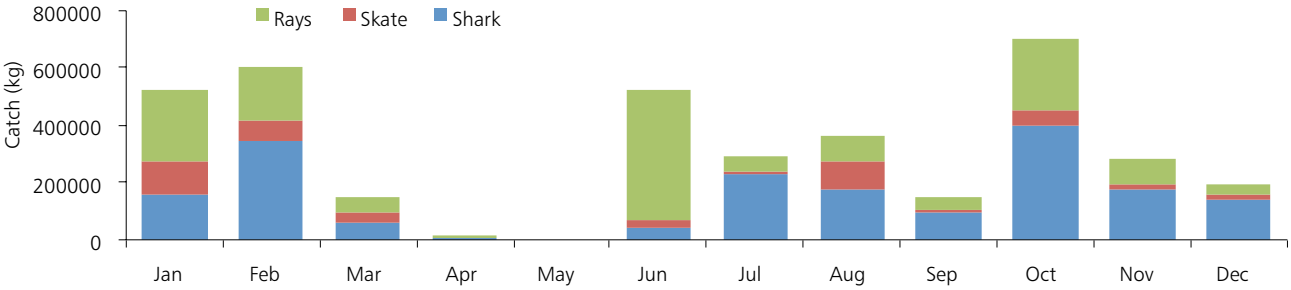

Fig. 2. Month-wise catch and group composition of elasmobranchs in West Bengal during 2018

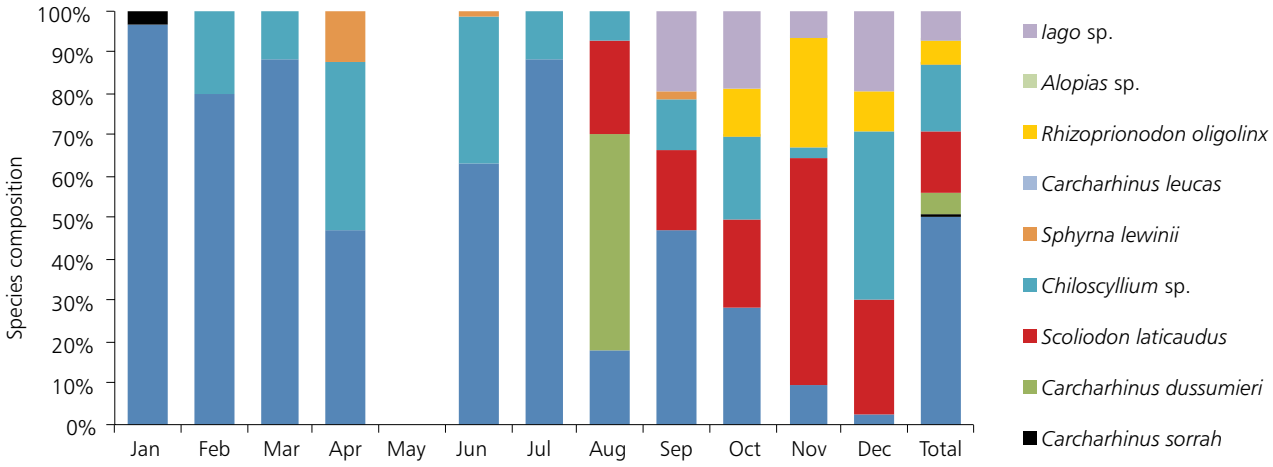

Fig. 3. Month- wise species composition of sharks in West Bengal during 2018

a. *Mobula mobular*

b. *Carcharhinus leucas*

c. *Glaucostegus granulatus*

d. *Himantura undulata*

e. *Chiloscyllium* sp.

f. *Gymnura poecilura*

g. *Iago* sp.

h. *Scoliodon laticaudus*

i. *Rhinobatos lionotus*

j. *Urogymnus polylepis*

k. *Sphyrna lewini*

l. *Glaucostegus obtusus*

m. *Pastinachus ater*

n. *Pateobatis bleekeri*

o. *Rhina ancylostoma*

p. *Galeocerdo cuvier*

q. *Rhinoptera jayakari*

r. *Rhinoptera javanica*

s. *Himantura urnak*

t. *Maculabatis gerrardi*

u. *Rhinobatos annandalei*

v. *Carcharhinus amblyrhynchoides*

Fig.4 (a-v). Different elasmobranch resources landed in West Bengal

and other rays (34%). The rays were mainly exploited by trawlers (76%) followed by hook and lines (15%) and gill netters (8%).

