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Marine Fisheries Information Service

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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.....

The beginning of the last quarter of the year 2013 saw the monsoon ban on fishing coming to a close and the resumption of fishing activities. This was reflected in the varied and bountiful fish catches recorded from the various fishing harbours and landing centres all along the coast. The varied biodiversity in the fish landings has been recorded in several instances, which can indicate normal species distribution and occurrence range of fish, crustaceans and sharks in the marine ecosystems for any future studies. The targeted fishery for elasmobranch resources and the trade associated with these resources have been documented which also highlights the need for sustainable exploitation. The bane of discarded plastic is as menacing in the marine ecosystem as on the land as reports appearing in this issue highlight. Knowledge on behavior and adaptations of marine species in relation to climate change are important for forming informed management decisions and are presented in the case of mussel which is an important resource in capture as well as mariculture sectors. The all India Marine Fisheries Census undertaken by CMFRI during 2005 and 2010 was a gigantic task which data forms the backbone for basing important decisions and choices regarding development projects for the fisheries sectors, fisheries policy etc. and such an analysis done for Tamil Nadu is presented in this issue.

It is hoped that pro-active approaches which includes studies on species of mariculture potential, marine environment and flagging important issues that have bearing on the management and utilization of various fishery resources shall make a difference in the long run and ensure a sustainable marine fisheries sector in the country. For this a vigilant and active research community should work hand in hand with other stakeholders.

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CONTENTS

New records of *Champsodon nudivittis* and *Champsodon snyderi* (Fam: Champsodontidae) from the Indian EEZ

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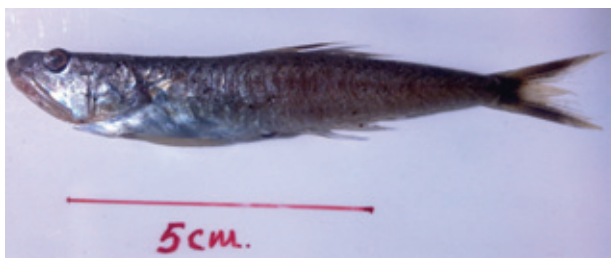
Champsodon genus belonging to the family Champsodontidae are constituted by bottom dwelling fishes at great depths (400 – 1000 m) in the oceans and are commonly referred to as gapers. These are characterized by a large head and mouth, an elongate compressed body densely covered with small denticulate scales, pre-opercle with a prominent postero-ventral spine bearing small serrations on the ventral side, a short spinous dorsal fin, small pectoral fins, unusually large pelvic fins and a complex acoustic-lateralis system that consists of two horizontal lateral lines interconnected by vertical rows of sensory papillae. The scale patterns on the chin, breast and abdomen regions; the vertebral structure especially in the caudal region, the arrangement of dorsal sensory papillae on the head, patterns of scales between the two horizontal lateral lines and the gill raker counts are the most important characters used to differentiate among the thirteen species currently valid, which is given in the taxonomic revision of the family by Nemeth (1994). The specimens of *C. nudivittis* and *C. snyderi* were obtained during an exploratory deep-water survey conducted on-board FORV *Sagar Sampada* (cruise 313) by using an EXPO model trawl net at a depth of 282 – 393 m in the northeast Arabian Sea (19^0 – 21^0 N latitudes). These are first records of the two species in the western Indian Ocean as they have been reported from the Indo-Pacific region only previously. The distinguishing characters of the two species were as follows:



Champsodon nudivittis

C. nudivittis (Ogliby 1895): Chin and belly area naked, area between pectoral and pelvic fin bases naked, breast with only a small central patch of scales, naked chin spotted with small melanophores, maxilla extending beyond posterior margin of eye; five to eight sensory papillae between the parallel bony ridges on dorsal surface of the head extending from snout to inter-orbital. The vertical rows of sensory papillae between the two horizontal lateral lines are not closely surrounded by scales.

C. snyderi Franz (1910). Chin and belly area naked, triangular patch of scales between pectoral and pelvic fin bases, breast fully scaled, four to seven sensory papillae between the parallel bony ridges on dorsal surface of the head extending from snout to inter-orbital, each row often with unequal numbers. The vertical rows of sensory papillae between the two horizontal lateral lines are not closely surrounded by scales.

