ISSN 0254-380 X

No. 232, April - June 2017

Marine Fisheries Information Service

Technical and Extension Series

Indian Council of Agricultural Research
CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
P.B. No. 1603, Ernakulam North P.O., Kochi - 682 018, Kerala, India

Marine Fisheries Information Service

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Front Cover : Fishing boats berthed at Punnakayal Landing Centre

Back Cover : Yellowfin tunas landed at Tharuvaikulam Landing Centre

The 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 field.

From the Editorial Board.....

Warm greetings to all

This issue of the MFIS has a collection of articles addressing topics related to the sustainable development of the marine fisheries sector in India. The proposed Minimum Legal Size (MLS) for marine fishes caught off Tamil Nadu coast is presented. If implemented it can immensely help in curtailing rampant fishing for juveniles that leads to growth overfishing and economic losses due to decline in yields in the long run. The Seasonal Fishing Ban (SFB) during the monsoon season, an important marine fishing regulation aimed at protecting marine fish stocks during their peak spawning period and the recruitment processes subsequently that also addresses fishermen safety when the seas are highly turbulent, is discussed in light of its implementation and transaction costs. New trends like light fishing and AIS happening in the marine fisheries sector are presented, flagging the related issues and concerns also. Notes on new trends in marine fisheries, biodiversity and other interesting observations are also included.

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Abbreviation - *Mar. Fish. Infor. Serv., T & E Ser.*

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Minimum Legal Size proposed for commercially exploited marine finfish and shellfish resources of Tamil Nadu

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Marine fisheries in Tamil Nadu have undergone tremendous change in terms of fishing pattern, fishing method, extension of fishing grounds, composition of fish catch and consequent increase in the total fish catch in recent years. The recent demand from industries involved in fish meal and fish oil encourages targeted fishing for by-catch resulting in heavy landing of low value by-catch in certain places along Tamil Nadu coast. These by-catch are often dominated by juveniles of many commercially important marine finfishes and shell fishes. So it warrants some caution and intervention. One of the methods 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 retained if caught. The advantage of a MLS is that it aids in the control of two major problems in the fisheries management, growth overfishing and recruitment overfishing either by increasing the minimum size of harvest or by increasing or maintaining the size of the spawning stock. The most common method of increasing the reproductive output through the use of size limits is to set the minimum size at which the females become sexually mature. As the individuals of a species do not attain sexual maturity at the same size, it can be a size at which higher proportions are mature. The greater the minimum size, the more protection it offers the spawning stock. In that way, size at first maturity is more useful. It is also given that if the ratio of minimum size for trade to the size at first maturity is more than 1.1, the stock is said to be at low risk. This also means a favorable condition to the stock if the minimum size permitted for trade is more than the size at first maturity (SFM). Notwithstanding this, any minimum size –even one that is set below the minimum spawning size – will increase the proportion of animals surviving to spawning size provided that the size protected would otherwise have formed part of the retained catch. Thus the MLS does not necessarily have to be the size at which animals spawn, although the closer it is to this size, the more effective it becomes (Hill, 1990, Key note Address : Minimum Legal Sizes and their use in management of Australian fisheries, *Bureau of Rural Resources Proceedings* No. 13; 9-18). Among marine states of India, Kerala has already implemented the rules for MLS with reference to 58 species and Karnataka is in the process of implementing the same.

In the present study, different parameters like size at sex differentiation (SSD), minimum size of sexual maturity (MSM), size at 50 % maturity (SFM) were selected for different species based on their biological characteristics. The studies conducted on the biology of different resources from Tamil Nadu during the period 2012-16 along with the MLS already given for Kerala (Mohamed *et al*. 2014, *Mar. Fish. Infor. Serv., T&E Ser.*, 220 : 3-7 and Karnataka (Rohit *et al*., 2016 *Marine Fisheries Policy Series* No. 5, ICAR-CMFRI 110 p.) form the base of this report. Extension of fishing beyond territorial waters and often into the waters of other states necessitates more or less similar MLS all along India. Otherwise there are chances that the sizes that are

illegal in one state can be legal in the adjacent state resulting in clandestine deals. Moreover the growth and maturity of many resources are found to be almost same from different areas. Considering these reasons, the legal sizes found out for Kerala and Karnataka are retained for Tamil Nadu along with other resources studied from here. The decision logic for various parameters and MLS thus proposed are given in Tables 1 and 2. The catch can be considered as violation if only more than 50 % of the catch is below the MLS. Inspection of the catch may be done either at sea or at the landing centre taking an unsorted catch.

Table 1. Decision logic

Criteria	Explanation	Logic
SSD	Size at sexual differentiation into male and female	This metric can be used to prevent juvenile exploitation and growth overfishing in those stocks which are very abundant, have high reproductive potential and whose biomasses are not affected by high fishing pressure
MSM	Minimum size at maturity or the smallest mature fish	This metric can be used to prevent growth overfishing in stocks which are moderately resilient to fishing pressure
SFM / WFM	Size (or weight) at first maturity or Size / weight at 50 % maturity	Conventionally used as a metric to prevent growth overfishing completely and recruitment overfishing partially. Can be used in situations where the stock is depleted or rebuilding

Table 2. Minimum Legal size of commercially important species

Sl. No.	Species /Stock	Common name	Local name	MLS (cm)	Decision Logic
	Major pelagic fish stocks				
1	*Sardinella gibbosa**	Goldstripe sardinella	Chala,Kavalai	10TL	MSM
2	*Sardinella albella**	White sardinella	Thatta kavalai,Choodai	10TL	MSM
3	*Sardinella fimbriata**	Fringescale sardinella	Nedumkavalai,Choodai	11TL	MSM
4	*Sardinella longiceps*	Oil sardine	Mathi,Peychalai	10TL	SSD
5	*Amblygaster sirm**	Spotted sardinella	Keerimeen chalai,Varikavalai	11TL	MSM
6	*Escualosa thoracata*	White sardine	Mattakolunthan, Mutlasse	9TL	MSM
7	*Stolephorus indicus**	Indian anchovy	Nethili	10TL	MSM
8	*Stolephorus waitei*	Spot faced anchovy	Nethili	7TL	MSM
9	*Encrasicholina devisi*	Devis' anchovy	Nethili	7TL	MSM
10	*Rastrelliger kanagurta*	Indian mackerel	Kanangeluthi,Kumla,Ayila	14 TL	MSM
11	*Trichiurus lepturus*	Ribbonfish	Savalai, Valai	46TL	SSD
12	*Thunnus albacares*	Yellowfin tuna	Kera,choorai	50FL	MSM
13	*Thunnus tonggol*	Longtail tuna	Choorai,Ettala	44FL	MSM
14	*Katsuwonus pelamis*	Skipjack tuna	Varichoorai,Choorai	35FL	MSM
15	*Euthynnus affinis*	Little tunny	Ratha choorai,Choorai	31 FL	MSM
16	*Sarda orientalis*	Bonito	Cheela surai	35FL	MSM
17	*Auxis rochei*	Bullet tuna	Elichoorai	18 FL	MSM
18	*Auxis thazard*	Frigate tuna	Elichoorai	25 FL	MSM
19	*Gymnosarda unicolor*	Dogtooth tuna	Pallanchoorai	50FL	MSM
20	*Scomberomorus commerson*	Narrow barred Spanish mackerel, Kingfish	Vajram,Nettiyan Seelai	50FL	MSM
21	*Scomberomorus guttatus*	Indo-Pacific king mackerel, Spotted seer	Vajram,Seelai	37FL	SFM
22	*Coryphaena hippiurus*	Dolphinfish/Mahimahi	Ailas,Parla	38FL	MSM
23	*Decapterus macrosoma*	Shortfin scad	Kilichal,Parai	14TL	MSM
24	*Decapterus russelli*	Indian scad	Kilichal,Parai	11TL	MSM
25	*Megalaspis cordyla*	Horse mackerel	Kilichal,Parai	19TL	SSD
26	*Selar crumenophthalmus*	Bigeye scad	Ayila parai	16TL	MSM
27	*Scomberoides tala*	Barred queenfish	Thol parai,Katta parai	30FL	MSM

28	*Scomberoides tol*	Needlescaled queenfish	Thol parai,Katta parai	23FL	MSM
29	*Scomberoides commersonianus*	Talang queenfish	Thol parai,Katta parai	32FL	MSM
30	*Sphyraena putnamae*	Sawtooth barracuda	Ooli,seela	27FL	MSM
31	*Sphyraena obtusata*	Obtuse barracuda	Ooli,seela	17 FL	MSM
32	*Sphyraena barracuda*	Great barracuda	Ooli,seela	76FL	MSM
33	*Rachycentron canadum*	King seer/Cobia	Kadal baral	61FL	SFM
	Major demersal fish stocks				
34	*Nemipterus bipunctatus**	Delagoa threadfin bream	Changarah	13TL	MSM
35	*Nemipterus japonicus*	Japanese threadfin bream	Changarah	12TL	MSM
36	*Nemipterus randalli*	Randall's threadfin bream	Changarah	10TL	MSM
37	*Parascolopsis aspinosa**	Smooth dwarf monocle bream	Changarah	10TL	MSM
38	*Arius arius**	Threadfin sea catfish	Keluthi	8TL	MSM
39	*Nibea maculata*	Blotched croaker	Panna	14TL	MSM
40	*Otolithes ruber*	Tigertooth croaker	Panna kathalai	17TL	MSM
41	*Otolithes cuvieri*	Lesser tigertooth croaker	Panna kathalai	16TL	MSM
42	*Johnius carutta*	Karut croaker	Pulli kathalai	15TL	MSM
43	*Johnius dussumieri(J.sina)*	Sin croaker	Karun kathalai	11 TL	MSM
44	*Johnius glaucus*	Pale spot fin croaker	Kathalai	15TL	MSM
45	*Johnius belangerii*	Belanger's croaker	Kathalai	14TL	MSM
46	*Kathala axillaris**	Kathala croaker	Kathalai	14TL	MSM
47	*Pennahia anea*	Donkey croaker	Kathalai	13TL	MSM
48	*Lactarius lactarius*	Whitefish/False trevally	Sudumbu,Suthumbu,Kuthippu	10TL	MSM
49	*Parastromateus niger*	Black pomfret	Vaval,Karuvaval	17TL	MSM
50	*Pampus argenteus*	Silver pomfret	Vaval,Vella vaval	13TL	MSM
51	*Saurida undosquamis*	Brushtooth lizard fish	Udumbai,Thumbili,Uluvai	10TL	MSM
52	*Suarida tumbil*	Greater lizardfish	Uluvai,Thumbili	17TL	MSM
53	*Saurida micropectoralis**	Shortfin lizardfish	Uluvai,Thumbili	11TL	MSM
54	*Synodus myops** *(Trachinocephalus myops)*	Snakefish	Uluvai,Thumbili	11TL	MSM
55	*Upeneus sulphureus**	Sulphur goatfish	Chen Nakarai	11TL	MSM
56	*Upeneus taeniopterus**	Fin-stripe goatfish	Nakarai,Navarai	12TL	MSM
57	*Upeneus supravittatus**	Longfin goatfish	Nakarai,Navarai	13TL	MSM
58	*Parupeneus indicus**	Indian goatfish	Nakarai,Navarai	20TL	MSM
59	*Parupeneus heptacanthus**	Cinnabar goatfish	Nakarai,Navarai	13TL	MSM
60	*Sillago sihama*	Silver sillago	Kelangan	11TL	MSM
61	*Photopectoralis bindus**	Orangefin pony	Theevatti karal,Kaaral	7TL	MSM
62	*Gazza minuta**	Toothpony	Kaaral	7TL	MSM
63	*Eubleekeria splendens**	Splendid ponyfish	Kalikaaral,Kaaral	9TL	MSM
64	*Equuilites lineolatus**	Ornate ponyfish	Kaaral	9TL	MSM
65	*Leiognathus dussumieri**	Dussumier's ponyfish	Kaaral	8TL	MSM
66	*Secutor insidiator**	Pugnose ponyfish	Kaaral	6TL	MSM
67	*Priacanthus hamrur*	Moontail bullseye	Kakkasi	14TL	MSM
68	*Lutjanus lutjanus**	Bigeye snapper	Noolani,Theppili	14TL	MSM
69	*Lethrinus lentjan**	Redspot emperor	Velameen	15TL	MSM
70	*Epinephelus diacanthus*	Spinycheek grouper	Kalava	18TL	MSM
71	*Cephalopholis miniata**	Coral hind	Kalava	21TL	MSM
72	*Psettodes erumei**	Indian halibut	Erumai Nakku	20TL	MSM
73	*Cynoglossus macrostomus*	Malabar tonguesole	Nakkumeen	9TL	MSM