The month-wise catch of guitarfishes is shown in Fig.2. Maximum catch was observed during January followed by August and February. These landings were mainly contributed by *Glaucostegus granulatus* (57.31%) followed by *Rhinobatos lionotus* (42.68%). Guitarfishes are mainly landed by trawlers (91%) followed by gill nets (9%).

Consumer preference for shark, ray or skate meat is very low in local market of West Bengal. The catch are auctioned in landing centres and sold to the fish trading entities and processors for the overseas markets. There is a good export trade for meat and fin of sharks and rays in Digha and Kakdwip. The fish traders cut the whole sharks, rays and guitarfishes in their processing plants and export the meat and fins to different cities like Kochi, Chennai, Bengaluru in India and to some foreign countries such as China, Nepal, Japan, Hong Kong through their Kolkata and Sialda based processing hubs.

Minimum Legal Size (MLS) for marine capture fisheries management in Maharashtra

C. Anulekshmi. K. V. Akhilesh, R. Ratheesh Kumar, A. D. Nakhawa, S. N. Bhendekar and S. Ramkumar
Mumbai Research Centre of ICAR-Central Marine Fisheries Research Institute, Mumbai-400 061, Maharashtra

*E-mail: anulekshmic@gmail.com

The marine capture fisheries sector of Maharashtra has undergone tremendous change in terms of fishing patterns, fishing methods, spatial expansion of fishing grounds, multiday fishing and innovations in crafts and gears, among others. With the increasing demand for marine fish for consumption and other non-food utilization of fishes, exploitation of juvenile fishes is becoming more common. Exploitation of juveniles which causes 'growth overfishing' is a major concern as it affects the health of fish stocks and the ecosystem which impacts livelihood of fishers and causes much economic loss to all stakeholders.

Juveniles of slow growing fishes (sharks) and high value fishes (groupers/pomfrets) are becoming a common sight in Maharashtra marine fish landings in these days. If these are allowed to grow to a minimum size by fishermen voluntarily avoiding such fishing grounds where juvenile are in abundance, the economics of trade would be different. If fishes are allowed to grow to their sexual maturity and spawn at least once before they are caught in nets, the fishery of the next years would be better. Demand for marine fish drives the injudicious exploitation of juvenile fishes and there is no restrictions on sale of undersized fishes in Maharashtra. This can lead to collapse of fish stocks and hence, fishers, traders and consumers should be made aware of consequences of juvenile fish exploitation/ utilization and need for adoption of measures for a sustainable marine fisheries sector in Maharashtra. One of the means to discourage the indiscriminate exploitation of juveniles is to impose a Minimum Legal Size (MLS) which is the size at which a particular species can be legally caught, retained and traded. This can lead to the control in growth overfishing either by increasing or maintaining the spawning stock. Along with avoiding of juvenile fish aggregation sites and spawning grounds, implementation of MLS can maintain healthy fish stocks and ensure a sustainable fishery that delivers economic benefits to all stakeholders.

MLS for 58 species of commercially important fishes occurring in Maharashtra was estimated (Tables 1 & 2) following Mohamed *et al.*, (2014).

Table 1. Criteria and Decision Logic adopted to formulate the MLS of marine fishes of Maharashtra

Criteria	Decision Logic
Minimum size at Maturity MSM	To prevent growth overfishing in stocks which are the smallest mature fish moderately resilient to fishing pressure
Size (or weight) at maturity or size /weight at 50% maturity SFM/WFM	To prevent growth overfishing completely maturity and recruitment overfishing partially. Can be used in situations where the stock is depleted or rebuilding
Size at sexual differentiation into male and female SSD	To prevent juvenile exploitation and growth overfishing in those stocks which have high reproductive potential

Table. 2. Estimated MLS (in cm) for commercially important fishes caught along Maharashtra coast.