The species reported to occur in the Indian Ocean (FAO Fishing Areas 51 and 57) are *C.capensis*, *C.omanensis*, *C.pantolepis*, *C.sagittus* and *C.sechellensis* while *C. nudivittis* and *C.snyderi* reported above are occurring in the Indo-Pacific region. Among the two species recorded from the exploratory survey in the north-east Arabian Sea, *C.snyderi* has been earlier reported only from the seas off Japan and Australia while *C. nudivittis* occurs in seas off Madgascar, Phillippines, Indonesia and Australia and has recently been reported from the Red Sea as well as the Mediterranean Sea. The

Champsodon snyderi

observations from exploratory survey indicate an extended distribution for *C. nudivittis* in the north eastern Arabian sea which is a part of the Indian Ocean region. Oceanographic studies have indicated that there is mixing of the Indian Equatorial water mass found between the 200 -2000 m depth zone with Red Sea water resulting in the formation of a unique intermediate deep-water mass in the Arabian Sea. In recent years several fishes found in the Red Sea have also been reported from the west coast of India as range extensions. The spurt in off-shore fishing activities has resulted in several hitherto locally unrecorded species becoming available in the fish landings and adding to the documentations on the fish diversity of the region.

The size range of the specimens of *C.nudivittis* was 55 - 105 mm with the 75 – 85 mm size group dominating. Females outnumbered males with a ratio of 3: 1 and gonads were found to be in early stages of maturation by the time they reached a size of 60 mm in total length. The Length at first maturity (L_m) in females, when 50% of the numbers assessed have gonads in ripe condition, was estimated to be 70 mm. Very little information on the biology of the champsodontids is available as indicated in FishBase. They are reported to occur in large shoals and exhibit vertical migration. *Champsodon* species do not form target fisheries but are probably important in the food web dynamics of the extended benthic - mesopelagic realm, as they exhibit diurnal vertical migration patterns and therefore are available either as prey or predator in this realm, at any point of time. Several commercially important fishes including the bregmacerotid fishes, pandalid and sergestid shrimps were recorded in the guts of *C. nudivittis* during the present study indicating their importance as predators in the marine ecosystem. Thereby their possible role as one of the regulators of the natural mortality rate and recruitment variations of these commercially important fishes from the north west coast of India is also highlighted.

Occurrence of a rare species of red crab, *Ranina ranina* (Linnaeus 1758) along Chennai coast

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The red frog crab otherwise called spanner crab is a coastal water species and single representative of genus *Ranina* under family Raninidea. They prefer to inhabit in bare sandy areas of intertidal and coastal waters of more than 100m depth. Distribution of this crab is confined to tropical and sub topical coastal waters of Indian and Pacific oceans, from the coast of South Africa to Hawaii and the Great Barrier Reef. Occurrence of this species is very sparse in Indian waters and has been recorded once in Gulf of Mannar (Kasinathan *et al.*, 2007).

The present specimen was a female specimen collected on 14.09.2013 from Pulicat landing centre, north of Chennai coast (Fig. 1). It was caught in bottom set gillnet operated at 15-25m depth, 40 km, away from the barrier island of Sriharikota, north of Chennai coast. The carapace width was 9.0 cm and weight 285g. Morphometric details of the present specimen are given Table 1. Carapace completely covered by low rounded scale like spines in large or small numbers, are broader anteriorly. The eye stalks set vertical and longer. Body colour

Dorsal view Ventral view

is reddish brown with about 10 white spots on anterior part of carapace. They aggregate to spawn during the warmer months and mate at any stage in the mould cycle (Brown, 1986). This species form exclusive fishery and are largely exploited for its edible value in Australia. In India, there is commercial value for this species but are less encountered in fisheries.

Table 1. Morphometric measurements of *Ranina ranina*

Characters	Measurements (mm)
Carapace length	: 105
Carapace width	: 90
Abdomen length	: 57
Abdomen width	: 42
Weight	: 285 g
Sex	: female
Carapace spines	: 21 nos
White spot on the anterior Side of the carapace	: 10 nos
Colour	: Reddish brown
Colour of egg	: Orange

Occurrence of pelagic thresher shark, *Alopias pelagicus* Nakamura, 1935 from Porbandar, Gujarat

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On 28th November, 2013 a single male specimen of *Alopias pelagicus* (pelagic thresher shark) measuring 160 cm length and weighing 7.178 kg was landed at Veraval fishing harbor by a multiday gill netter in the morning 7 o' clock. The shark belonging to the family Alopidae is named as 'Pakistani shark' by the local fishermen to gain good market price. The species is known to be distributed in many of the tropical and temperate waters. The information on the fishing ground collected from the fishermen indicated that the fishes were caught in the waters of Porbandar (21^0 39' 68''N and 68^0 17' 76'' E) in front of Harisiddhi mata temple (Fig. 1) nearly at a depth of 110 m by the multiday gillnetter of mesh size 140 mm. The specimen was brought to the laboratory, photographed and the species identification was confirmed following Compagno (1984).