74	*Carcharhinus limbatus**	Black tip shark	Kundan sorrah	98TL	MSM
75	*Carcharhinus falciformis**	Silky shark	Paal Sorrah	180TL	MSM
76	*Scoliodon laticaudus**	Spade nose shark	Pillai sorrah	29TL	MSM
77	*Rhizoprionodon acutus**	Milkshark	Pal sorrah	58TL	MSM
78	*Rhizoprionodon oligolinx*	Grey sharpnose shark	Pal Sorrah	53TL	MSM
79	*Brevitrygon imbricata* *(Himantura imbricata)*	Bengal whipray	Sembadathan	14DW	MSM
80	*Pateobatis jenskinsii* *(Himantura jenkinsii)*	Jenkins whipray	Sembadathan	61DW	MSM
81	*Gymnura poecilura*	Longtailed butterfly ray	Adavani thirukkai	29DW	MSM
	Major cephalopod stocks				
82	*Uroteuthis (Photololigo) duvaucelii*	Indian squid	White kanava, Oosi kanava	8DML	MSM
83	*Uroteuthis (Photololigo) singhalensis**	Long barrel squid	Oosi kanava	9DML	MSM
84	*Sepia pharaonis*	Pharaoh cuttlefish	Muttai, Kadamba, Varikanava	11DML	MSM
85	*Sepia prabahari**	Small striped cuttlefish	Muttai kanava	7DML	MSM
86	*Amphioctopus neglectus*	Neglected ocellate octopus	Pei kadamba	5DML	MSM
	Major crustacean stocks				
87	*Charybdis feriatus*	Crucifix crab	Siluvai nandu,Kurissu nandu	5CW	MSM
88	*Charybdis natator**	Ridged swimming crab	Vari nandu,Parnandu	5CW	MSM
89	*Charydis smithii**	Indian swimming crab	Chekappu nandu	4CW	MSM
90	*Portunus sanguinolentus*	Three-spot swimming crab	Mukkannu nandu, Pottu nandu	7CW	MSM
91	*Portunus pelagicus*	Flower crab	Pulli nandu	9CW	MSM
92	*Portunus gladiator**	Redswimming crab	Cheeni nandu,Chippi nandu	5CW	MSM
93	*Penaeus semisulcatus**	Green tiger prawn	Vara eral,Era	11TL	MSM
94	*Penaeus indicus**	Indian white prawn	Vella eral,Era	11TL	MSM
95	*Penaeus latisulcatus**	Western king prawn	Chori eral,Era	11TL	MSM
96	*Metapenaeus dobsoni*	Kadal prawn	Chemakara eral,Era	6TL	MSM
97	*Metapenaeus monoceros*	Speckled prawn	Valucha eral,Era	11TL	MSM
98	*Metapenaeus affinis*	Jinga prawn	Chaya Valicha eral,Era	9TL	MSM
99	*Metapenaeus moyebi**	Moyebi prawn	Vella Valicha eral,Era	6TL	MSM
100	*Parapenaeopsis maxillipedo**	Torpedo prawn	Karikadi, Vandu eral	6TL	MSM
101	*Parapenaeopsis stylifera*	Kiddi prawn	Vandu eral,Era	7TL	MSM
102	*Metapenaeopsis stridulans**	Fiddler shrimp	Eral,Era	6TL	MSM
103	*Metapenaeopsis hilarula**	Minstrel prawn	Eral,Era	6TL	MSM
104	*Metapenaeopsis andamanensis**	Rice velvet prawn	Karikadi	8TL	SFM
105	*Solenocera choprai*	Ridge back shrimp	Karikadi	6TL	MSM
106	*Plesionika quasigrandis*	Oriental narwal prawn	Chenakarikadi	8TL	SFM
107	*Heterocarpus gibbosus**	Humpback nylon prawn	Karikadi	7TL	SFM
108	*Solenocera hextii**	Deep sea mud shrimp	Kall eral, Thakkali eral	7TL	SFM
109	*Aristeus alcocki*	Arabian red shrimp	Redring	13TL	SFM
110	*Panulirus homarus*†	Scalloped spiny lobster	Singi eral	200g	WFM
111	*Panulirus ornatus*†	Ornate spiny lobster	Singi eral	500g	WFM
112	*Panulirus polyphagus*†	Mud spiny lobster	Singi eral	300g	WFM
113	*Thenus unimaculatus*†	Slipper/Shovelnosed lobster	Kal eral, Madaku eral	150g	WFM

TL-Total Length, FL-Fork length, DW-Disc width, SL- Standard Length, CW - Carapace Width (of crabs), DML-Dorsal Mantle Length (in cephalopods), SFM - Size at First Maturity or the size at which 50% of the fishes (of the particular species) are mature, WFM - Weight at First Maturity, MSM - Minimum Size at Maturity or the size of the smallest mature fish. *Inclusion from Tamil Nadu studies †Legal weight fixed by Marine Products Export Development Authority (MPEDA)

Transaction cost of implementation of seasonal fishing ban in selected maritime states of India

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Marine fisheries management is important to ensure sustainable harvest of the fishery resources. In India, the management of fisheries is governed by rules and regulations formulated under the Indian Fisheries Act, 1897. The development of marine fisheries in the territorial waters extending up to 12 nautical miles from the shore is under the jurisdiction of the maritime states who have formulated rules and regulations for management of the resources which by and large prohibit use of destructive gears, explosives and poison for fishing. Among regulatory measures formulated for management of marine fisheries in India, the seasonal fishing ban (SFB) is the one measure that is diligently followed. A closed season of 45 to 75 days for mechanised fishing vessels under the Marine Fishing Regulation Act of the various maritime states is observed. Earlier there was no uniformity of ban period, but following interventions by the Ministry of Agriculture, Government of India, since 1998, the ban was made uniform for states and union territories on the west coast (June 15 – July 31) and east coast (April 15 – May 31). Since 2015, the ban period was extended to 60 days for both the coasts *i.e.*, from April 15 to June 14 (east coast) and from June 1 to July 31 (west coast).

The implementation of any management or regulatory measures is always associated with a cost. In environmental economics, this cost of management is referred to as transaction cost which is a significant component of the valuation of any ecosystem services since it decides the benefit of the enforcement of any regulatory measure. In this study the transaction cost of implementation of the SFB was estimated in selected maritime states of India (Tamil Nadu, Andhra Pradesh, Kerala, Karnataka and Gujarat) profiled in Table 1.

Transaction cost primarily involves,

(i) Search and information costs – This includes cost of educating the stakeholders, getting information and related costs

(ii) Bargaining and decision costs - This includes cost of arriving at a particular decision or programme for implementation of fishing ban

(iii) Policing and enforcement costs – This includes cost of enforcing a particular decision or program. Eg., the SFB.

In this study, the cost incurred by the government to implement the SFB is arrived at by computing the cost incurred in notification of the SFB, conducting awareness campaigns, inspections by the Fisheries Development Officials, and other expenses associated with the enforcement of the ban individually and adding them. The transaction cost is divided into major heads namely information cost, enforcement cost and compensation cost. The information cost relates to the expenses incurred in the information exchange on the ban to the masses either through audio or visual media like Radio, Newspaper, TV, print Notices/ Others including awareness campaigns. The enforcement costs include the expenses computed for enforcing the ban across the coast by way of involving officials in the enforcement from the Department of

Table 1. Marine fishery profile of the selected maritime states

State	Coast line (km)	Average annual landngs 2011-2013 (in tonnes)	Share of major resources (in %) in total fish landings	Number of marine fishing villages	Number of marine fish landing centres	Number of boats Mecha-nised#	Moto-rised#	Non-mecha-nised#	Fisher folk popula-tion (in lakh)*
Andhra Pradesh	974	2,81,688 (10%)	PL-56 DM-29 CR-13	555	353	3167	10737	17837	6.05
Tamil Nadu	1076	6,54,569 (19%)	PL-61 DM-29 CR- 6ML-4	573	407	10692	24942	10436	8.02
Kerala	590	7,51,223 (25%)	PL-73 DM-14 CR-6 ML-7	222	187	4722	11175	5884	6.10
Karnataka	300	4,34,063 (12%)	PL-64 DM-24 CR-5 ML-7	144	96	3643	7518	2862	1.67
Gujarat	1600	7,20,591 (20%)	PL-36 DM-35 CR-21 ML-8	247	121	18278	8238	1884	3.96

Note: Figures in brackets indicate the average share of the respective states in India's marine fish landings
PL-Pelagic resources; DM-Demersal resources; CR-Crustacean resources; ML-Molluscan resources
**National Marine Fisheries census, CMFRI, 2010*
 # Mechanised sector: Use engine power for cruise and fishing; Motorised sector: Use engine power for cruise and fishing done manually; Non-mechanised sector: Generally use manual labour for cruise and fishing

Fisheries (DOF), police force and the Coast Guard patrol. Also cost is computed for the hiring charges of the patrol boat and its Petrol and oil (POL) expenses. The Compensation Cost includes incentives and compensation paid during the ban which includes free rations and cash allowance paid to the fishers in lump sum or with sharing from the central and state government during the ban period. But it is to be noted that compensation cost is not a part of transaction cost. The data for estimation of the transaction cost was collected from the State Fisheries Department (DoF) of the selected states using the pre-tested questionnaire. The statewise estimated transaction cost of implementation of SFB is presented below.

Kerala : The estimated total transaction cost in 2014 was ₹ 248.14 lakhs out of which the information costs accounted for a major share of ₹ 210 lakhs (84.63%) followed by the enforcement cost, ₹ 38.14 lakhs (15.37%). The awareness about SFB is created through various channels of communication like personal, electronic, print media and also through small publications. The expenses incurred to advertise in media, publication of notices and awareness campaigns were computed as information costs. Besides the above transaction cost, the government also gives compensation to the fishermen during the fishing ban period that includes cash allowance and free rations. The total compensation cost was ₹ 5,802.38 lakhs out of which the free ration cost ₹ 1,392.38 lakhs and cash allowance was ₹ 4,410 lakh which formed 24% and 76% of the total compensation cost respectively.

Table 1. Estimated transaction cost in Kerala

Components of transaction cost	Amount (in ₹ Lakhs)	% share to total
Information Cost	210.00	84.63
Enforcement cost		
Salary of government staff	13.63	5.49
Patrolling	21.71	8.75
Fuel	2.80	1.13
Total enforcement cost	38.14	15.37
Total transaction cost	248.14	100.00

Andhra Pradesh : The total transaction cost worked out to ₹ 172.52 lakhs out of which the enforcement costs accounted for a major share of ₹168.58 lakhs (97.71%) followed by the information cost, ₹ 3.95 lakhs (2.29 %). The awareness about SFB is created through various channels of communication like personal, electronic and print media.

Table 3. Estimated transaction cost in Andhra Pradesh

Components of transaction cost	Amount (in ₹ Lakhs)	% share to total
Information Cost	3.95*	2.29
Enforcement cost		
Salary – DoF	141.88	
Salary – Police officials	26.71	
Total enforcement cost	168.58	97.71

**This cost was incurred by Reliance Foundation on their own. Reliance India Limited initiated a programme to connect farmers and fishermen as a part of their expansion programme. Since this exercise aimed at creating awareness about SFB, the cost incurred by them is taken as information cost (as a proxy to the expenses incurred by the Government of AP).*

Tamil Nadu: SFB is implemented for a period of 45 days from the 15th April to the 29th May of every year along the entire East coast of the state starting from Thiruvallur to Kanyakumari District and from the 15th June to the 29th July of every year along the west coast portion of the state in the Kanyakumari District from Kanyakumari to Neerodi Village limit. The government of Tamil Nadu does not make any public announcements through media regarding the enforcement of SFB. However instructions are given to authorized officers through official channels and notices are issued in newspapers as Press Release where no cost is involved

The enforcement is done with the help of the Department of Fisheries officials which includes Joint Director, Deputy Director, Assistant Director, Fisheries Inspectors, Fisheries Officers and Coast Guards. Patrolling is carried out in Kanyakumari District using fishing boats of local fishermen with 2 patrolling trips with 2 boats per week for 6 weeks during east coast (*i.e*. 4 x 6 = 24 boat trips) and west coast ban periods. There are no hiring charges for patrolling boat but 200 litres per boat per trip was provided for all the 48 trips which require of 9600 litres diesel valued at ₹ 1.50 lakh during 2013-14. However, the enforcement cost of overall patrolling worked out to be 11.49 lakhs for the 100 odd coast guards involved in implementing the SFB. In 2014, the compensation paid to the 1,49,855 fishermen families was ₹ 30,01,59,565 which included the allowance of ₹ 2,000 per family.

Karnataka: Announcements regarding the ban are made through newspapers as news item and hence no cost is involved. No officials are specifically engaged for enforcement of closed fishing season. The Fisheries Department staff in the fishing harbours/fish landing centres are responsible for enforcement of fishing ban without any additional cost. Patrolling during SFB is done by coast guard and enforcement cost of patrolling worked out to 10.92 lakhs for the 75 odd Coast Guard staff involved.Compensation was paid to 43,000 fishermen under centrally sponsored "Saving cum Relief Scheme where ₹ 900 was contributed by the beneficiary and ₹ 900 each by state and central governments. The total compensation paid was ₹11.61 crores.

Gujarat: The enforcement is taken care by the Coast Guard as a part of their duty. Fishermen comply with the ban in total and no separate costs of enforcement are incurred. There is no specific compensation cost except that given through the centrally sponsored scheme of Government of India during this period. The enforcement cost of patrolling worked out to 17.24 lakhs for about 100 Coast Guard staff who spent their time in implementing the SFB enforcement cost.

Table 4. Estimated transaction costs of implementing SFB in the selected maritime states

State	Transaction cost (₹ In lakhs)
Andhra Pradesh	168.58
Tamil Nadu	12.99**
Kerala	248.14
Karnataka	10.92**
Gujarat	17.24**
Total	457.87

*Note * landing centre level estimate*

*** In these states, enforcement of SFB is being taken care by the Coast Guard, whose salary is apportioned as costs of enforcement*

The estimated total transaction cost of implementing the SFB in the selected maritime states thus worked out to ₹ 457.87 lakhs (Table 4). This cost will be used to estimate the net benefit due to the implementation of SFB by deducting from

the economic benefit accruing due to the incremental growth of fish during the ban period. The transaction cost thus estimated will help to derive the net social benefit due to the implementation of the SFB in the selected maritime states. The final result will be helpful in arriving at management decisions like continuation of the SFB to modify the management measures to improve the implementation process.