Group	Species	English common name	Local name (Marathi)	MLS (cm)		Decision logic
Squids	*Uroteuthis (Photololigo) duvaucelii*	Indian squid	Nal Mhakul	10	DML	MSM
	Uroteuthis (Photololigo) singhalensis	Long barrel squid	Nal Mhakul	10	DML	MSM
	Uroteuthis (Photololigo) edulis	Sword tip squid	Nal Mhakul	10	DML	MSM

Group	Species	English common name	Local name (Marathi)	MLS (cm)		Decision logic
Cuttlefish	*Sepia pharaonis*	Pharaoh cuttle fish	Mhakul	11	DML	MSM
Octopus	*Amphioctopus neglectus*	Ocellate octopus	Shera Mhakul	5	DML	MSM
	Cistopus indicus	Old women octopus	Shera Mhakul	9	DML	MSM
Crustaceans	*Parapenaeopsis stylifera*	Kiddi prawn	Tiny	7	TL	MSM
	Metapenaeus monoceros	Speckled prawn	Kapshi	11	TL	SFM
	Metapenaeus affinis	Jinga prawn	Kolambi	9	TL	MSM
	Metapenaeus dobsoni	Flower tail prawn	Kolambi	6	TL	MSM
	Solenocera choprai	Coastal mud prawn	Goinar	7	TL	MSM
	Solenocera crassicornis	Coastal mud prawn	Goinar	6	TL	MSM
	Portunus pelagicus	Blue crab	Khekhada/Chimbore	9	CW	MSM
	Portunus sanguinolentus	Spotted crab	Khekhada/Chimbore	7	CW	MSM
	Charybdis feriatus	Crucifix crab	Khekhada/Chimbore	5	CW	MSM
	Thenus unimaculatus	Sand lobster	Fatfati	150	g	WFM
	Panulirus ornatus	Ornate spiny lobster	Shevand	500	g	WFM
	Panulirus polyphagus	Mud spiny lobster	Shevand	300	g	WFM
	*Panulirus homarus**	Scalloped spiny lobster	Shevand	200	g	WFM
Elasmobranchs	*Scoliodon laticaudus*	Spadenose shark	Mushi	38	TL	MSM
	Rhizoprionodon oligolinx	Grey sharpnose shark	Mushi	53	TL	MSM
	Gymnura poecilura	Longtailed butterfly ray	Pakat	50	DW	MSM
Teleosts	*Megalaspis cordyla*	Torpedo scad	Kat Bangada	26	TL	MSM
	Decapterus russelli	Indian scad	Teli bangda	11	TL	MSM
	Parastromateus niger	Black pomfret	Halwa	17	TL	MSM
	Scomberoides tala	Barred queen fish	Falai	30	TL	MSM
	Scomberoides tol	Needle scale queen fish	Falai	23	TL	MSM
	Scomberoides commersonnianus	Queen fish	Dagol/Falai	32	TL	MSM
	Sardinella longiceps	Oil sardine	Tarli	10	TL	SSD
	Coilia dussumieri	Gold spotted anchovy	Mandeli	12	TL	MSM
	Rastrelliger kanagurta	Mackerel	Bangda	14	TL	MSM
	Scomberomorus commerson	Narrowbarred spanish mackerel	Toovar	50	FL	MSM
	Scomberomorus guttatus	Spotted seer	Surmai	37	FL	SFM/Lm50
	Euthynnus affinis	Little tunny	Telya Kupa/Gedar	38	TL	MSM
	Auxis thazard	Frigate tuna	Kupa/Gedar	25	FL	MSM
	Auxis rochei	Bullet tuna	Kupa/Gedar	18	FL	MSM
	Katsuwonus pelamis	Skipjack tuna	Kupa/Gedar	35	FL	MSM
	Thunnus tonggol	Longtail tuna	Khawalya Kupa/Gedar	48	TL	MSM
	Thunnus albacares	Yellowfin tuna	Kupa/Gedar	50	FL	MSM