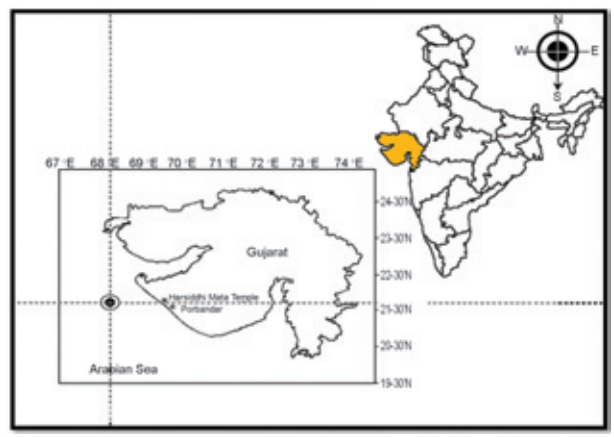

Fig. 1. Location of the catch of *A. pelagicus* in Gujarat

A. pelagicus (Fig. 2) belonging to the family Alopidae is the smallest thresher shark with moderately large eyes, but not extending to the surface of the head. Pectoral fins are long having

Fig. 2. Male specimen of *A. pelagicus*

nearly straight anterior margin and broadly rounded tips. The first dorsal fin origin is much closure to the pectoral fin. Both second dorsal and anal are very small. The upper lobe of the caudal fin is very long than lower. Snout is moderately long and conical. Mouth is semicircular (Fig. 3) without labial furrow. The teeth are small with a single, oblique, smooth-edged cusp (Fig. 4). The species is deep blue colour dorsally with sides silvery and whitish ventrally. The detailed morphometric measurements have been given in table 1. Teeth count of the specimen was done and the dental formula was calculated as 38/30. Upon dissection, the weight of liver was found to be 155 g and the stomach content analysis showed that the total stomach was full with a weight 257 gm (124 ml). The shark was a maturing male.

Fig. 3. Mouth of *A. pelagicus*

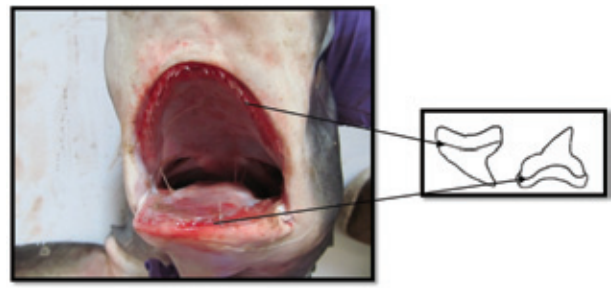

Fig. 4. Upper and Lower teeth pattern of male *A.pelagicus*

Table 1. Morphometric and meristic characters of Pelagic thresher shark

Characters	Measurements (cm)	Percentage to the total length
Total length	160	100
Fork length	83.5	52.18
Head length upto 1st gill slit	21	13.12
Snout length	7.2	4.5
Pre first dorsal	42	26.25
Pre second dorsal	70.5	44.06
Pre pectoral	26	16.25
Pre pelvic	58	36.25
Pre anal	72.5	45.31
Pre caudal	78	48.75
Pre nasal	5	3.12
Inter nasal	2.3	2.3
Pre orbital	7.3	7.3
Eye diameter	2.8	1.75
Mouth length	3	1.87
Mouth width	5.4	3.37
Body depth	21.5	13.43
Height of 1st dorsal	9.5	5.93
Base of 1st dorsal	8	5
Height of 2nd dorsal	1.2	0.75
Base of 2nd dorsal	0.8	0.5
Height of pectoral	22.5	14.06
Base of pectoral	9.5	5.93
Height of pelvic	7.7	4.81
Base of pelvic	7	4.37
Height of anal	1.4	0.87
Base of anal	0.9	0.56
Caudal length (lower lobe)	81.6	51
Clasper length	6.7	4.18
Testes length	18	11.25
Height of 1st gill slit	5.5	3.43
Height of 2nd gill slit	5.5	3.43
Height of 3rd gill slit	5	3.12
Height of 4th gill slit	4.3	2.68
Height of 5th gill slit	3.3	2.06
Teeth count (Upper jaw)	38	
Teeth count (lower jaw)	30	

Pelagic threshers are oceanic epipelagic and highly migratory species. The landing of thresher sharks has considerably decreased in Gujarat during the last 10 years. Raje (2003) reported that, in Gujarat the elasmobranchs which require protection are the tiger shark (*Galeocerdo cuvieri*), hammer-headed sharks (*Eusphyra blochii*, *Sphyrna lewini*, *S. mokarran*), thresher sharks (*Alopias vulpinis, A. pelagicus*), all species of the genus *Pristis*, the skates *Rhynchobatus djiddensis* and *R. halavi*; and rays such as *Mobula diabolus* and *Manta birostris*. The one time occurrence of the pelagic thresher shark in last three years throws some light on its declining population along the Gujarat coast. Currently the shark is assessed as "vulnerable" by IUCN (2013).