Acknowledgement

The authors acknowledge the financial support provided by the GIZ-India Biodiversity Programme through the TEEB India Initiative to conduct the study in Economic valuation of seasonal fishing ban in selected maritime states of India and also record their sincere thanks to the Director, ICAR-CMFRI for facilities provided.

Light fishing - conflicts and concerns in Maharashtra

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Technological intervention in the Indian fishing industry are intended to increase marine fish production of the country. Crude light fishing methods practiced in Mandapam was reported for catching silverbellies (Sekharan 1955, *Indian J. Fish.*, 1955; Anon., 1957, *Indian J. Fish*). Fishing experiments with light attraction for pelagic fishes using purseseines was conducted by Fishery Survey of India (Ninan and Sudarsan, 1988, *Occasional papers of Fishery Survey of India No. 5*) who reported that no aggregation was noticed in the areas where water turbidity was high and strong current (above 2 Knots) was present. Mohamed (2016) reviewed light fishing practices in India and suggested restrictions in power of lights used, area of operation, mesh size for exploitation etc *(Marine Fisheries Policy Brief No. 4, 2016, ICAR- CMFRI)*.

In Maharashtra, the use of lights designed for fishing was limited earlier, and mostly confined to squid fishing boats (squid jigger) along the coast. Currently, high power light-emitting diode (LED) lights ranging from 2000-6000 watts are used by purse-seine net operators with the help of power generator, and almost all kinds of pelagic fish such as mackerel, tuna, seer fish, sardine, moon fishes, pelagic sharks etc. which are attracted to the light get netted.

Single boat light fishing operation is accomplished by a single boat, where high power LED lights are mounted on-board on purse-seiners. In some cases, submerged light bulb costing over ₹ 1 lakh is also used to attract fish when boat is anchored. This kind of operation is handled by single boat owner. Two boat light fishing operations are also observed where one specially fitted light providing vessel illuminates the sea. Once sizable fish congregate around the vessel, the purse seine net is operated by the second boat to encircle and capture the attracted fish resources. The light

Specially fitted light providing vessel

illumination time depends upon the abundance of the fish resources in the region. This fishing practice was first observed in Raigad district of Maharashtra where the specialized vessel powered metal halide lamps of 1000 W and 4000 W with diesel generator (Total light capacity ranging from 20 to 30 kW). The profit shared between the owners of light provider boat and purse seine boat is in the ratio of 40:60. For this specific purpose as light providing vessel, few fishers have converted their traditional crafts 10-15m OAL (Over All Length). This system is being slowly adopted by the fishers of neighboring villages.

As per Marine fisheries census records (2010) Maharashtra has 435 numbers of purse-seiners . Following Karnataka and Goa, purse-seine fishers of Maharashtra are also adopting light fishing which has raised concerns as juvenile fish are caught along with mature fish and conflicts with the small-scale fishers arise. Hence appropriate regulations are of paramount significance.

Observations on the monsoon prawn fishery in Kerala

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The ban on trawling in Kerala from June 15th to July 30th coincides with the southwest monsoon. During the period fishermen venture into the sea with their traditional/motorised crafts and gears such as thermocol boats (Alapuzha) and Thanguvallom (Ernakulam and Thrissur). The latter is operated with outboard engines and operate up to 8 km from the shore. The thermocol boats fish very near the shore (up to 3 km). The gear operated are ring seines or *thangu vala* and gill nets. The unique phenomenon in the monsoon season known as mud-bank or 'chakara' is characterised by calm areas close to the shore. The area marked by nutrient rich water upwelled from the bottom layers to the surface favors aggregation of fishes and crustaceans and hence ideal for fishing. This plays a pivotal role in the livelihood of fishermen as it provide them opportunity to catch large quantities of fishery resources during the lean fishing period. But over the years there has been inconsistency in the appearance of mud bank with certain years having very poor mud bank formations. Erratic monsoons may be a reason for the diminishing mud banks and declining trend in the mud bank fishery (Kurup, 1979, *Mar. Fish. Infor. Serv. T&E Ser.*, 12:12-13).

The monsoon prawn fishery in Kerala including the mud bank areas was studied based on samples collected during July 2015 from different fish landing centres in the Alapuzha (Punnapra, Paravoor, Kappakadavu, Thottappally), Ernakulam (Kalamukku, Chellanam), Thrissur (Chavakkad) and Malappuram (Chettuva, Ponnani) districts. Prawn samples were collected from both mud-bank and non-mud bank areas for the study. Comparison of the sex ratio of *Metapenaeus dobsoni* and *Fenneropenaeus indicus* and maturity stages of females between mud-bank and non-mud bank samples was done. Means of total length, weight, juvenile composition, length weight relationship and gastro somatic index of males and females of mud bank and non-mud bank samples were compared using standard methods.

Prawn fishery: An estimated 17377 outboard ring seine units and 17684 non-motorized ring seines were operated during the period (Table 1). Outboard

Table 1 Effort expended (units & hours) by different gears in the districts during July 2015

District	Alappuzha		Ernakulam		Thrissur		Malappuram	
	Units	Hours(h)	Units	Hours(h)	Units	Hours(h)	Units	Hours(h)
OBGN	563	4680	901	2447	3627	8917	731	1881
OBRS	11396	25629	2720	7473	2763	4756	687	811
OBTN	_	_	_	_	4234	6288	338	676
NM	10080	15780	_	_	7387	13112	217	477
MRS	101	304	1142	3153	1446	2877	658	1315

OBGN-outboard gill net, OBRS - outboard ring seine, OBTN - Outboard trawl net, NM - Non - mechanised. MRS - Mechanised ringseine

ring seines expended maximum effort in terms of hours of operation (382669 h) followed by non-motorised ring seines (29369 h). Maximum catch per hour and catch per unit were observed in the outboard ring seines – 128.3 kg/unit and 58.3 kg/h respectively. In all the districts observed *Metapenaeus dobsoni* was the dominant species while *Parapenaeopsis stylifera* was recorded only in the Thrissur district (Table 2).

Mud bank fishery was observed in Punnapra, Kappakadavu, Paravoor, Purakkad (Alapuzha), Chavakkad (Thrissur) and Chettuva, Ponnani (Malappuram). Biological parameters of samples from different landing centres are given in Table 3. *M. dobsoni* dominated the catches followed by *F. indicus*. The dominance of *M. dobsoni* with catch of *F. indicus* and *P. stylifera*. (Regunathan *et al.*, 1972, CMFRI Bulletin: 30; Kurup, 1979, *Mar. Fish. Infor. Serv. T&E Ser.*, 12:12-13) has been reported earlier. In the present study low catches of *P. stylifera* were observed from Chavakkad in Thrissur district. The low salinity during monsoon probably triggers the migration of this marine species to deeper waters. The biological data of the species from the centres covered was analysed. Overall sex ratio (male : female) in *M. dobsoni* was 1:1.16. Females ranged in total length from 50 to 114 mm and males 53 to 97 mm. 48.7% were in the spent stage followed by 17.5% mature, 10.2% late mature, 14.9% early mature and 8.7% immature. Juveniles of females (1.7%) were more than males (0.3%). In *F. indicus* females ranged in total length from 95 to 180 mm

Table 2. Species wise gearwise landings (kg) of prawns in the four districts

Species/District	OBGN	OBRS	OBTN	NM	MRS	Total
F. indicus						
Alapuzha	-	147976	-	5237	-	153213
Ernakulam	771	31685	-	-	2098	34554
Thrissur	17488	12895	26394	17736	81464	155977
Malappuram	1764	15470	2591	-	40768	60593
Total	**20023**	**208026**	**28985**	**22973**	**124330**	**404337**
M. dobsoni						
Alapuzha	-	858774	-	62747	-	921521
Ernakulam	5554	306747	-	-	141505	453806
Thrissur	11313	649354	587513	30077	1109163	2387420
Malappuram	-	222521	67383		327543	617447
Total	**16867**	**2037396**	**654896**	**92824**	**1578211**	**4380194**
P. stylifera						
Thrissur	-	393	5685	-	-	6078
Total	-	**393**	**5685**	-	-	**6078**

OBGN-outboard gill net, OBRS - outboard ring seine, OBTN - Outboard trawl net, NM - Non - mechanised. MRS - Mechanised ringseine

Table 3. Biological parameters of *M. dobsoni* and *F. indicus* from different landing centres

Ponnani	***F. indicus***		***M. dobsoni***	
	Male (n=40)	**Female (n=53)**	**Male (n=30)**	**Female (n=87)**
Total length (mm)	100-156	95-175	78-105	68-92
Weight (g)	5.4-48.1	6.9-31.6	3.6-11	3.5-6.2
Sex ratio (M:F)	1:0.75		1 : 2.9	
Juvenile distribution (%)	11.32	10	0	1.1
Punappra	***F. indicus***		***M. dobsoni***	
	Male (n=72)	**(n=71)**	**Male (n=390)**	**Female (n=509)**
Total length (mm)	111-162	95-180	54-96	61-114
Weight (g)	6.5-47.5	9.2-31.5	1.4-6.6	1.7-10.8
Sex ratio (M:F)	1 : 0.98		1 : 0.76	
Juvenile distribution (%)	20.8	19.7	6.9	2.8
Kappakadavu	***F. indicus***		***M.dobsoni***	
	Male (n=14)	**Female (n=11)**	**Male (n=168)**	**Female (n=103)**
Total length (mm)	125-165	103-151	53-92	50-105
Weight (g)	6-28	12.7-39.9	1.1-11.3	1.3-5.1
Sex ratio (M:F)	1 : 0.78		1 : 0.69	
Juvenile distribution (%)	-	-	-	-
Paravoor	***F. indicus***		***M. dobsoni***	
	Male (n=37)	**Female (n=43)**	**Male (n=299)**	**Female (n=149)**
Total length (mm)	105-158	108-175	66-96	68-110
Weight (g)	8.8-31.2	6.3-48	1.7-9.8	2.2-10.9
Sex ratio (M:F)	1 : 1.15		1 : 0.59	
Juvenile distribution (%)	5.5	0	0	2.7
Purakkad	***F. indicus***		***M. dobsoni***	
	Male (n=11)	**Female (n=18)**		
Total length (mm)	112-149	132-170	No sample	
Weight (g)	10.3-23.3	18.4-27.4		
Sex ratio (M:F)	1 : 0.61			
Juvenile distribution (%)	5.5	0		
Chettuva	***F. indicus***		***M. dobsoni***	
			Male (n=24)	**Female (n=111)**
Total length (mm)	No sample		63-97	75-108
Weight (g)			1.8-6.3	2.9-9.3
Sex ratio (M:F)			1 : 0.72	
Juvenile distribution (%)			4.2	1.8
Chavakkad	***F. indicus***		***M. dobsoni***	
	Male (n=11)	**Female (n = 76)**		
Total length (mm)	136-146	153-162		No sample
Weight (g)	16.5-29.2	21.3-42.6		
Sex ratio (M:F)	1: 0.77			
Juvenile distribution				

Table 4. Maturity stages (%) of prawns from different landing centres

	M. dobsoni					*F. indicus*				
Centre	**IM**	**EM**	**LM**	**M**	**SP**	**IM**	**EM**	**LM**	**M**	**SP**
Ponnani	10	-	-	2.5	87.5	1.1	4.6	11.5	25.3	57.5
Punappra	31	-	-	-	69	6.9	17.2	12.1	17.2	46.7
Kappakadavu	18.8	-	-	-	81.8	37.9	6.8	8.7	8.7	37.9
Paravoor	27.9	-	-	7	65.1	2.7	28.9	8.7	12.8	47
Purakkad	-	-	9.1	-	90.9	No sample				
Chettuva	2	4	7	30	68	No sample				

IM-Immature, EM-Early maturing, LM-Late maturing, M-Mature, SP-Spent

Table 5. Comparison of biological information of *M. dobsoni* and *F. indicus* in mud-bank and non-mud-bank areas

	Mud bank		Non mud bank	
	Female	**Male**	**Female**	**Male**
M. dobsoni				
Mean Total length (mm)	90.6	76.6	93.1	78.2
Mean weight (g)	5.5	3.4	5.5	3.11
Sex ratio (M:F)		1 : 1.16*		1 : 1.3
Juvenile%	1.7	0.3	0	0
b value	2.96*	2.57*	3.03*	2.4*
Gastro Somatic Index	0.01	0.08	0.009	0.006
F. indicus				
Mean Total length (mm)	140.2	135.2	134	126
Mean weight (g)	21.7	18.4	19.4	17.7
Sex ratio (M:F)	-	1 : 1.13	-	1 : 1.04
Juvenile%	13	15.8	19	13.6
b value	3.1	3.2	3.5	3.1
Gastro Somatic Index	1.91*	1.62	1.0*	1.5

*p<0.05

Table 6. Comparison of maturity stages (%) from mud bank and non mud-bank areas

Species	**Mud bank**					**Non mud bank**				
	IM	**EM**	**LM**	**M**	**SP**	**IM**	**EM**	**LM**	**M**	**SP**
M. dobsoni	8.7	14.9	10.2	17.5	48.7*	1		1	38	60
F. indicus	22.5			1.6	75	19				81

IM-Immature, EM-Early maturing, LM-Late maturing, M-Mature, SP-Spent

and males from 100 to 162 mm, ratio of male to female being 1:1.10. Spent stages dominated (75%), mature shrimps being very meagre (1.6%). Immature shrimps formed 22.5%. Juvenile percentage was 13% in females and 15.8% in males. The Gastro Somatic Index(Ga.SI) in *M. dobsoni* ranged from 0.004 to 0.01 in females and 0.004 to 0.08 in males. In *F. indicus* the Ga.SI was 0.89 to 1.91 in females and 0.7 to 1.62 in males. In *M. dobsoni*, 85 to 96% of the gut content consisting of detritus and rest had algae

and crustacean fragments. In Ponnani, 20% of *M. dobsoni* had their gut full and in samples collected from Punnapra, 31.4% of the prawns had 1/4 filled guts and rest were with empty stomachs. In Chettuva, all *M. dobsoni* had 1/4 to 1/2 filled guts while in Kapakadavu, only 50% had full guts. In Punnapra, 34.2% of *F. indicus* sampled had empty stomachs.