Group	Species	English common name	Local name (Marathi)	MLS (cm)		Decision logic
	Rachycentron canadum	Cobia	Sakala/Modusa	61	FL	SFM/Lm50
	Sphyraena putnamae	Sawtooth barracuda	Tok/Badri	28	FL	MSM
	Coryphaena hippurus	Dolphinfish	Popat/Habnus	55	TL	MSM
	Trichiurus lepturus	Ribbonfish	Bala	45	TL	MSM
	Nemipterus japonicus	Threadfin bream	Rani/Chiri	13	TL	MSM
	Nemipterus randalli	Threadfin bream	Rani/Chiri	10	TL	MSM
	Lactarius lactarius	False trevally	Saundala	10	TL	MSM
	Pampus argenteus	Silver pomfret	Pamflet	14	SL	MSM
	Pampus chinensis	Chinese pomfret	Pamflet	14	SL	MSM
	Epinephelus diacanthus	Spinycheek grouper	Hekru	18	TL	MSM
	Saurida tumbil	Lizard fish	Chor bombil	17	TL	MSM
	Saurida undosquamis	Lizard fish	Chor bombil	12	TL	MSM
	Harpadon nehereus	Bombay duck	Bombil	18	TL	MSM
	Otolithes cuvieri	Tiger-toothed croaker	Dhoma	16	TL	MSM
	Otolithes ruber	Tiger-toothed croaker	Dhoma	18	TL	MSM
	Protonibea diacanthus	Black spotted croaker	Ghol	70	TL	MSM
	Cynoglossus arel	Largescale tongue sole	Lep	15	TL	MSM
	Plicofollis tenuispinis	Thinspine sea catfish	Shingala	29	TL	MSM
	Osteogeneiosus militaris	Soldier catfish	Shingala	25	TL	MSM

Abbreviations
TL - Total Length, FL - Fork length, SL - Standard Length, CW - Carapace Width, DML - Dorsal Mantle Length in case of Cephalopods, DW - Disc Width, L_{m50} - Length at which 50% of the fishes are mature, SSD- Size at Sex Differentiation, MSM - Minimum Size at Maturity or Size of the smallest mature fish, WFM - Weight at first maturity or the weight of the animal where 50% of the fishes are mature *notified as legally permitted weight for export by Marine Products Export Development Authority, Govt.of India.

For recognizing the catch as juvenile fishing or below MLS, a random species-wise subsample (about 30-50 numbers) of the catch should be examined and if catch consists more than 50% below the prescribed MLS, the catch can be considered as violation of MLS, if a law is enacted. Inspections may preferably be carried out at sea or in the landing centre using unsorted samples. The Mumbai Research Centre of ICAR- CMFRI conducted a Stakeholders Meet on 03.05.2018 to know their views and concerns on MLS for marine fishes as recommended for Maharashtra. Some further actions recommended were the introduction of log-book, mandatory installation of Vessel Monitoring System (VMS) or Automatic Identification System (AIS) in fishing boats. Monitoring for science-based management actions are required in the sector. Participatory research and fisheries management obligations where fishers must share information with researchers about the regions of high juvenile fish aggregations on a temporal and spatial scale can help in ensuring that fisheries are sustainable.

Landings of *Penaeus vannamei* at Kalamukku Fish landing Centre, Kerala

S. Lakshmi Pillai*, G. Maheswarudu and L. Sreesanth
ICAR-Central Marine Fisheries Research Institute, Kochi - 682 018, Kerala

*E-mail: slakshmipillai@rediffmail.com

Penaeus vannamei Boone, 1931 commonly known as the white legged shrimp was observed along with *Penaeus indicus* in the landings at Kalamukku fish landing centre Ernakulam,on 15.11.20 18. The catch was from a single day trawler whose depth of operation was 15 m. Distributed along the Pacific coast of Mexico, central and south America up to Peru, the shrimp was introduced in India on a pilot scale for culture in 2003 and later in 2009 large scale production began. However, it was not recorded in the wild capture fisheries for shrimps. In the landings at Kalamukku, the females measured 109 to 146 mm in total length and weighed 8.9 to 26.6 g. The males measured 100 to 145 mm in total length and 7.5 to 24.4 g in weight. Among the sample analysed 51% were *P. vannamei* and 49% were *P. indicus* based on numbers. Its appearance in the landings is most likely due to the recent floods in Kerala during August, 2018. Information on their breeding populations in non-native waters are lacking, although there are reports on escapes of the species from aquaculture production facilities. In 71% of the females the guts were empty and rest 29% had half or full gut content. In males 50% had empty stomach and rest with half to full stomach content. Stomach contents comprised of digested matter and crustacean remains. The females had immature ovaries. The species can be distinguished from *P. indicus* by the following morphological characters