Record of a rare Sharp-tail sunfish, *Masturus lanceolatus* Liénard, 1840 (Tetraodontiformes: Molidae) landing from South-west coast of India

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The family Molidae comprises epipelagic fish commonly known as molas or ocean sunfish, which are distributed in warm, tropical waters in all the oceans (Matsuura, 2002). Among the sunfishes described, *Masturus lanceolatus* is considered rare on the Indian coast. Four species described in this family are:*Ranzania laevis* (Pennant 1776), *Mola mola* (Linnaeus 1758), *Masturus lanceolatus* (Liénard 1840) and *Mola ramsayi* (Giglioli 1883), which is restricted to the southern hemisphere (Parenti 2003; Bass *et al.*, 2005). *M. lanceolatus*, commonly known as the sharptail mola, has broad distribution in the western Atlantic, occurring from Nova Scotia to south-eastern Brazil.

Morphometric measurements for the collected could not be taken before the fish was cut. Measurements for the *M. lanceolatus* were taken directly in the field before the fish was cut and auctioned to retailers. Based on the available information and literature, the species was identified as *Masturus lanceolatus*. The species was caught at a depth of 100 m in a drift gill net operated on the Southwest coast.

Body deep, highly compressed, ovate, depth 1.3 in SL. Dorsal profile of head sloped; eyes moderate, diameter 17.2 in SL; mouth small with fused teeth; snout length 5.5 in SL; dorsal and anal fins similar in shape, placed posteriorly on body just before caudal fin origin, lengths 2.1 and 2.5 in SL respectively. Caudal fin tapering gradually, fleshy, pointed tail, length 2.6 in SL. Skin very thick and leathery with small denticles. Colour uniform grey with pale blotches. Gill openings very small, in front of pectoral fins. The morphometric details are given in Table 1.The present record is from the south west coastoff Cochin and is the second largest specimen recorded from India recorded after a gap of 59 years from the west coast of India. Though Bandana et al.(2012) reports that the fish has no market value in Parangipettai, Tamilnadu, the fish was cut (Fig.1) as soon as it was landed in Cochin Fisheries Harbour showing the economic importance of the species.

Table 1. Morphometric measurements of M. lanceolatus Liénard 1840

Characters	(in mm)
Total length	1705
Standard length	1205
Body depth	890
Eye diameter	70
Snout length	220
Dorsal fin length	570
Anal fin length	480
Caudal fin length at pointed tip	460

On the occurrence of a serranid fish, *Sacura boulengeri* (Heemstra, 1973) at Veraval, Gujarat

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On 28th October, 2013, a single specimen of *Sacura boulengeri* (locally known as 'Vekhli') belonging to the family Serranidae was collected from Veraval landing centre. The family serranidae, comprises of three subfamily Serraninae, Epinephelinae and Anthiinae. Fishes belonging to Anthiine are beautifully colored that inhabit coral and deep-reef habitats in tropical and warm temperate seas, and some of these species are taxonomically confusing. Many Anthiine fishes are very few in collection because of their rarity. The genus Sacura is comprised of 4 species: *Sacura boulengeri (Heemstra, 1973),S. speciosa, S. parva* (Heemstra and Randall, 1979) and *S.margaritacea* (Hilgendorf, 1879). *Sacura boulengeri* belongs to Anthiinae is small fish having a maximum recorded size 19.0 cm (Randall, J. E., 1995). It is not a commercially important species and landed as by-catch.

The information on the catch area and the depth of operation of the vessel was collected from the fishermen. It was caught by a multiday trawler (45 ft) from a depth of 80–100 m. The fish was 162 mm in length weighing 40 g. Morphometric and meristic counts have been made as per the method prescribed by Hubbs and Lagler (1949). The GPS location (22^0 17' 59'' N, 68^0 07' 92''E) collected from the fishermen confirms that the species has caught from the waters off Dwarka. The morphological and meristic characters of the current specimen was also compared with the earlier records from Indian water and given in table 2. The specimen was photographed, and deposited to the museum of Veraval regional centre of CMFRI.

Fig.1 Specimen of *Sacura boulengeri* (male) from Gujarat

Description

The specimen was found to be male having a very colorful body with dark pink color bands horizontally. Body is oval and moderately compressed. Mouth is terminal. Third dorsal spine and 3rd and 4th ray is very long. Caudal fin is lunate shaped. Morphometric measurement ratios are: Head length 39.5% of SL, Body depth 38.9% of SL, Third dorsal spine 44.8% of SL, Pectoral fin length 29.3% of SL, Pelvic fin 25.8% of SL, Anal fin 30.6% of SL, Caudal peduncle depth 13.4% of SL, Eye diameter 26.6% of HL, Snout 20% of HL andInter orbital space 23.7% of HL.

The species was found to be caught with other demersal fishes

The fish is known to be distributed in the western Indian Ocean. Earlier, it has been recorded from off the coasts of Muscat, Oman; Sindh, Pakistan and western India, Cochin (CMFRI, 2008) and Mumbai. Till now it has not been reported from Gujarat coast hence this constitutes the first record of the species from the coast.