Non mud-bank fishery was observed in Kalamukku and Chellanam. Female *M. dobsoni* ranged from 74 to 108 mm in total length and males from 66 to 90 mm. 60% of the prawns were in the spent stage followed by 38% mature, 1% each in immature and late mature stages. Juveniles were absent. Sex ratio was 1:1.3. In *F. indicus*, females ranged in total length from 109 to 151 mm and males from 105 to 150 mm. Male to female ratio was 1:1.04. 19% of the prawns were immature and 81% in the spent stages. Juveniles constituted 19% in females and 13.6% males. In *M. dobsoni* the Ga.SI ranged from 0.001 to 0.009 in females and 0.002 to 0.006 in males. In *F. indicus*, the Ga.SI ranged from 0.25 to 1.0 in females and 0.42 to 1.5 in males. Nearby 95% of the guts of *M. dobsoni* was dominated by detritus and rest by algae.

A comparison of prawns sampled from mud bank and non-mud bank areas was made (Table 5 & 6). In *F. indicus* there was no significant variation between the mean total length, mean weight, sex ratio, juvenile contribution and maturity stages in females and males of the two areas. Length weight relationship analysis revealed no significant difference ($p>0.5$) in the slope (b value) between the females and between the males of the mud-bank and non-mud bank samples. The gastro-somatic index showed significant variation only among the females ($p<0.05$) of the two areas, being higher in the mud bank samples.

In *M. dobsoni* there was no significant variation in the mean total length and mean weight, but significant difference in the sex ratio and maturity stages in the samples from the mud-bank and non-mud bank areas. The slope of the regression lines in the length weight relationship was significantly different deviating from the isometric value 3 in the two areas. The gastro-somatic index did not show any significant variation in females and males of the two areas ($p>0.05$).From this study it is concluded that there is not much variation in the biology of the two species sampled from the mud-bank and non-mud bank areas. During monsoon nearly 85% of the females of both the species had mature/spent gonads irrespective of their association with a mud-bank. This indicates that breeding takes place during monsoon and mature females from deeper waters migrate to nearshore areas reaffirming the necessity for trawl ban. The migration of mature females is most probably due to the strong upwelling that happens in the coastal waters during the south west monsoon.

Price behaviour, marketing channels and efficiency of marine fish marketing in Karnataka

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Karnataka state contributes around 13% of marine fish landings in India. More than 80% of the catch in Karnataka are landed at Mangalore, Malpe and Karwar Fisheries Harbours. While only singleday trawlers and purse seiners operated in Karwar fisheries Harbour, multiday trawlers, purse seiners and small motorized units operated in Malpe and Mangalore harbours.The catch is generally traded

through auctioning at major and minor harbours in the state and the marketing channels varied for different resources. Nearly 70% of the marine fishes landed in the state is utilized in the fresh form and the rest 30% in processed forms. Processing of marine fish is mainly done for export in fresh frozen form, canned, dried or as fish meal. Shrimps, squids, cuttle fishes and other high value fishes go to the export market. Threadfin breams, ribbon fishes, lizard fishes and rockcods go to cutting sheds and *surumi* plants while oil sardines are taken by the fish meal plants.

Data on species wise prices of marine fishes were collected at landing center(LC), wholesale(WS) and retail markets(RT) in the Dakshina Kannada, Udupi and Uttara Kannada districts of Karnataka for the year 2014 and 2015. The price spread, and Fishermen's Share in the Consumer's Rupee(FSCR) in the domestic marketing channel within the state was calculated. Marketing efficiency was assessed based on Fishermen's Share in the Consumer's Rupee(FSCR) which is the ratio of price received by the fishermen at landing centre to the price paid by the consumers at retail markets expressed as percentage. The gross value of marine fish at landing centre and retail levels in Karnataka were calculated based on the species wise landings and average prices in the state.

The major channels of marine fish marketing existing in Karnataka are,

Fishermen-Auctioneer-Retailers-Consumers

Fishermen-Auctioneer-Commission Agents-Wholesalers-Retailers-Consumers

Fishermen-Auctioneer-Processors-Exporters-Consumers

Fishermen-Auctioneer- Cutting sheds-*Surumi* Plants-Exporters- Consumers

Fishermen-Auctioneer- Fishmeal plants- Fish feed units/Exporters- Aquaculture/ Poultry industry

Fishermen-Auctioneer-Commission Agents-Wholesalers-Interstate agents- Consumers

District wise analysis of marine fish price behaviour in Karnataka showed that in Dakshin Kannada at landing centre level in 2014, the lowest price (per kg) was recorded for short neck clam at ₹ 28 and the highest price was recorded for silver pomfrets (₹ 559/kg). At retail level, the lowest price was recorded for shortneck clam at ₹ 47 and the highest was ₹ 633 for silver pomfrets. In 2015 also the prices varied from ₹ 30 for shortneck clam to ₹ 521 for silver pomfet at landing centre level and from ₹ 53 for shortneck clam to ₹ 671 for silver pomfret at retail level. The FSCR ranged from 55% for octopus to 92% for great barracuda in 2014 and 57% for shortneck clam to 89% for barracuda in 2015.

In Udupi, at the landing centre level, the highest price was recorded for silver pomfrets at ₹ 535 and ₹ 540 per kg respectively in 2014 and 2015 at landing centre level to ₹ 616 and ₹ 639 at retail level. The lowest price (per kg) was for short neck clam at ₹ 26 and ₹23 at landing centre level to ₹ 37 and ₹ 36 at retail level. FSCR varied from 66.4% for oil sardines to 86.8% for silver pomfet in 2014 and 57.14% for oilsardines to 84.38% for silver pomfret in 2015.

In Uttara kannada, at landing centre level, the prices (per kg) varied from ₹ 43 for oilsardines to ₹ 505 for silver pomfret in 2014 and ₹ 57 for oilsardines to ₹ 521 for silver pomfret in 2015. FSCR varied from 46.24% for oilsardines to 86.24% for groupers in 2014 and from 65.52% for oilsardines to 80% for giant sea perch (Table 1).

The FSCR was higher in Mangalore (Dakshina Kannada district) when compared to Udupi and Uttara Kannada districts. The fishermen in Mangalore receive a higher share due to the high demand and competition among a large number of buyers /traders. The gross value of marine fish in Karnataka at landing centre level increased from ₹ 3565 crores in 2014 to ₹ 4617 crores in 2015 and at retail level from ₹ 6404 crores to ₹ 7694 crores in 2015. However in general FSCR showed a declining trend in 2015 when compared to 2014, in all the districts. The increase in value and average prices of marine fish at landing centre and retail levels with reduction in FSCR shows the increase in marketing costs and margins besides lower marketing efficiency.

Table 1. Fishermen's Share in the Consumers Rupee(FSCR) for commercially important resources in Karnataka 2014-15

Name of fish / District	Dakshina Kannada			Udupi			Uttara Kannada		
	2014	2015	Average	2014	2015	Average	2014	2015	Average
Black-barred Half Beak	87.74	80.15	83.95	80.14	71.26	75.70	77.78	79.67	78.73
Anchovies	80.20	71.62	75.91	75.43	80.46	77.95	70.59	70.37	70.48
False Trevally	83.56	79.73	81.65	78.54	82.46	80.50	71.17	75.00	73.09
Flathead mullet	85.37	85.71	85.54	79.36	80.48	79.92	78.51	80.12	79.32
Flower crab	83.82	73.33	78.58	84.15	75.00	79.58	83.33	66.67	75.00
Giant sea perch	81.82	80.18	81.00	83.35	72.73	78.04	76.47	80.00	78.24
Great barracuda	91.96	79.84	85.90	80.28	78.21	79.25	-	-	-
Indian halibut	79.42	69.23	74.33	68.35	70.12	69.24	67.61	66.67	67.14
Indian mackerel	75.23	68.75	71.99	79.78	72.00	75.89	77.78	67.46	72.62
Indian squid	83.69	74.38	79.04	81.27	73.33	77.30	72.86	73.79	73.33
Indian white prawn	85.76	77.31	81.54	86.58	84.15	85.37	76.14	76.47	76.31
Lesser tiger tooth croaker	74.44	83.33	78.89	75.72	75.86	75.79	68.35	68.60	68.48
Malabar tongue sole	82.54	72.22	77.38	76.92	73.68	75.30	72.31	75.43	73.87
Mangrove snapper	90.74	82.76	86.75	80.45	82.13	81.29	71.79	75.00	73.40
Sharks	85.44	87.62	86.53	78.21	78.41	80.21	-	-	-
Seer fish	85.76	76.47	81.12	84.64	78.24	81.44	78.85	79.63	79.24
Octopus	55.00	85.71	70.36	64.00	72.32	76.25			
Oil sardine	73.11	63.91	68.51	66.38	57.14	61.76	46.24	65.52	55.88
White sardine	86.49	69.23	77.86	79.65	76.24	77.95	71.24	74.26	72.75
Barracudas	86.31	89.19	87.75	78.65	82.24	80.45	76.58	80.14	78.36
Short neck clam	59.23	57.14	58.19	71.72	62.79	67.26	58.25	57.52	57.89
Skipjack tuna	81.14	77.78	79.46	86.61	71.08	78.85	-	-	-
Silver pomfret	88.38	77.64	83.01	86.76	84.38	85.57	80.16	79.66	79.91
Black pomfret	80.77	82.21	81.49	85.51	81.03	83.27	74.81	74.64	74.73
Silverbellies	73.55	73.33	73.44	76.23	74.12	75.18	71.24	69.56	70.40
Groupers	74.45	76.24	75.35	77.82	77.78	77.80	86.24	77.50	81.87
CuttleFish	76.35	80.24	78.30	78.16	81.20	79.68	75.71	75.86	75.79
Average	80.45	76.86	78.66	78.69	75.88	77.66	73.22	73.46	73.34

Market structure analysis of fish markets in North coastal districts of Andhra Pradesh

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Andhra Pradesh is one of the predominant fish producing states in the country which stood first in total fish and shrimp production in India for the year 2015-16. The fisheries sector contributes 6.01 % of the states Gross State Domestic Product (GSDP) and provides meaningful employment opportunities to nearly 14.5 lakh people directly and indirectly in the secondary and tertiary sector.

The total fish production in the state during 2015 was found to be 19.64 lakh tonnes of which 24.18 % was marine and 75.82 % from inland sector (Fishery Policy 2015, Government of Andhra Pradesh 2016). This sector also plays a significant role in reducing poverty and also one of the major contributors to foreign exchange earnings. The Government of Andhra Pradesh is unveiling the policy of good governance and best culture practices in enabling the sustainable development of fisheries and aquaculture in the coming years.

In Andhra Pradesh, nine out of thirteen districts are along the coastline *viz*. Srikakulam, Vizianagaram, Visakhapatnam, East Godavari, West Godavari, Krishna, Guntur, Prakasam and Nellore. The total continental shelf is more than 33,227 sq.km. The profile of marine fisheries sector in the state having 4 major fishing harbours, 349 fish landing centres and 555 marine fishing villages is presented (Table 1). The estimated marine fish landings of Andhra Pradesh in 2016 dominated by motorised sector is 1.92 lakh tonnes (CMFRI-Marine Fish Landings in India, 2016). Provisional estimate of the value (₹ crores) of marine fish landings in 2016 at Point of First Sales and Point of Last Sales was 2516 and 3916 respectively.

Fish market structure analysis

The study assessed the fish market structure of North coastal districts of Andhra Pradesh with focus on marine fish markets using a pre-tested schedule with information gathered from the various stake holders for the year 2016-17. It was found that the marine fish marketing operation were performed / controlled by a large number of intermediaries who were well organised locals with good network on fish trade and other facilitating functions. The fish market channels were in operation with the wholesalers buying fish in bulk quantities from auctioneers and selling it to retailers or other traders. The wholesalers imparted value addition in terms of sorting, grading, cleaning, icing and packing fish prior to sale. Subsequently the retailers sold the fish directly to consumers over the counters or with the help of vendors. Retailers mostly buy fish from the wholesaler, but in several cases, groups of retailers were found participating in the auction process for buying fish directly from the auctioneer.