Fig.1 a. *Penaeus indicus*; b. *Penaeus vannamei*

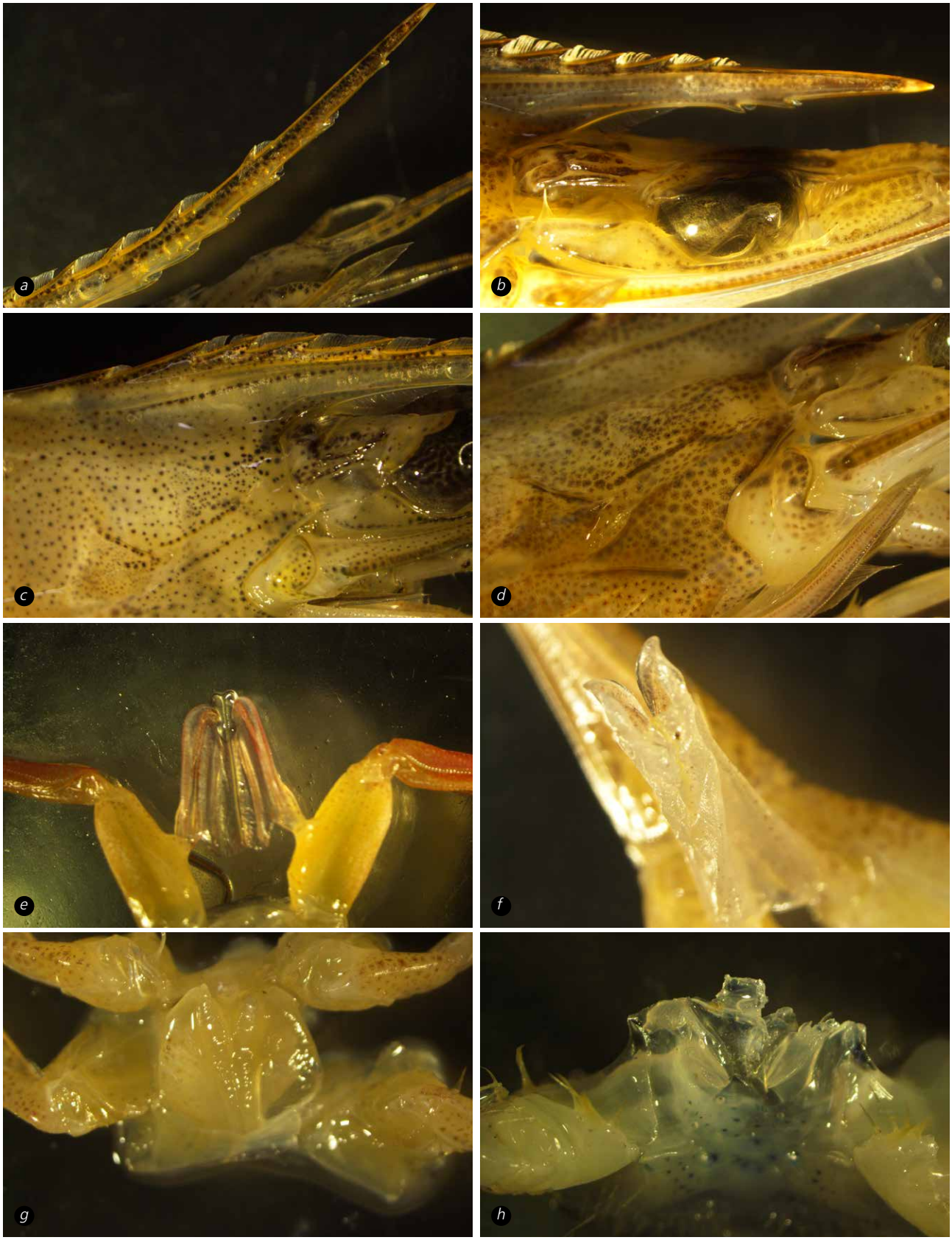

Fig.2. Morphological characters of *P. indicus*: a. Rostrum; c. Hepatic sulcus; e. Petasma; g. Thelycum and *P. vannamei*: b. Rostrum; d. Hepatic sulcus; f. Petasma; h. Thelycum