Table 1. The comparative morphometric data of *S. boulengeri* (SL = standard length, HL = head length)

Character	Muscat (1979)	Sindh (2004)	Neendakara (2005)	Mangalore (2006)	Mumbai (2005)	Cochin (2008)	Gujarat (2013)
Greatest body depth (% SL)	41- 43	41.7	39.1	41.8	41.9	39.4	38.9
Head length (% SL)	42- 43	39.2	38.1	44.0	35	38.8	39.5
Pectoral fin length (% SL)	29-32	29.2	29.7	29.2	33	29.1	29.3
Pelvic fin length (% SL)	25-29	28.3	30.2	29.2	24.1	27.6	25.8
Caudal peduncle length (% SL)	20-22	20.8	21	20.3	15.9	18.8	16.5
Caudal peduncle depth (% SL)	12 - 14	12.5	14.6	12.3	13.1	13.1	13.4
First dorsal spine length (% SL)	6.4-7.3	5.8	6.5	6	6.1	6.3	4.8
Second dorsal spine length (% SL)	9.7-11	7.5	9.2	9.9	8.9	17.1	6.4
Third dorsal spine length (% SL)	52-66	55	40.9	50.8	53	45.1	44.8
Fourth dorsal spine length (% SL)	13-15	14.2	13	13.6	13.2	13.1	12.8
Third dorsal soft ray length (% SL)	50-52	47.5	48.4	52.5	49.1	39	39.2
Anal fin length (% SL)	33-36	32.5	31	31.8	30.5	32	30.6
First anal spine length (% SL)	7.6-8	7.5	7	7.3	7.4	6.6	6.4
Second anal spine length (% SL)	14-17	15	12.6	14.6	14.1	12.6	12.8
Second anal soft ray length (% SL)	26-29	25	27.9	27.8	24.3	26.3	26
Pelvic fin spine length (% SL)	15-18	15	14	15.2	15.7	14.3	14.4
Snout length (% HL)	20-21	21.3	21	20.4	20.3	19.1	20
Orbit length (% HL)	26-28	27.7	27.5	27.6	22.3	23.5	26.6
Inter orbital width (% HL)	20-22	23.4	22	22	22	23.5	23.7
Post orbital distance (% HL)	53-56	53.5	53	57.2	63.1	55.9	55.8
Upper jaw length	43-44	42.6	42	42.3	45.3	42.6	42
Maxilla depth (% SL)	14-16	17.3	15.4	16.3	16.9	-	16
Gill rakers (Upper)	14-16	N.S.*	12	12	12	14	18
Gill rakers (Lower)	30-33	N.S.*	27	27	27	29-30	28

Southern sun fish *Mola ramsayi* (Giglioli, 1883) recorded from Kochi, southwest coast of India

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Family Molidae with three genera (*Ranzania*, *Masturus* and *Mola*) and four species are known as the world's heaviest fishes with a planktivorous diet. Known for their truncated anatomy, these fishes are characterized by lack of caudal bones, ribs and pelvic fins (Tifler, 1980). A southern ocean sunfish *Mola ramsayi* with total length 111cm and weighing 50kg was landed at Munambam Fisheries Harbour on 6 September 2013. The fish was caught by trawlers at a depth of 50m off Quilon (8^0 58' 487 N and 76^0 05' 381 E) for threadfin breams along Kerala coast.

Mola ramsayi is characterized by 16 fin rays on the clavus region, of which 8 bear ossicles. It bears close resemblance to *Mola mola* from which it differs in the number of fin rays on clavus and rougher nature of skin (Bass *et al*. 2005). Southern ocean sunfish is an oceanic species and has been

Fig. 1. *Mola ramsayi* landed at Munambam Fisheries Harbour

reported from Australia, New Zealand (Peque 1989) and southeast Atlantic. It has been reported earlier from Chennai (Mohan *et al*. 2006) in 2006 with a total length of 83.5 cm and weight 10.5kg. This is the first report from the Eastern Arabian Sea and also the largest specimen recorded from Indian waters. The fish is said to attain 300 cm TL (Heemstra 1986). The present report contributes to the extended distribution of the species.

The meat of sunfishes are reported to be a delicacy in Japan, however, the fish was not auctioned here, probability due to its low market value in internal markets.

Morphometric measurements of *M. ramsayi* (in cm).