Under the study five fish markets -one wholesale cum retail, two retail and two terminal fish markets were surveyed in North coastal districts of Andhra Pradesh viz. Visakhapatnam Fisheries Harbour (wholesale cum retail), Rajayyapeta in Visakhapatnam district and Mukkam in Vizianagaram district (retail) and Chintapalli in Vizianagaram district and Bandaruvanipeta in Srikakulam district (terminal). The market structure analysis was based on the major dimensions namely, location, type of market, timing, access, arrival and disposal sources, conduct, infrastructure amenities, market union and regulation. The market structure of these markets was analysed and the details are given in Table 2.The

Table I. Marine fisheries profile of Andhra Pradesh

Particulars	Andhra Pradesh	Srikakulam	Vizianagaram	Visakhapatnam
Length of the coastline (km)	974	200	29	136
Number of landing centres	349	55	12	66
Number of fishing villages	555	128	20	63
Number of fishermen families	1,63,427	25,579	5,138	28,779
Total fisher folk population	6,05,428	98,450	20,812	1,13,632
Number of export units	121	0	0	36
Total fishing crafts	31318	5571	1280	8019
Mechanised fishing crafts	1871	0	0	579
Motorised fishing crafts	14648	691	522	2480
Non mechanised fishing crafts	14799	4880	758	4960

Source: Department of Fisheries, Government of Andhra Pradesh
Andhra Pradesh Marine Fisheries Census, 2010, ICAR-CMFRI

Table 2. Market structure analysis of the major fish markets

Market Dimension	Visakhapatnam Fisheries Harbour	Rajayyapeta	Mukkam	Chintapalli	Bandaruvanipeta
A. Location					
Year of establishment	1933	1910	1920	1940	1930
Type of Market	Wholesale and Retail	Retail	Retail	Terminal	Terminal
Area of the market (acres)	One	Two	Three	Four	Ten
Latitutde/Longitude	17.69617 N 83.30096 E	17.43803 N 82.91235 E	17.98438 N 83.55646 E	18.07307 N 83.65670 E	18.32480 N 84.12667 E
Market control	Individual/ Traders/ Commission agents/Local bodies	Individual	Local bodies	Individual / Others	Individual / Others
B. Market access					
Nearest landing Centre	Fishing Harbour	Rajayyapeta	Mukkam	Chintapalli	Bandaruvanipeta
Nearest railway station (km)	Visakhapatnam, 5	Tuni, 25	Vizianagaram, 28	Vizianagaram, 35	Srikakulam, 35
Nearest bus station (km)	Visakhapatnam, 5	Nakkapalli, 7	Bhogapuram, 12	Chintapalli, 1	Bandaruvanipeta, 1.7
Nearest airport (km)	Visakhapatnam, 25	Visakhapatnam, 68	Visakhapatnam, 60	Visakhapatnam, 70	Visakhapatnam, 130
Nearest seaport (km)	Visakhapatnam, 1	Visakhapatnam, 80	Visakhapatnam, 50	Visakhapatnam, 70	Visakhapatnam, 130
C. Market Timing	6-12 hrs 15-19 hrs	9-12 hrs 15-18 hrs	8-12 hrs 16-20 hrs	4-8 hrs	4-8 hrs
D. Market Conduct					
Number of Wholesalers	20	-	-	-	-
Number of retailers	50-70	12	10	40	30
Number of middlemen	10	-	-	1-2	1-2
Commission agents	10-15	-	-	-	-

market access indicated that the distance from the landing centre to the nearest railway station for these markets are almost 5- 35 km and bus station is about 1-12 km. Visakhapatnam international airport and Visakhapatnam sea port is the nearest airport and sea port to these markets. Due to good connectivity by highway roads and rail, transportation of fishes from one place to another is done in a very short span of time.

Around 20-25 marine species were marketed in these five selected markets. The most common species traded were sardine, mackerel, seer fish, croakers, cat fish, ribbon fish and shrimps. Price discrimination exists for the different fish species. The Visakhapatnam fishing harbour wholesale cum retail market trades fishes to an average of 23 tonnes(t) followed by Chintapalli (3.7 t), Rajayyapeta(1.9 t), Mukkam(1.72 t) and Bandaruvanipeta(1.3 t) . The average daily market capitalization of the fish trade was found to be ₹ 43.7 lakhs in wholesale market of Visakhapatnam, 3.38, 1.03, 0.75 and 0.72 lakhs in retail/ terminal markets of Chintapalli, Bandaruvanipeta, Mukkam and Rajayyapeta markets respectively. The observations on market arrivals and disposals of the markets of North Coastal districts of Andhra Pradesh indicated that in Visakhapatnam, fish arrive mainly from Bhimili, Mangammavaripeta, Uppada, Mukkam,

Lawsons Bay, Pudimadaka and Chintapalli. In other markets, the main arrivals are from their respective landing centres and the fish goes for sale to the nearby villages, towns and neighbouring states (Table 3).

In conclusion, north coastal districts of Andhra Pradesh are one of the major zones where fish markets and the trading operations are widely distributed covering the different parts of the state and other distribution and consumption destinations. Among these markets, Visakhapatnam which is one of the largest wholesale markets in the zone offers significant marketing functionaries and trade and caters to the fish demand of the nearby towns and cities as well as the neighbouring states. However lack of appropriate infrastructure and adequate amenities and low product diversity act as limiting factors in fish trade in majority of the markets studied. Hence appropriate government interventions in terms of strengthening infrastructure and imparting value addition may be created to facilitate better functioning of these markets, thereby augmenting revenue and catering to the increased demand for marine fish from nearby states.

Table 3. Market arrivals and disposal of various fish species in selected markets

Market	Arrival	Disposal
Visakhapatnam	Bhimili, Mangammavaripeta, Uppada, Mukkam, Lawsons bay, Pudimadaka and Chintapalli	Visakhapatnam, Chennai, Kerala, Odisha and West Bengal
Rajayyapeta	Rajayyapeta	Nakkapalli, Tuni, Anakapalle and Narsipatnam
Mukkam	Mukkam	Bhogapuram, Vizianagaram and near by villages and towns
Chintapalli	Chintapalli	Vizianagaram, Srikakulam, Visakhapatnam and near by villages and towns
Bandaruvanipeta	Bandaruvanipeta	Srikakulam, Visakhapatnam and South Odisha

Exploitation of the non-conventional bullseye fishery resource in Karnataka

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The estimated average all India marine fish landings during 2012-2016 was 36,71,651 t. Of late, the catch of priacanthids has increased in commercial landings all along Indian coast. The bullseye contribution to the total production which was 0.3% in 2011 increased to 3.6% during 2016 and increased by two times from an annual average 23,031 t (2007-2011) to 45,544 t in 2012-2016. Nearly 94% production was from the west coast. During 2007-2016, lowest contribution was by West Bengal (0.4%) and highest by Gujarat (36.1%) and Karnataka (35.8%) followed by Kerala (17%). Bullseye is mainly exploited by trawl nets (95.1%) and the other gears that contributed include gillnet (2.4%), hook & line (0.8%), purse seine (0.39%), ring seine (0.1%), *dol* net (0.06%), non-mechanised (0.04%) and other gears (1.2%). However, since 2015, the purse seines, ring seines and *dol* nets have significantly contributed to the bullseye catch. Karnataka has contributed 11.6% to 52.4% to the all India bullseye catch during 2007-2016 and landings has increased from an annual average 5,017 t during 2007-2011 to 19,564 t during 2012-2016. Gear-wise landings in Karnataka during 2007-2016 indicated that trawl net accounted for 97.1% followed by purse seine (2.5%) and other gears till late 2015. However, during

2016, the purse seines contributed 4.5% to the total bullseye catch in Karnataka. The seven species that contribute to the bullseye fishery of the country include *Priacanthus hamrur*, *P. blochii*, *P. tayenus*, *P. macracanthus*, *P. prolixus*, *Cookeolus japonicus* and *Heteropriacanthus cruentatus* of which the most dominant species is *P. hamrur (*99%) followed by *C. japonicus*.

During 2008-2016, monthly *in-situ* samples were collected from selected multiday trawlers operating along the south west coast of India (11°26.454' N to 17°9.789' N and 72°30.08 E to 75°0.283' E) encompassing the states of Kerala, Karnataka, Goa and Maharashtra. The analysed data revealed that priacanthids had a wide distributional range from 20 to 200 m depth. A slight shift in exploitation grounds from 11°26.454' N to 15°20.446' N and 73°22.242' E to 75° 0.283' E in 2008-09 to 13°34.224' N to 17°9.789' N and 72°30.08' E to 74°19.041' E in 2015-16 was observed (Fig. 1). This was mainly due to the introduction of high speed pelagic trawl nets which enabled operation of these nets even in areas with rocky bottoms (Dineshbabu *et al.*, 2016, *Fishery Technology*, 53: 263-272). Such changes in gears and operational methods, could be one of the reason for the sudden spurt of bullseye landings during 2015-16. Further, highly productive sea mount off Panaji was tapped for bullseye resources. An earlier study had indicated that

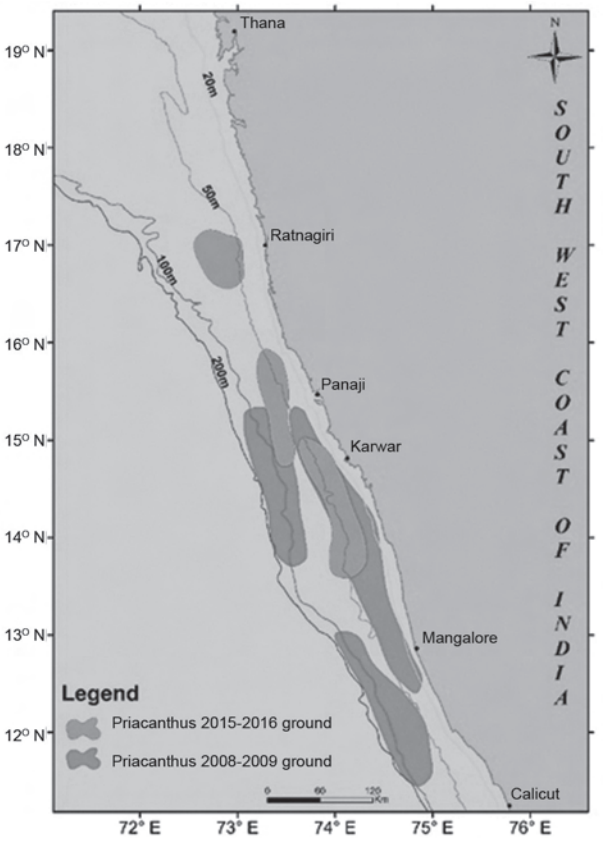

Fig. 1. Locations of operations by multiday trawlers during 2008-2009 and 2015-2016 period

Priacanthus spp. are abundant in the depth zone up to 100 m in area of 11°–12° N and 100 –200 m depth in 13° N (Vijayakumaran and Naik, 1988, *Fish. Surv. India. Spl. Publ., No.* 2: 106 –119; Bande *et*

Table 2. Average gearwise landings of bullseye (in tonnes) in India during 2007-2016

States / Gears	TN	DN	GN	PS	HL	NM	RS	OTHS	Total
West Bengal	129	-	0	-	-	-	-	-	129
Odisha	314	-	0.1	-	-	-	-	-	314
Andhra Pradesh	746	-	9	-	3	6.0	-	0.4	764
Tamil Nadu	611	-	17	-	24	0.02	-	3	655
Puducherry	208	-	25	-	5	0.45	-	4	242
Kerala	5080	42	289	42	133	5.1	4	267	5821
Karnataka	11939	-	1	307	-	-	24	21	12291
Goa	466	-	0	23	-	-	-	-	488
Maharashtra	417	0.1	6	9	-	-	-	-	431
Gujarat	12257	34	92	-	1.2891	-	-	0.01	12384
Daman & Diu	768	-	-	-	-	-	-	-	768
Grand Total	32933	76	439	338	166	11	28	294	34287
% contribution	95.1	0.6	2.4	0.3	0.8	0.04	0.1	1.2	100

TN, Trawl net; DN, *dol* net or bag net; GN, Gillnet; PS, Purse seine; HL, Hook & line; NM, Non-mechanized; RS, Ring seine; OTHS, Other gears

Table 1. Bullseye landings (in tonnes) in India during 2007-2016

States	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average	%
West Bengal	0.5	490	41	225	193	30	50	29	70	160	129	0.4
Odisha	72	46	619	239	126	333	597	361	243	506	314	0.9
Andhra Pradesh	887	529	498	786	443	1282	1418	968	402	422	764	2.2
Tamil Nadu	100	761	796	165	335	385	616	627	1099	1662	655	1.9
Puducherry	0	14	0	7	0	1794	0	30	331	246	242	0.7
Kerala	2893	6956	3727	3096	2692	0	1887	2398	4691	29869	5821	17.0
Karnataka	8166	8349	5520	1688	1364	2652	2487	2782	21347	68554	12291	35.8
Goa	80	2740	274	65	54	1	0	22	1420	228	488	1.4
Maharashtra	729	1144	409	92	13	44	96	176	208	1401	431	1.3
Gujarat	10506	30901	5717	5255	5076	8493	13404	8374	13088	23032	12384	36.1
Daman & Diu	0	0	0	0	275	840	920	308	679	4662	768	2.2
Grand Total (t)	23434	51930	17600	11618	10572	15854	21474	16074	43576	130740	34,287	100
All India catch (t)	2881336	3215242	3163314	3074282	3830262	3948938	3781868	3592853	3404771	3629823	–	–
% contribution	0.8	1.6	0.6	0.4	0.3	0.4	0.6	0.4	1.3	3.6	–	–

al., 1989, *Proc. First Workshop Scient. Result. FORV Sagar Sampada.* p. 233-239) and in the shelf area along Gujarat coast (Bhargava *et al.*, 1995, *Bull. Fish. Surv. India*. 25: 1 –50).