Character	*Penaeus vannamei*	*Penaeus indicus*
Rostral teeth	Only two rostral teeth on the ventral side.	Three to five rostral teeth on the ventral side.
Hepatic sulcus	wide and prominent	not prominent
Petasma	Symmetrical semi open, with free distal part of lateral lobe long considerably overreaching median lobe and subelliptical	Petasma symmetrical semi closed with median lobe short and the lateral lobe strongly curved and gaping distally
Thelycum	Open with pair of oblique sharp ridges on anterior part of sternite 14, mesial part of ridges produced ventrally in sharp auricles	Closed with the pair of lateral plates on sternite 14 forming thick mesial lips meeting along mid line
Body colour and appearance	Body translucent white with often bluish hue. Legs often appear white	Body pale pink to yellowish, semi translucent. Pleopods pink or red.

Brief Communications

Weed anemone menace in marine aquaria and its management

R. Saravanan*, I. Syed Sadiq, B. Saravanakumar and R. Jayakumar
Mandapam Regional Centre of ICAR- Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu
*E-mail: stingray_mr@yahoo.com

Sea anemones are coming under the Phylum Cnidaria and Class Anthozoa. Like many Cnidarians, sea anemones contain specialized cells, known as cnidocytes or nematocytes, in their body column, oral disc, pharynx, tentacles and mesenterial filaments. Sea anemones of *Aiptasia* genus are distributed in temperate and tropical oceans attached to any hard substratum. The genus *Aiptasia* includes 13 species all equipped with 96 tentacles which are filled with nematocysts to sting their prey. The name *Aiptasia* itself means 'beautiful', however in marine aquarium keeping even if few *Aiptasia* are found in the tank it should not be taken so lightly. A hardy species it can explode in numbers within weeks. *Aiptasia* is a zooxanthellate anemone and survives well in the illuminated marine aquarium due to the photosynthetic activity of its algal symbiont. The main form of reproduction is asexual through pedal laceration, where a small piece of anemone tissue separate from the anemone and each bit of this tissue can grow into an individual anemone. These weed anemone can slowly engulf the tank species through their armoured tentacles. There are about four species of *Aiptasia* commonly encountered in the marine aquarium such as *Aiptasia pallida* (Brown Glass Anemone or Pale Anemone), *Aiptasia pulchella* (Glass anemone), *Aiptasia diaphana* (Small Rock Anemone), *Aiptasia mutabilis* (Rock Anemone or Trumpet Anemone). The fouling of *Aiptasia* anemone on the rocks and glass walls is quite common in marine aquaria, peaking in summer months (Figs. 1 & 2). If such colonization begins, it has to be controlled or eradicated through mechanical, biological or chemical methods.

Fig.1. Weed anemone *Apitasia cf. diaphana*

Fig.2. Colony of weed anemone *Apitasia cf. diaphana*

In mechanical method, the *Aiptasia* fouled rocks will be removed from the tank and disinfected. This should be done properly otherwise even remnant of a single cell will start a new colony after being replaced in the aquarium. In biological control method, certain marine invertebrates like peppermint shrimp *Lysmata* sp is used, which act as a natural bio-control agent. This method is effective in the early stages of colonization of *Aiptasia* in the aquarium. If there is a widespread growth of *Aiptasia* in tanks, it has to be dealt with chemical methods. There are various commercial brands of *Aiptasia* killers available in the aquarium industry which can be used or saturated calcium chloride solution can be injected in the body column to eradicate them, which itself is a time consuming act. Several nudibranch species especially aeolid nudibranchs are known to feed on *Aiptasia* anemone. A dorid nudibranch *Chromodoris geminus* (Fig.3), a species of sea slug dominant in the Palk Bay is being assessed if useful to control the menace of *Aiptasia* in marine aquariums.