Total length	:	111
Standard length	:	91
First dorsal length	:	48
Anal length	:	47.5
Pectoral length	:	14.5
Eye diameter (vertical)	:	6.5
Eye diameter (horizontal)	:	6.5

A record of the largest big eye hound shark *Iago omanensis* (Norman, 1939) from Gujarat, North West Coast of India

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A female specimen of big eye hound shark*Iago omanensis* measuring 66 cm was landed at Mangrol fishing harbor on 17th September 2013. The specimen was collected along with 13 others of the same species. *I. omanensis* was not recorded earlier from Gujarat. The largest size description given in Fish base is58 cm (female).The species is distributed from Oman to Pakistan and southwestern coast of India. The information on the fishing ground collected from the fishermen indicated that the fishes were caught at Okha by a multiday trawler from a depth of 120 m. The specimens were brought to the laboratory, photographed and the species identification was confirmed following Compagno, 1984. Detailed morphometric measurements were noted and the shark was dissected for biological observation.

I. omanensis had a small and slender body with a moderately long and narrowly rounded snout (Fig 1). The first dorsal was far anterior over the

Fig.1. Dorsal view of *Iago omanensis*

pectoral fin base. The second dorsal was smaller than the first dorsal.The pectorals were larger than the first dorsal. Eyes were moderately larger having nictitating eye lids and horizontally oval eyes on both the sides of head. The gill slits were wider and longer having the last two gill slits over the pectoral fin base. Mouth was angular (Fig. 2) having same small lateral teeth with cusps but no cusplet in both the jaws. There were three functional rows of the teeth (Fig. 3) in the specimen and the dental formula was calculated as 54/40. Compagno and Springer calculated the dental formula as 46-55/37-45. The species was grey-brownish above and white below. The tip of the dorsal fins and upper caudal fin was black tipped. The total length of the female specimen was 66 cm having a weight of 1.20 kg. The detailed morphometric measurements have been given in table 1.

Fig. 2. Ventral view of *Iago omanensis*

Fig. 3. Mouth and teeth pattern of *I. omanensis*

Table 1. Morphometric characters of big eye hound shark

Characters	Measurements (cm)
Total length	66
Fork length	56
Head length upto 1st gill slit	8.5
Pre first dorsal	18.5
Pre pectoral	16
Pre pelvic	32
Pre anal	43
Pectoral pelvic distance	14
Pelvic anal distance	8.5
Pre nasal	5
Inter nasal	2.5
Pre orbital	5
Eye diameter	1.7
Mouth length	3
Mouth width	4.5
Body depth	10.5
Height of 1st dorsal	6.8
Base of 1st dorsal	6.5
Height of 2nd dorsal	5.5
Base of 2nd dorsal	5
Height of pectoral	8.5
Base of pectoral	4
Height of pelvic	3.5
Base of pelvic	3.5
Height of anal	3
Base of of anal	3.5
Uterus length	12
Ovary length	2
Liver length	15.6
Length of labial furrow	1.1
Pre oral length	3.7
Height of 1st gill slit	1.9
Height of Vth gill slit	1.5
Distance between 1st&Vth gill slit	6.2
Teeth count (Upper jaw)	54
Teeth count (Lower jaw)	40

The shark is a demersal, viviparous species found at a depth of 110-2195 m (fish base). Upon dissection, it was found that the female was pregnant with 19 embryos (Fig. 4) with a size range from 4.5 to 5.1 cm. All the embryos were having yolk sac and placental connections to the uterus of the mother and there were 9 and 10 numbers of embryos in each compartment of the uterus. The stomach was half with semi-digested fish of species *Nemipterus* and *Apogon*. Out of 15 specimens, 8 were females and 7 males. The females were larger than the males. The species has been assessed at Least Concern by IUCN.

Fig. 4. *I. omanensis* with 19 embryos having yolk sac and placental connection

First record of Bull shark, *Carcharhinus leucas* (Valenciennes, 1839) in commercial landings from New Ferry Wharf, Mumbai, Maharashtra

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On 10th January 2013, the bull shark *Carcharhinus leucas* was landed by a trawler at New Ferry Wharf, Mumbai. The depth of operation was about 30-40 m at 70- 80 km off North of Mumbai coast. The total length of the shark was 325 cm and weight 450 kg. The specimen was a pregnant female with 14 full grown up pups (Right lobe -7, Left lobe – 7). The size range of pups ranged between 80-84 cm with corresponding weight ranging from 3.4 to 3.9 kg (Table 1). According to fishermen, the shark was very exhausted because of carrying of 14 pups (Approximate wt. 52 kg) at the time of catching. The shark was sold for ₹ 30,000/- and pups for Rs.700/- each. The sex ratio of pups was: 1: 1.8 (M: F). One pup was brought to the laboratory for the identification of species (Fig.1, Fig. 2 and Fig. 3).