An unprecedented increase in the catches of bullseye in Karnataka could be due to the adoption of high power engines (popularly known as "Chinese engine") and use of lights during fishing. The bullseye were generally caught from the 30 to 200 m depths by trawlers in earlier years. However, in 2015-2016 these fishes were caught within 30 to 70 m depth by various gears (purse seine, ring seine and mid water trawlers). Changes in the consumer preference about bullseye has made it a popular table fish in recent times. As a result the retails unit value (per kg) for medium sized (about 25 cm Total Length) fishes increased from ₹ 8 during 2007 to around ₹ 45 in 2016. The big sized fishes (above 25 cm TL) fetched a price of ₹ 70 per kg in 2016. The characteristic white meat and gel strength texture has made it a preferred raw material in *Surumi* plants. The small sized fishes (10 –20 cm TL) are also in great demand for salting and sun drying while very small sized (<10 cm TL) fish are sold as trash for making poultry feed or used as manure.

Large scale harvest of lizardfish juveniles along the Kerala coast

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Lizardfishes are one of the major demersal resources, which contribute 5.3% of the total marine landings of Kerala. They are locally known as "Aranameen" and are sold and consumed in fresh and dried condition in Kerala, and support a regular fishery. The lizardfish landings in commercial trawlers along Kerala during the period 2007-2016 was 1,05,848 tonnes (t), with an annual average catch of 10,858 t, which constituted 5.3% of the total marine landings of Kerala. The highest catch was noticed in 2015 (13,365 t) and lowest in the year 2007 (7,359 t). The catch rate of lizardfishes ranged from 1.8 kg h^{-1} in 2007 to 3.4 kg h^{-1} in 2015, with an annual average catch rate of 2.5 kg h^{-1} during

2007-2016. The gear-wise landings of lizardfishes indicates that the major share was contributed by multiday trawlers (90%) followed by other mechanised fishing units, which include multiday trawlers vessels with trawl nets, hook and line, pair trawl units etc.

The lizardfish fishery was observed throughout the year, but peak landing was noticed during post-monsoon period from August to October, with highest landings in August, immediately after the monsoon season's mechanised fishing ban. The average annual species composition of lizardfishes landed in the state was *Saurida undosquamis* (43%), *Saurida tumbil (*52%*) Trachinocephalus myops (*4%*)* and *Saurida micropectoralis (1%). Saurida undosquamis,* or the brushtooth lizardfish, forms a major demersal fishery resource in all maritime regions of India except the northeast coast. The average annual landings of *S. undosquamis* during 2006-16 period was 4,140 tonnes, which formed 40.2% of total lizardfish landings of Kerala with highest volume recorded in 2012 (6316 t) and the lowest in 2007 (2434 t). They have good local demand in fresh condition and are sold at ₹ 50-80 per kg. During April – June, 2016, there were massive landings of juvenile lizardfishes (*Saurida undosquamis*) observed at Munambam Fisheries Harbour, which is one of the major trawl landing centres along the Kerala coast. The total landings of lizardfishes during the period by multiday trawl net units were 1533 tonnes (t) at Munambam Fisheries Harbour, which formed 11% of the total landings in the harbour during the period. The bulk

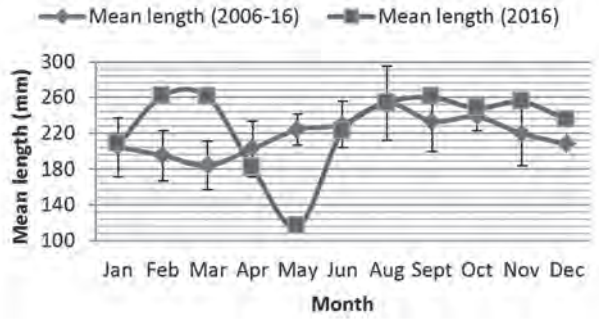

Fig. 1. Monthly mean size (Mean+SD) of *S. undosquamis* landed along Kerala coast during 2006-16 and in 2016.

of the landings of lizardfishes during the period comprised of *Saurida undosquamis* . The quantity of undersized fishes was higher in the catch during the period. As the Minimum Legal Size (MLS) estimated for this species (10 cm TL) is less than the size at first maturity (L_m 21.5 cm), estimates were made separately to quantify the juveniles ie., the quantity below MLS and those of below L_m. The average monthly landing of fishes below size at first maturity during April June period was estimated at 181 t and that below MLS was estimated at 57 t. Even though there were no landings of the species below MLS in April, 67% of the landings in the harbour comprised of individuals below the L_m. During May 2016, nearly 45% of the total *S. undosquamis* landed by mechanised trawlers in the Munambam Fisheries Harbour comprised of individuals below MLS and the rest comprised of fishes below L_m. In June, the juvenile component below the MLS was only 5%, but 19% of catch comprised of individuals below the L_m. Mean size of the fishes landed were 181, 116 and 222 mm in April, May and June respectively.

The under-sized/ juveniles of *S. undosquamis* were sold at the point of first sale for an average price of ₹ 30 per kg during the above period, while the adult/ marketable size of the species fetches ₹ 80 per kg at the point of first sale. These juvenile catch is utilised in fish meal industries of Karnataka. The economic loss due to the growth overfishing of *S. undosquamis* landed during the above period at Munambam Fisheries Harbour was estimated using the bio-economic model (Najmudeen *et al.,* 2016 *Book of Abstracts, International Congress on Post-harvest Technologies of Agricultural Produce* for *Sustainable Food and Nutritional Security* 379 p.) based on the population parameters such as growth rate, natural mortality and length weight parameters. The average monthly discounted loss due to growth overfishing of the species landed at Munambam Fisheries Harbour during April-June period was estimated at ₹ 35.36 million, had the species been left to attain the marketable size. It was one among the 58 species of marine finfish and shellfish species, whose MLS was estimated and

recommended to Department of Fisheries (DoF), Government of Kerala for enforcement (Mohamed *et al.*, 2014. *Mar. Fish Infor. Serv. T& E Ser.*, 220:3-7). 14 species of finfish/shellfish were placed Vide notification No. G. O. (P) No. 40/15/F&PD in Kerala Gazette on 24th July 2015, but *S. undosquamis* was not included. However, in a second notification G.O. (P) No. 11/2017/F&PD dated 17th May 2017, more species of finfish and shellfish including *S. undosquamis* were notified. Considering the estimated economic loss to the marine fisheries sector due to growth overfishing of this species, it is strongly recommended to strictly enforce the MLS regulations to sustain the stocks.

A rapid assessment of the fish trade, arrivals and price realization in Kerala

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Fisheries contribute to around 3 % of the economy of Kerala and provides employment to about 2.14 lakh people including its secondary and tertiary sectors such as marketing and processing. The marine fish landings in Kerala (2015) was 4.82 lakh tonnes forming 73.36 % of the total fish production in the state. A considerable 30% reduction in the marine fish landings during 2015 compared to the average (2010-14) landings of 6.82 lakh tonnes was noticed. The inland fisheries sector showed a marginal increase in the production which hovered around 1.50 lakh tonnes. Kerala is the largest fish consuming state in the country with more than 85 % of the population eating fish at an average per capita fish consumption of 27- 30 kg which is four times the national average. The domestic market in Kerala is regulated not only by the purchasing power of the consumers but also by their taste and preferences. Competition between different buyers viz., local consumers, processors and exporters for fish is observed. It has been found that the domestic prices of some of the exportable species of fish viz., sardine, mackerel, squids, cuttle fish, pomfrets, seer fish and ribbon fish are found to be higher in the domestic market compared to the export market (Shyam, *et al.*,2013, *Seafood Export Journal*, 43 (5): 34-40; *Journal of the Marine Biological Association of India*, 55 (2):48-54). The exporters tend to export more to the international market due to the export economies of scale and realize revenue gains contributing by quantity effect rather than the price effect. While the exports lead to valuable earnings, the diversification of fish and fishery products from local communities may lead to questions of availability and affordability of fishes in domestic market. During the past three years dwindling fish landings across the Kerala coast against the soaring demand for fish have forced the state to rely upon other neighbouring states for its fish supplies. The valuation of the marine fish landed at the point of first sales during 2016 was provisionally estimated at ₹ 9753 crores registering an increase of 1.87 % compared to 2015. At the point of last sales (2016) it was provisionally estimated at ₹ 13062 crores registering a decrease of 10.78 % compared to 2015. Due to lower marine landings the unit prices rose by more than 35 % during 2015 compared to previous year. The marine fish landings in 2016 showed a marginal increase of 5% (4.82 lakh tonnes).The demand / supply estimate for fish in Kerala is furnished in Table 1.

Table 1. Total fish demand and anticipated supply assessed for Kerala

Year	2014	2015	2016	2020	2025	2030	2035
Population (in million)	33.89	34.06	34.15	34.91	35.78	36.68	37.6
Fish eaters (million)	28.81	28.95	30.74	31.42	32.20	33.01	33.84
Per capita annual fish consumption (kg)	29	30	30	30	32	34	35
Total fish demand (lakh tonnes)	8.35	8.69	9.22	9.43	10.30	11.22	11.84
Sector							
Marine fisheries (lakh tonnes)	5.76	4.82	5.02	5.87	5.95	5.92	5.86
Inland fisheries (lakh tonnes)	1.58	1.73	1.75	1.82	1.91	2.01	2.11
Total fish supply (lakh tonnes)	7.34	6.55	6.77	7.69	7.86	7.93	7.97
Export(lakh tonnes) @ 10%	0.73	0.75	0.75	0.77	0.79	0.79	0.8
Wastage(lakh tonnes) @ 2.5%	0.18	0.16	0.17	0.19	0.20	0.20	0.2
Bait industry @ 5 %	0.37	0.33	0.34	0.38	0.39	0.40	0.40
Total supply (lakh tonnes)	6.06	5.31	5.51	6.34	6.48	6.55	6.57
Demand – Supply Gap (lakh tonnes)	2.29	3.38	3.71	3.08	3.82	4.68	5.27

The demand- supply gap indicates that Kerala will be a net deficit state in terms of fish availability and will need to rely on fish arrivals / imports to the tune of 40 %. It has been found that based on the demand estimates an average of 2500 tonnes of fish is required for the daily consumption, of which the domestic supply caters to only 60 %, the rest. Around 1000 tonnes is to be sourced/ imported from other states/ countries. Barring sporadic import of Oman sardine during 2015 the entire fish demand is met by arrivals from others states. During 2016 the prices realized, registered a fall (15-20 %). The fish arrivals from the neighboring states were the major drivers which ensured stability in prices during the year 2016.The objectives of the study reported here was to assess the quantum of fish arrivals in Kerala and to determine fish arrivals across different species and states and their comparison alongside. This study has significance in the context of huge inflow of fish into Kerala and related apprehensions on its quality and checks.There are around 2500 fish markets in Kerala catering to fish business either as wholesale, retail, way side markets and terminal markets with several of them being seasonal , non-operational and with varying times and market functionaries .These markets are owned by individuals, private, corporation, societies and other agencies. Among them 60 markets are found to be major wholesale markets characterized by higher quantum of trade and supply to retail markets, export demand and limited retail sales during marketing hours. The information on the quantum of fish trade, species traded, arrivals from different states *vis-a-vis* species were collected from 20 wholesale markets

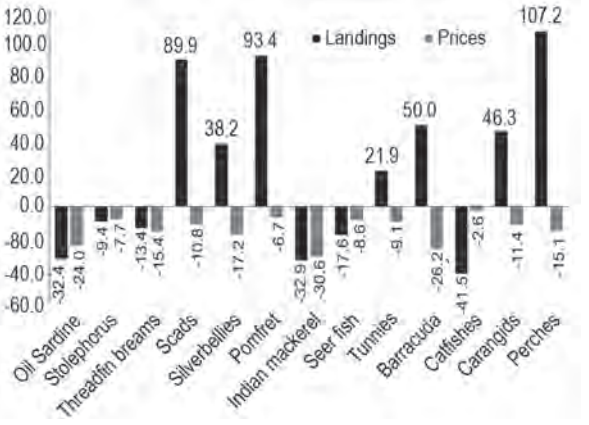

Fig. 1. The percentage change in the quantity landed and price realization of major fishes traded in 2015-2016 period

such as Pangode (Trivandrum), Neendakara (Kollam) Kodimatha, Ettumanoor (Kottayam), Kondotty, Kozhikode Central Market (Kozhikode), Tirur, Kuttippuram, Perinthalmanna, Manjeri, Ponnani, (Malappuram), Punnapra (Alappuzha) , Chambakkara, Muvattupuzha, Aluva, Perumbavoor (Ernakulam), Shakthan market (Thrissur), Payyanur, Kannur Central market (Kannur) and Kanhangad (Kasargod) that had considerable fish trade year round. The primary data was collected through personal interviews, phone calls and visits from

different whole sale markets across Kerala during the second week of February 2017.The percentage change in the quantity of fish landings and the price realization of major species traded in the state during 2015-16 is depicted in Figure 1.The prices realized during 2016 showed a decline for all the species and registered an average decrease of 14.6 % ranging from 30.6 (Indian mackerel) to 2.6% for cat fishes.

Price decline was also noticed for species which recorded increased landings during the period. The price demand relationship did not hold good for major species and highlights the fact that even if the domestic supply is less when compared to the demand, the demand supply gap is met from the fish arrivals coming from neighboring states that keeps the price fluctuations limited.The macro level analysis of the quantum of fish traded in the selected markets indicated that 1132 tonnes of fishes are traded daily in the domestic markets of which 40% were sourced from Kerala and 60% came from other states. Karnataka contributes the most followed by Andhra Pradesh and Tamil Nadu (21% each), Odisha and Gujarat (6% each) and Maharashtra (10%). It was found that the different states supply 23 fish species to Kerala for its trade and consumption. Among these, sardine the mainstay of the arrivals was nearly 256 tonnes constituting more than 37.48 % of the total arrivals. Sardine being the most preferred fish in Kerala and decline in supply by 32 % in 2016 contributed to the increased sardine arrivals from other states. The Indian mackerel which was the major contributor to the landings in the state in 2015 declined by 32% in 2016 and 15.11% of the mackerel demand (103 tonnes) was met by the arrivals from other states. Besides these species high value fishes like tunnies (15%), seer fishes (13%), perches (4%), pomfrets (3%), anchovy (3%), scads (2%), threadfin breams (1%), sail fish (1%), fresh water fishes (1%), rohu (1%), carangids (1%), *Catla* (0.89%) and other fishes arrived from various states.