Fig.3. Dorid nudibranch *Chromodoris geminus*

Brief Communications

Unusual fishery of black clam near Aluva sand banks after the floods

R. Vidya*, K. S. Mohamed, Geetha Sasikumar, V. Venkatesan, K. K. Sajikumar, B. Jenni, P. S. Alloycious, K. M. Jestin Joy and P. P. Sheela

ICAR-Central Marine Fisheries Research Institute, Kochi - 682 018, Kerala

*E-mail: vidya.panicker@gmail.com

In August 2018, severe flood affected in the state of Kerala due to unusual high rainfall. The black clam, *Villorita cyprinoides*, is found in the backwaters of Kerala, mainly in Vembanad backwaters which support annual average fishery of about 40,000 tonnes. Immediately after the floods, unusual fishery of *V. cyprinoides* was noticed in the Aluva river as the water level receded after the flood, and it was very easily handpicked by the diving fishermen. This fishery lasted for almost 1 month after the flood and was supported by large sized clams which fetched an average market price ₹100 to 150 per kg of meat. About 22 persons were involved in the fishery with a catch of 15 kg shell-on / day / person for a period of 3 weeks. Another 10 persons were involved in the fishery of black clam with a catch of 5 kg shell-on per

day for each fisherman during the last week. Approximately 7280 kg of shell-on clams were obtained during the month.

A survey was conducted in an area of 400 m^2 in the Aluva river to estimate the clam biomass in the area using a quadrat square frame of 0.25 x 0.25 m size. About 5 clams were obtained per m^2 for the first 3 weeks which reduced to 2 clams/ m^2 for the last 1 week. The total length (Anterio-posterior margin) ranged from 24.4 to 44.2 mm and the total weight (TW) ranged from 9.54 g to 47.45 g. The length weight analysis indicated an allometric relationship $TW=0.016\ TL^{2.061}$. The sex ratio (male : female) was 4 : 1. Gonads examined indicated about 95% of clams in maturing condition.

Hydrographic characters of the study area indicated fresh water conditions (salinity 0 ppt) with pH and turbidity of the water samples at 7.2 and 4.1 mg/l respectively. Dissolved oxygen (2.99mg/l) and Chlorophyll (3.19mg/m^3) were low in the area. Other parameters like NH_4-N (0.029 mg/l), PO_4-P (0.011mg/l), Dissoved Inorganic Nitrogen (DIN) (0.011mg/l) and Net Productivity values (33.26 mgC/l/day) were recorded. Sediment profile showed sand content was more (79.6%) than silt or clay which is an ideal habitat for black clam. Organic carbon percentage in the sediment was 0.411.

Local fishermen opined that such a profuse catch of black clam was observed for the first time in the last 50 years. The upper reaches of the Periyar River near Aluva are normally not a clam fishing zone. The clams may have been present earlier, and the floods and currents may have exposed them because of the shifting sand. Further studies are needed to find the real reason for this unusual abundance in riverine areas

Kaleidoscope

Stranding of a Humpback dolphin in Calani Creek

Sujit Sundaram*

*E-mail:sujitsundaram@hotmail.com (Retd. Technical Officer, ICAR-CMFRI)

A Humpback dolphin, *Sousa plumbea* was found dead in Calani Creek, Thrissur district of Kerala on 12.12.2018. The female dolphin measured 265 cm in total length and weighed approximately 300 kg (Fig.1). Local fishermen

Fig.1. Dead Humpback dolphin found in Calani Creek

found the dolphin in the early morning about three kilometers inside the creek from the creek mouth and reported the same to the authors who reached the site for documentation and records. Measurements recorded (in cm) were as follows Beak length-27; Length from tip of snout to origin of dorsal fin-107; Tail width-107; Tail length-24; Length of flipper-33; Girth at the level of origin of dorsal fin-164.

After some time a veterinary surgeon from the forest department conducted post mortem on the carcass and collected samples of the internal organs to ascertain the cause of death. Later the carcass was disposed away by the forest department officials. Various reasons have been attributed to the stranding of marine mammals. Among them is the disorientation of the mammals caused by failed echolocation capability when they enter shallow waters in pursuit of fish schools for foraging. However, their mortality is attributed to the psychological panic and exhaustion due to physical strain in trying to get away from shallow water. In all probability this dolphin might have entered the Calani Creek for food during high tide and would have got stranded during low tide. Moreover, since gill nets are operated across the creek, attempts to escape during low tide might also have been in vain.