Fig. 1. Lateral view of *Carcharhinus leucas* (Pup) collected from New Ferry Wharf, Mumbai

The morphometric and meristic characters of one of the pups were as follows, a massive shark with a short and stocky body, broad and blunt snout, small eyes, no inter dorsal ridge, 1st dorsal fin broad and triangular, First dorsal fin origin anterior or over pectoral fin axil, pectoral fins moderately long and broad, total 9 rows of upper and lower jaw teeth pattern of *Carcharhinus leucas* (Pup) collected from New Ferry Wharf, Mumbai was observed (Fig.4 & Fig.5). The bull shark, *Carcharhinus leucas* reaches maximum size of 350 cm and common size is 260 cm (Fisher & Bianchi, 1984). Rajapackiam *et al.*

Fig. 3. Upper teeth pattern of *Carcharhinus leucas* (Pup) collected from New Ferry Wharf, Mumbai

(2007) reported a giant sized female bull shark, *C. leucas* measuring 356 cm in total length and 320 kg weight caught by a gillnet operated at a depth of 50-60 m on 22.06.2005 which is the largest record of *C. leucas* so far in Indian waters.

The bull shark, *C. leucas* is distributed in the Western Atlantic: Massachusetts, USA to Southern Brazil. Eastern Atlantic: Morocco, Senegal to Angola.

Fig. 4. Lower teeth pattern of *Carcharhinus leucas* (Pup) collected from New Ferry Wharf, Mumbai

Indo-west Pacific: Kenya and South Africa to India, Vietnam to Australia. Eastern Pacific: Southern Baja California, Mexico to Ecuador and possibly occurring in Peru and the depth of occurrence reported up to 152 m (Compagno, 1984). The same latitudinal distribution of this species in Chennai on east coast and Mumbai on west coast throws more light on the distributional range and latitudinal diversity around peninsular Indian coast and there is considerable population dispersal occurred over a period of time, since its first report. The IUCN has assessed the bull shark as "Near Threatened".

In the light of published data on *C. leucas*, it was observed that Morphometric measurement for the pups has not been reported so far. Table 2 shows the detailed morphometric measurements of one of the pups recovered from the collected bull shark.

Table 1. Size, weight and sex of *C. leucas* (Pups) from New Ferry Wharf, Mumbai

Sl. No.	Size (mm)	Weight (kg)	Sex
1.	820	3.70	Male
2.	810	3.75	Female
3.	801	3.65	Female
4.	806	3.80	Male
5.	805	3.70	Female
6.	800	3.45	Female
7.	801	3.55	Female
8.	804	3.80	Male
9.	809	3.90	Male
10.	800	3.60	Male
11.	808	3.55	Female
12.	803	3.65	Female
13.	811	3.90	Female
14.	804	3.45	Female

Table 2: Morphometric measurements (in mm) of Pup of*Carcharhinus leucas*collected from New Ferry Wharf, Mumbai.

Sl.No.

Date	:	10.01.2013
Place	:	New Ferry Wharf, Mumbai
Sample No.	:	1
Weight (kg)	:	3.7

1	Total Length (TOT)	: 820
2	Fork Length (FOR)	: 650
3	Pre-caudal Length (PRC)	: 610
4	Pre-second dorsal length (PD2)	: 510
5	Pre-second dorsal length (PD1)	: 236
6	Head length (HDL)	: 183
7	Pre-branchial length (PG1)	: 148
9	Pre-orbital length(POB)	: 48.76
10	Pre-pectoral length (PP1)	: 161
11	Pre-pelvic length (PP2)	: 406
12	Snout-Vent length (SVL)	: 430
13	Pre-anal length (PAL)	: 424
14	Inter-dorsal space(IDS)	: 176
15	Pectoral –pelvic space (PPS)	: 198
16	Dorsal-caudal space (DCS)	: 62
17	Pectoral pelvic space (PPS)	: 202
18	Pelvic-anal space (PAS)	: 60.48
19	Anal-caudal space (ACS)	: 45.50
20	Pelvic-caudal space (PCS)	: 106
21	Vent-caudal length(VCL)	: 386
23	Pre oral length (POR)	: 51.18
24	Eye length (EYL)	: 8.49
25	Eye height (EYH)	: 8.76
26	Inter gill length (ING)	: 44.20
27	First gill slit height (GS1)	: 30.13
28	Second gill slit height(GS2)	: 32.84
29	Third gill slit height(GS3)	: 32.98
30	Fourth gill slit height (GS4)	: 33.78
31	Fifth gill slit height (GS5)	: 25.57
33	Seventh gill slit height (GS7)	: -
35	Pectoral radial length (PRL)	: -
36	Pectoral base(P1B)	: 57.06
37	Pectoral inner margin (P1I)	: 42.15
38	Pectoral posterior margin (P1P)	: 99.20
39	Pectoral height (P1H)	: 120
40	Sub-ocular pocket length (SOD)	: 6.29
41	Dorsal caudal margin (CDM)	: 225
42	Pre-ventral caudal margin (CPV)	: 95
43	Upper post-ventral caudal margin (CPU)	: 134
44	Lower post-ventral caudal margin (CPL)	: 49
45	Caudal fork width (CFW)	: 65
46	Caudal fork length (CFL)	: 62
47	Sub-terminal caudal margin (CST)	: 21.88
48	Sub-terminal caudal margin (CSW)	: 19.73
49	Terminal caudal margin (CTR)	: 36
50	Terminal caudal lobe (CTL)	: 50.38
51	First Dorsal length (D1L)	: 101
52	First dorsal anterior margin (D1A)	: 10.86
53	First dorsal base ((D1B)	: 96.06
54	First dorsal height (D1H)	: 67.19
55	First dorsal inner margin (D1I)	: 23.04
56	First dorsal posterior margin (D1P)	: 50.41
57	Second dorsal length (D2L)	: 65.46