The sardine which is the prime species in demand mainly arrives from Tamil Nadu (33%)followed by Karnataka (27%), Andhra Pradesh (16.3%), Maharashtra (13.9%) and Gujarat (9%). Mackerel comes from Tamil Nadu (30%) followed by Andhra Pradesh (29%), Karnataka (26%), Goa (14%) and Gujarat (1%). Tuna comes from Goa (29%), Andhra Pradesh (28%), Odisha (27%), Maharashta (7%), Karnataka (6%) and Tamil Nadu (3%). Seerfish comes from Karnataka (27%), Goa (23%), Andhra Pradesh (23%), Maharashtra (14%), Tamil Nadu (11%), Odisha (2%). Other perches arrive from Goa (53%), Tamil Nadu (21%), Gujarat (14%), Maharashtra (7%), Karnataka (4%), Andhra Pradesh (0.2%). Pomfrets arrive from Karnataka (49%), Goa (34%), Maharashtra (11%) and Tamil Nadu (7%). Anchovy arrivals are contributed by Gujarat (39%), Andhra Pradesh (30%), Maharashtra (23%) and Karnataka (8%). Scads are mainly from Goa (97%) and Maharashtra (3%) while threadfin breams arrive from Tamil Nadu (56%), Gujarat (25%) and Karnataka (19%). Sail fish comes entirely from Andhra Pradesh and fresh water fishes from Odisha (100%). Carps come from Odisha (68%), Karnataka (25%), Andhra Pradesh (52%) and Gujarat (5%). The non-traditional fish species like carps and fresh water fishes arrive probably for catering to the requirements of the migrant population in the state.

To summarize, the fish landings of Kerala registered a marginal increase of 4.9 % in 2016 over the last year , but the retail prices realized marked a significant decline (15-20 %). The state being the largest fish consumer and with widening fish demand supply gap has led to the increased arrivals of fish from neighboring states. The results indicated that 60 % of the current total fish demand is met through the arrivals from other states. Karnataka, Tamil Nadu, Andhra Pradesh and Goa together contribute 78 % of the total fish arrivals in the state. Among the different species, sardine ranked first (38 %) followed by mackerel (15 %), tuna (14 %) and seer fish (13 %). The rapid assessment was based on the data collected during pre monsoon season when the landings were quite low and the dependency rate from other states was comparatively higher. The fish demand supply estimates for Kerala strongly reveals that fish demand to the tune of 40-50 % is to be met with arrivals from other states. As fish landings are seasonal, often fishes are sold at very

low prices during post monsoon while during the times of shortage the retail prices soar exorbitantly. Therefore governmental intervention in fixing minimum support prices (benefit of fishers) and maximum ceiling price (benefit of consumers) would act as price stabilizing measures in ensuring better distribution across the value chain. The other major concern for the future would be to ensure quality checks for the sourced fish at appropriate entry points. It is also important to evolve alternate fisheries production systems including mariculture and inland fisheries for improving fish production in the state.

Automatic Identification System (AIS): An initiative in purse seine fisheries along Mumbai coast

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Automatic Identification System (AIS) is a significant development in navigation safety since the introduction of RADAR. It was originally developed as a collision avoidance tool for commercial vessels to improve the helmsman's information about his surrounding environment. AIS does this by continuously transmitting a vessels identity, position, speed and course along with other relevant information to all other AIS equipped vessels within range. Combined with a shore station, this system also offers port authorities and maritime safety bodies the ability to manage maritime traffic and reduce the hazards of marine navigation. Nowadays, it is used in fishing vessel for fishing gear operation, safety of vessel and identification of other vessels in the vicinity. AIS was made compulsory throughout the world in 2002 for all passenger ferries and vessels over 300 gross tonnes.

In Maharashtra mechanised crafts contribute significantly to the total fish landings. 228 purse seiners operate from Sassoon Dock Fishing Harbour of which 37 vessels are using AIS units purchased from Mayan Communication costing around ₹ 55000 per unit. The company has its own ground station and receiver at Mumbai and Ratnagiri. An AIS uses VHF radio and GPS technology to communicate with other ships nearby. An AIS transponder determines its own position, speed and course using a built in GPS receiver. This information is combined with other important navigation information and automatically communicated between AIS equipped vessels without any user interaction. AIS transponders on other vessels and coast stations receive this information and use it to build up a live graphical display of traffic in the area. The transponder can be connected to many types of chart plotter or PC charting software to give a RADAR type display of vessel positions. AIS does not require RADAR, but can offer similar capabilities and even enhance a RADAR image if RADAR has already been fitted to the vessel. The range or coverage of the system is similar to a VHF radio.

With FindShip, an android app available in google playstore or webpage (http://www.findship.co/) one can track movements of all type of vessels in real-time on the map. With the help of Vessel Name, Call sign, Maritime Mobile Service Identity (MMSI), International Maritime Organization (IMO) or Port name one can track the vessel, distance from shore and its activity. The benefits of AIS are thus

- "See and be seen". Combined with RADAR, AIS gives the best possible picture of the surroundings dynamic environment (moving vessels).
- The 12 nautical mile boundary at sea can be demarcated.
- Safety at night and in poor weather conditions.
- Safety in high traffic / commercial shipping areas.
- Position transmission to authorities / nearby vessels in case of emergency.
- Positively identify the identity of a target with name, callsign and MMSI number available – then easily establish VHF voice contact or initiate a Very High Frequency Digital Selective Calling (VHF DSC) call.

As per Maharashtra Fisheries Department notification MatsyaVi-1116/98/14 dated 5th July 2016, it is mandatory to install Vessel Tracking System (VTS) or AIS on all purse seiner operating beyond 12 nautical miles. The permission for the same should be taken from Ministry of Telecommunication, Wireless, Planning and Coordination Wing, Government of India. AIS installation should be done from agencies identified by the Central Government. After installation they have to set electronic fencing for marine boundaries as mentioned in Marine Fisheries Regulation Act of Maharashtra.

Fishermen have given a positive feedback about AIS as they can find and inform nearby fishermen in case of abundant catch. AIS will be also be useful for fisheries management agencies to track and keep a record of the number of fishing vessels at sea.

Giant sized rays landed at Cochin Fisheries Harbour

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On 4th March 2017, three huge rays - two *Mobula tarpacana* and one *Manta birostris* were landed at Cochin Fisheries Harbour. They were caught in long lines, which were operated for skipjack tuna. These rays caught off Ratnagiri coast at a depth of 500m weighed around 400 kg each. Of these, *Mobula tarpacana* locally called '*Kakkathirandi*' measured 2.4 m in disc width (DW). Since the rays were too big to be put into the fish hold they were cut into 3 pieces and iced. Of the two mobulids, one was a female and the other a male. The fishes were auctioned at ₹ 15000 for the central piece which included the gill rakers or flowers, and ₹ 9000 for the fins. Meat generally fetched only ₹ 18-20 per kg while the flowers locally called 'white' fetched a higher price. *Mobula tarpacana* is one the largest of the genus *Mobula*, reaching 37 cm in disc width. They are slow-growing, large-bodied migratory, planktivorous animals with small, highly fragmented populations distributed across the tropical and temperate oceans of the world. Their biological and behavioural characteristics (low reproductive rates, late maturity and schooling behaviour) make these species particularly vulnerable to over-exploitation in fisheries and extremely slow to recover from depletion. They are protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Morphometric measurements of the *Mobula tarpacana* landed at Cochin Fisheries Harbour are listed below

Disc width	2.4 m
Horn length	40 mm
Mouth Width	39 mm
Fin length	127cm

Inter gill distance	
I-I gill distance	29 cm
II-II gill distance	27 cm
III-III gill distance	21 cm
IV-IV gill distance	17 cm
V-V gill distance	13 cm

Giant manta ray (*Manta birostris)* caught weighed around 250 kg. Measurements were impossible since the fish was cut to be stored in the fish hold. Widely distributed throughout the world's major oceans, this species has a high value in international trade. The rate of population reduction appears to be high in several regions.

The giant manta ray and the Chilean devil ray are listed as Vulnerable on the IUCN Red List (http://www.iucnredlist.org). Giant mantas are also included in the Appendix II rendering trade of the products from these species traceable. India being a party to CITES, documentation of landings of *Manta* or *Mobula* rays is very important for the conservation of this resource.

Cut giant manta ray

In recent years, manta ray fishing has expanded in many places throughout their range, primarily in response to the emerging international market for their gill plates (Nair *et al*. 2016 *Indian Journal of Geo-Marine Sciences*, 44 (9):1265-1283). Given the slow growth and very low fecundity for these species, it is imperative to estimate available fishing stock from Indian waters.

Note on the unusual landings of *Amblygaster sirm* off Vizhinjam coast

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Unusual landings of the clupeid *Amblygaster sirm* (spotted sardinella), was noticed during the October – December 2016 along the Vizhinjam coast. Locally known as Keerichala, regular landings of *A. sirm* was observed in all the major landing centres along the Thiruvananthapuram coast like Mampally, Anjengo, Perumathura, Thazhampally, Marianad, Valiyathura, Poonthura etc. Chalavala, Thattumadi (boat siene) and ring siene were the major gears used for the fishery. The fishery was supported by juveniles and adults whose average size ranged from 16.5 cm to 21.8 cm in total length (TL). The gonadal examination revealed that most of the fishes were in maturing and fully matured condition. Highly perishable but fresh catch of *A. sirm* fetched a price range of ₹ 70-110 per kg in domestic market while the damaged ones were taken for feed industry at the rate of about ₹ 300 per basket of approximately 30 kg each. Fishermen from the landing centres like Thazhampally and Perumathura, mostly operated ring seines with the average catch of the species per day around 600 kg. The boat seine operations

got an average catch of 300-350 kg per day. Only small quantities of this species were reported earlier from this coast. But in 2016 in certain landing centres, catch up to 1.6 tonnes per boat per day was recorded. The fishery of *A. sirm* along the south of Kerala coast is seasonal and occurs during the post monsoon months. The catch comprised of several species of clupeids among which 30–40% was constituted by *A.sirm*.

Ring seines were normally single day operations commencing at 04.00 am. Usually two or three carrier boats were associated with ring seine operations to land the catch without much quality loss. The mother boats with an overall length of 14-16m length with 90 HP outboard motor of 20 m OAL with 280 HP inboard engine on an average had 24 and 36 crew members respectively.

Local fishermen opined that, this is the first time such a profuse quantity of *A. sirm* is being along with consistently landed here a decline in the oil sardine (*Sardinella longiceps*) landings during this season. The local fish-sellers opined that, due to the non-availability of oil sardine, consumers who specifically preferred small fresh fishes chose *A. sirm* due to the fresh condition of the fish landed.

Observations on a bumper catch of oil sardine by *Rampan* nets in Goa

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During the past decade *Sardinella longiceps* has contributed about 30 to 50% of the total fish catch along the Goa coast. The annual oil sardine landings in Goa during the year 2015 and 2016 was 16,212 and 24951 tons (t) respectively. There are 20 landing centres on the South Goa district and 14 landing centres in the North Goa district. At Pale Landing Centre (15^0 22" 017' N 073^0 52" 552' E) fishing 20 shoreseine (*Rampan*) units are engaged in fishing. On 28th February 2017, unusual bumper catch of *S. longiceps* in *Rampan* net was observed here. On 27th February 2017 information about a huge shoal of oil sardine received by a mini-purseiner was passed on to the *rampani* owners also. The operation of the *rampani* net (mesh size 14 mm) at a depth of 5-6 meters was started immediately at 1700 hrs which continued upto 2100 hrs. The heavy catch remained in the net which was kept in the sea by tying the both end ropes of the net to nearby trees on the shore. Next day the dragging of the net was started early with 32 fishers engaged. Since the catch was very heavy, another 15 fishers were additionally employed for the harvest. The catch was brought to shore using scoop nets and by 0530 hrs, totally 8 t of oil sardine was harvested and marketed locally at the rate of ₹ 30-35 per kg. The activity was continued employing another additional group of 25 labourers and a total of 68 tons was harvested. The entire catch packed in plastic tubs with ice were loaded in trucks and transported to fish meal plants at Goa at the rate of ₹ 15-20 per kg.

The *rampan* catch consisted of oil sardine along with stray numbers of mackerel and jelly fishes. The oil sardine catch analysed indicated size range of 121-183 mm with a modal length of 130 mm and an average weight of 22 gms. Most of the fishes were immature (71%), 10% were mature and 19% had spent gonads. The sex ratio (male: female) was 1: 1.36. The gut content contained phytoplankton (*Tintinnopsis sp., Coscinodiscus sp., Biddulphia sp.*) and partially digested copepods.

Plesionika reflexa - a new record of deep-sea caridean shrimp from the south-west coast of India

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Plesionika reflexa, Chace, 1985 (Decapoda: Pandalidae) was recorded from the catch of deep sea shrimp trawlers operated at a depth of 200-300 m off Sakthikulangara (8°56'60.78"N / 76°32' 34.27"E), Kollam south-west coast of India. The ovigerous female [Carapace length (CL): 15mm; Rostrum length (RL): 28mm] was reddish in colour with dark red ring formation in posterior abdomen. The telson was found damaged. The eggs were spherical in shape with pale green colour. Voucher specimen was deposited in the National Designated Repository, ICAR-CMFRI, Kochi with Accession Number ED2.4.3.8.