Kaleidoscope

A note on the finless porpoise washed ashore

V. Mahesh*, K. P. Said Koya, P. K. Asokan, K. Vinod and C. P. Ansar
Calicut Research Centre of ICAR-Central Marine Fisheries Research Institute, Kozhikode - 673 005, Kerala

*E-mail: mahesh.fishco@gmail.com

A male finless porpoise *Neophocaena phocaenoides* measuring 130 cm in total length was washed ashore off Konadu beach near Kozhilode on 1st August 2018 (Fig.1). The morphometric measurements of the partially decomposed specimen is presented in Table 1. There were no injuries on its body and death might have been due to accidental entanglement in gillnet net or seine net.

Fig. 1. Carcass of *N. phocaenoides* washed ashore

Table 1. Morphometric measurements of *N. phocaenoides*

Particulars	Length (cm)
Snout to the angle of mouth	8
Snout to blowhole	10.5
Snout to the centre of the eye	15
Snout to fluke notch	130
Snout to anterior insertion of the flipper	29
Snout to the centre of genital aperture	60
Snout to the centre of the anus	79
Fluke width	29
Girth: axillary	18
Girth: maximum	27
Girth: at the level of anus	18

Kaleidoscope

Unusual heavy landing of Blackspotted croaker at Jafrabad, Gujarat

Tarachand Kumawat* **and Vipul M. Solanki**
[1]Veraval Regional Centre of ICAR-Central Marine Fisheries Research Institute, Veraval -362 269, Gujarat
*E-mail: tarachand.kumawat@icar.gov.in

The Blackspotted croaker (*Protonibea diacanthus*) locally known as *Ghol* was landed in huge quantity at the Jafrabad Fish Landing Centre on 10th December 2018. The total weight of the catch was 10,700 kg with the croakers in the length range of 679 to 1298 mm (Fig.1). The motorized fishing vessel with an overall length of 14 m and powered by 95 hp engine carried the catch harvested from the bag (*dol*) net. The cod-end mesh size of the net was 60 mm. The fishing period was 6 hours for the 2 hauls. The total number of fishes landed were 1105, of which male to female ratio was 1:2. The catch location locally known as *Ghata-vara buoy* between Surat and Valsad, had depth around 15 m. In general, fish meat fetches ₹300 per kg whereas the high-value air-bladder price depends on its size and weight. Similar seasonal heavy landing of *Ghol* fish has been reported earlier also from the nearby areas which pointed its region-specific and seasonal abundance of fishery.

Fig.1. Catch of croakers transported to shore

Rare Palmate octopus landed

K. P. Said Koya, V. Mahesh and P. K. Asokan
Calicut Research Centre of ICAR-Central Marine Fisheries Research Institute, Kozhikode-673 005, Kerala

In recent years, the octopus fishery is gaining importance due to the increase in the export demands. The catches of the same has been steadily increasing due to the expansion of the trawl fishing activities into the deeper waters. They are mainly landed as by-catch in the trawl landings. The octopus landings in Malabar are mainly supported by the species like *Amphioctopus neglectus, A. marginatus, Octopus vulgaris, Cistopus indicus, Callistoctopus luteus etc.* However, in the last week of August 2018 rare palmate octopus *Tremoctopus gracilis* were observed. Also known as blanket octopus, it belongs to the family tremoctopodidae. Eleven specimens of *T. gracilis,* measuring 6.7 to 12.5 cm mantle length and weighing 86 to 554 g each in total weight were landed by a multiday trawler in the Puthiyappa Fisheries Harbour, Kozhikode, Kerala. This is the first record of the species from the Malabar region.

Fig. 1. *Tremoctopus gracilis specimen*

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Taylor *et al*., 1998. *Aquaculture*, 162: 219-230. (Reference with more than two authors)

Friedman and Bell. 1996. *J. shellfish Res*., 15: 535-541. (Reference with two authors)

Pauly, 1980. *FAO Fish. Tech. Pap*., 234.

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Indian Council of Agricultural Research
Central Marine Fisheries Research Institute

Post Box No.1603, Ernakulam North P.O., Kochi-682 018, Kerala, India.
Phone: +91 484 2394357, 2394867 Fax: +91 484 2394909
E-mail: director.cmfri@icar.gov.in **www.cmfri.org.in**