Voucher speciment of *Plesionika reflexa*

The morphometric characters recorded were as follows: Rostrum extending beyond the antennal scale, dorsally armed with 6 teeth, including 3 on carapace posterior to level of orbital margin, armed ventrally with 35 teeth; abdomen with strong, recurved posteromesial tooth but without median dorsal carina on 3rd somite, 4th somite with pleuron rounded, 3rd maxilliped with epipod; pereopods with well-developed epipods on anterior pairs, 2nd pair sub equal, 3rd pair extending beyond the antennal scale by a length of dactylus, none of pereopods are extremely slender or thread like. This species is closely related to *Plesionika ensis* (A.Milne-Edwards, 1881). In *Plesionika reflexa*, the posteromesial tooth on the third abdominal somite shows a tendency to recurve, whereas same has not been noticed in *P.ensis*.

Report of dorsal fin abnormality in silver pomfret

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During a routine sampling for silver pomfret *Pampus argenteus*, specimens with dorsal fin abnormality were collected from Ratnagiri and Mumbai, Maharashtra. On 29th April, 2016 a single silver pomfret with deformed dorsal region and a deep pit in the dorsal region was observed in the purse seine landings at Mirkarwada fish landing centre, Ratnagiri (Fig. 1). On 29th May, 2016 another abnormal deformed specimen was collected from the trawl landings at New Ferry Wharf, Mumbai

Fig. 1. Deformed *Pampus argenteus* from Mirkarwada, Ratnagiri

(Fig. 2 & 3). Dorsal region of the fish was deformed being thicker compared to other parts. The female specimen measuring 210 mm in Fork Length (FL), weighed 313 g. Gut contained semi digested prawns and plastic. X-ray revealed that entire pterygiophores supporting the dorsal fin were absent and vertebral spines below the deformed area were curved. The lack/deformity of dorsal fin rays whether it is partial or complete is known as 'saddleback syndrome' (SBS). Although rare in marine fauna, the causes for deformed marine fish are

Fig. 2. Anterior portion of the dorsal fin absent in silver pomfret from Mumbai

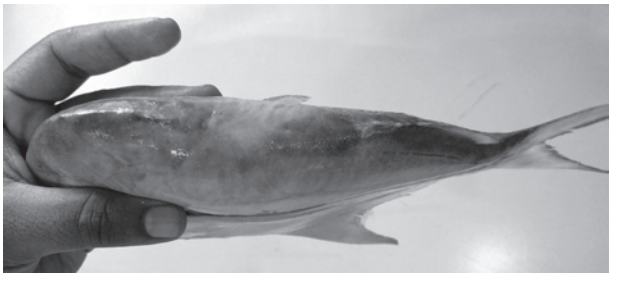

Fig. 3. Deformed dorsal profile

attributed mostly to adverse environmental conditions, pollution, stress in larval stage, attack by predators and physical injuries, besides mutation.

Indigenous FAD based fish culture system in open creeks of Krishna and West Godavari districts of Andhra Pradesh

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Fish aggregating devices (FAD) are natural or artificial objects of permanent or temporary nature that are used to lure the fish. When installed in water bodies they attract and aggregate the fishes as they can be used for the purpose of shade, shelter, food and breeding ground by the fishes. Traditional FAD systems have been used by the fishermen all over the world to to facilitate easy harvest of fishes. Materials like tree branches, bamboo shoots with aquatic weeds etc, are commonly used in shallow areas of creeks and backwaters to attract and aggregate the fishes and it is variously known as acadja fishery in West Africa, *Samarahs* in Cambodia, *Katha* in Bangladesh and *Padal* fishing in southern India.

View of battery of FADs

Krishna and West Godavari districts in Andhra Pradesh have vast areas of water bodies with diverse fish fauna. Different kinds of traditional fish culture and fish harvest methods are being practised in most of these creeks. One such indigenous fish aggregating device based activity is popularly called as "Gudu fishing". The FAD is prepared with the dried branches of mesquite bean tree (*Prosopis juliflora*), tamarind tree and mangrove plants. There are artificially planted in shallow areas along the periphery of the creeks. Generally, square shaped FAD system is prepared with a size ranging from 5 to 30 m and 1 to 1.5 m in height. Most of the brackish water creeks available in these districts are controlled by the adjacent fishing villages. Accordingly, a stretch of 2 - 3 km in length of the creek is marked and allotted to the particular fishing village and all major fishing activities in that particular stretch is managed by the respective villagers. Indigenous FAD based fish culture is one of the major activities apart from regular fishing using cast nets and small drag nets in these water bodies. Permission for carrying out this fish culture method is based on auctioning for a period of one year. The funds generated through the auction are used for the welfare of the villages. A group of 6-15 fishermen carry out the activities within the respective places allotted for the particular village in the creek.

Encircling the FAD before harvest

Around 10-20 numbers of FADs are installed within the 2-3 km stretch. Different species of fishes get attracted and are allowed to remain for 1 to 2 months and then harvested. The FADs are harvested one by one subsequently during the low tide period. At harvest, entire area is encircled by a net, erected with the help of poles. After entire area is encircled the branches are slowly removed and the fishes harvested using drag nets, cast nets and scoop nets. While collecting fishes, the juvenile fishes which do not have any market value are released back. The removed branches are dried and reused depending on their condition. This kind of aquaculture is repeated for 3-4 times in a year. The species harvested are mainly mullets, milk fish, sea bass, pearl spot, catfishes and different varieties of shrimps. Mullets are available in all the seasons and milk fish availability is higher during June and July. Seabass catch is high during August to December months. However, small quantities of all the species are available in all times. The quantity of the fish harvest varies according to the size of the *Gudu* system. Generally, mixed composition of small quantities (25-40 kg) of each mentioned species are harvested from the system. These small quantities are directly sold in the market by the fishers themselves. But, if large quantity of any single species are caught they are sold through local market intermediaries. Generally, average income generation from a single FAD varies from ₹ 15,000-30,000 per crop and occassionally even more than ₹ one lakh per crop. This system provides an additional income source to the local fishermen fishing in the brackishwater areas.

Necropsy findings and observations on marine mammals stranded in Gulf of Mannar coast

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A dead female dolphin was washed ashore on 19 April 2016 at Singhivalaikuchu, near Vedhalai, Ramanathapuram district, Tamil Nadu along the coast of Gulf of Mannar (N.09.260700; E.79.084858). Based on morphological features and teeth pattern, the specimen was identified as Indo-pacific bottlenose dolphin, *Tursiops aduncus*. A total of 26 morphometric parameters were recorded and given in the Table 1.

Table 1. Morphometric measurements of the Indo-pacific bottlenose dolphin

Morphometric	Measurement (cm)
Length, snout to melon	15
Length, snout to angle of mouth	32
Length, snout to blowhole	45
Length, snout to center of eye	39
Length, snout to anterior insertion of dorsal fin	84
Length, snout to tip of dorsal fin	96
Length, snout to fluke notch (total length)	210
Length, snout to anterior insertion of flipper	53
Length, snout to center of umbilicus	105
Length, snout to center of genital aperture	135
Length, snout to center of anus	150
Length, notch of flukes to center of anus	65
Length of flipper: anterior insertion to tip	35
Length of flipper: axilla to tip	25
Width of flipper: Maximum	15
Fluke span	40
Width of flukes	18
Height of dorsal fin	28
Width of dorsal fin	20
Base of dorsal fin	46
Girth: axillary	96
Girth: maximum (at anterior insertion of dorsal fin)	108
Girth: at level of anus	68
Blubber thickness: ventral	5
Total number of teeth on one side of upper jaw	25
Total number of teeth on one side of lower jaw	24

The specimen had relatively robust body with relatively longer and slender beak and a tall falcate dorsal fin. The melon was slightly convex and the flippers were typically curved with acutely rounded tips. The dorsal fin was tall and relatively more wide-based. The colour pattern could not be studied as most part of its skin had sloughed off. The total number of teeth in each half of the upper jaw was 25 and of the lower jaw was 24.

On 19 April 2016, a dead female sea cow (*Dugong dugon*) measuring more than two meters of total length was stranded along the Gulf of Mannar coast at Pudhumadam, Ramanathapuram district, Tamil Nadu (09.273203 N; 78.988599 E). The morphometric parameters recorded are given (Table 2.)

Table 2. Morphometric measurements of the sea cow washed ashore

Morphometric parameters	Measurement (cm)
Tip of snout to fluke notch	227
Tip of snout to center of anus	180
Tip of snout center of genital aperture	174
Tip of snout to center of umbilicus	140
Tip of snout to anterior insertion of flipper	62
Tip of snout to center of eye	35

Tip of snout to external ear	44
Center of eye to ear	10
Distance between centers of eyes	33
Center of eye to center of nostril (same side)	15
Flipper length, anterior insertion to tip	47
Flipper length, axilla to tip	33
Maximum width of flipper	20
Girth at umbilicus	150
Girth at axilla	138
Length, Muzzle	24
Breadth, Muzzle	22
Length, Chin	13
Breadth, Chin	15
Sex	Female
Weight (approximate)	250 kg

The necropsy was performed on the same day. There were no significant external injuries or lesions except few abrasions and sloughed off patches of skin which might be due to physical damage after death. The actual cause of death could not be determined as most of the internal organs were in advanced stage of decomposition.

Observations on the flesh-footed shearwater

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A dead specimen of the flesh- footed shearwater *Ardenna carneipes* (Gould, 1844) was collected on 21.07.2017 from Paravoor beach, Alappuzha district, Kerala. The bird had a total length of 40 cm (bill tip to tail tip) and a wingspan of 86 cm. The specimen was deposited in the National Designated Repository, ICAR- CMFRI, Kochi under the Accession No. Misc.36. The bird is distinguished from other shearwaters in this area, namely, the Persian shearwater, Audubon's shearwater, Sooty shearwater, Wedge-tailed shearwater, Short-tailed shearwater and Streaked shearwater by its pale bill with distinct black tips. It also has darker underwings and a shorter rounded tail as compared to other shearwaters of the region. Its flight is described as "a stiff-winged glide interspersed with slow lazy flaps" (Kazmierczak, 2015, *A field guide to the birds of the Indian Subcontinent*, p.34). Flesh footed shearwater are currently classified under the Near Threaterned category by (IUCN). During its non- breeding period it ranges over vast distances in the north Pacific and west to the Indian Ocean up to South Africa (Reid *et al., 2013. Biological Conservation 166:3-10*). The specimen obtained appears to be one such passage migrant. All sightings in Kerala are limited to the months March to October (*http://ebird.org/ebird/view/checklist)*. This bird is perhaps common in the Arabian sea during its non- breeding season. More pelagic surveys are required to determine its pattern of distribution. On enquiry with the fishers it was learnt that a flock of these birds were present offshore during the period.

Plastic reinforced fiberglass- an addition to beach litter

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Beach litter or beach debris are solid wastes discarded intentionally by human beings or unintentionally either through land runoff or by waves. Marine litter is anthropogenic waste that has been released in water bodies or on land. Beach litter can become part of marine litter and *vice versa* due to water, wind and wave action. Among the beach litters 40-43% are formed by plastic litters which never get biodegraded but are progressively fragmented into tiny pieces called microplastics. These microplastics are even found inside the gut of filter feeding animals. Marine mammals and turtles are also killed by plastic litter every year. Nylon ropes, strings, net pieces, plastic carry bags, pet bottles, sachets and wrappers of oil and food items, ice cream containers, plastic spoons, glass bottles, parts of toys, CDs, chargers of mobile phones, electric bulbs, styrene plates and cups, insulating foam pieces, thermocole floats etc are the commonly seen litter items on our beaches. Recently sheets of fiberglass coated with epoxy polyester resin detached from a salvaged fiber canoe piled up in Arthungal beach, Alappuzha District of Kerala was observed. A few more fibreglass canoes to be salvaged were also seen at this beach. Fibreglass crafts are coated with glass fibers reinforced with plastic matrix most often Epoxy Polyester Resin or Vinylester through thermosetting. They are preferred over wooden crafts due to higher durability, added strength and protection from corrosion and biofouling.

As per the Kerala Marine Fishery Statistics-2013, there were 25542 motorised fishing vessels in Kerala. Of this, several Fibre crafts fitted with outboard engines are registered with the Department of Fisheries, Government of Kerala. Salvaging of these

condemned crafts occur on beaches itself as there are no exclusive salvaging yards in India. One such canoe can shed 25- 30 kg of fiberglass debris. Over a period of time these crafts can generate tremendous quantities of fibreglass with plastic matrix which will be deposited in the beaches of Kerala. Plastic reinforced fibreglass is considered as human carcinogen if inhaled. If proper disposal mechanisms are not observed, these materials can reach levels above 5-15 mg/m^3 and become hazardous causing irritation to eyes, skin, nose and throat. From the beaches these tiny particles of glass fibre coated with plastic resin can also enter the marine food web which is undesirable.

Whale shark recorded from Ponnani

A whale shark *Rhincodon typus* measuring 4.5 m in total length and weighing around 1.5 tons was observed in the Ponnani Fishing Harbour on 3rd November 2016. The fish had no injuries and was reportedly accidentally entangled in a floating drift gill net operated off Ponnani. The dead shark was later buried on the beach itself.

Reported by: P.Ansar, Calicut Research Centre of ICAR-Central Marine Fisheries Research Institute.

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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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