58	Second dorsal anterior margin (D2A)	:	48.76
59	Second dorsal base (D2B)	:	44.27
60	Second dorsal height (D2H)	:	40.69
61	Second dorsal inner margin (D2I)	:	20.36
62	Second dorsal posterior margin (D2P)	:	33.27
63	Pelvic length (P2L)	:	67.59
64	Pelvic anterior margin (P2A)	:	52.61
65	Pelvic base (P2B)	:	42.25
66	Pelvic height (P2H)	:	44.92
67	Pelvic inner margin length (P2I)	:	30.50
68	Pelvic posterior margin length (P2P)	:	44.42
69	Head length (HDL)	:	109
70	Trunk height (TRH)	:	126
71	Abdomen height (ABH)	:	140
72	Tail height (TAH)	:	98
73	Caudal peduncle height (CPH)	:	38
74	Anal length (ANL)	:	71
75	Anal anterior margin (ANA)	:	60
76	Anal base (ANB)	:	47
77	Anal height (ANH)	:	32
78	Anal inner margin (ANI)	:	24
79	Anal posterior margin (ANP)	:	32
80	First dorsal midpoint-pelvic origin (DPO)	:	110
81	Pelvic midpoint-first dorsal insertion (PDI)	:	94
82	Pelvic midpoint-second dorsal origin (PDO)	:	65
83	Second dorsal origin-anal origin (DAO)	:	15.45
84	Second dorsal insertion-anal insertion (DAI)	:	16.21
85	Mouth length (MOL)	:	79
86	Mouth width (MOW)	:	92
87	Upper labial furrow length (ULA)	:	54
88	Lower labial furrow length (LLA)	:	556
89	Nostril width (NOW)	:	12.32
90	Internarial space (INW)	:	49.93
91	Anterior nasal flap length (ANF)	:	5.21
92	Clasper outer length (CLO)	:	15.09
93	Clasper inner length (CLI)	:	30.19
94	Clasper base width (CLB)	:	9.46
95	Inter orbital space (INO)	:	89.76
96	Spiracle length (SPL)	:	-
97	Eye spiracle space (ESL)	:	17.14
98	Head width (HDW)	:	115
99	Trunk width (TRW)	:	119
100	Abdomen width (ABW)	:	122
101	Tail width (TAW)	:	70
102	Caudal peduncle width (CPW)	:	35
103	Girth (GIR) at first dorsal fin	:	124

Due to population declines, it is very important to develop management and protection programs for many elasmobranch species, which require well-founded knowledge about the taxonomy, distribution, and abundance of the species. However, although many new elasmobranch species have been described in recent years, the knowledge on many known species is still scarce due to the often very old and sketchy original descriptions like those by Müller and Henle (1841). Another reason for the gaps in knowledge is the often insufficient declaration of elasmobranch catches by fishermen, who classify most caught specimens simply as "diverse Elasmobranchii" or "small sharks" instead of making a more detailed determination.

On the egg case of Arabian carpet shark, *Chiloscyllium arabicum* from Gujarat

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On 18.04.2013, a female specimen of *Chiloscyllium arabicum* (Fig. 1) measuring 52.5 cm (TL) and 405 g was obtained from the trawl landing at Mangrol. The Arabian carpet shark, *C. arabicum*(Order: Orectolobiformes; Family: Hemiscylliidae)is native to Western Indian Ocean and has been currently reported from India, Islamic Republic of Iran; Kuwait; Oman; Pakistan; Qatar; Saudi Arabia and United Arab Emirates. It is common in the waters off Gujarat. The shark which is a bottom dwelling species predominantly inhabits coral reefs, lagoons, rocky shores and mangrove estuaries, between depths of 3-100 m on the bottom. It has been reported that the species grows up to 70 cm and matures between 45- 54 cm. It is mainly caught as a bycatch in trawl nets along the

Fig. 1. A view of the egg cases

Gujarat coast. It contributes to a meager 0.1% of the total shark landings in Gujarat.Specimens in the size range of 50.5-58 cm (558-695 g) have been found to be occurring in the trawl catches. It fetches a market value of Rs. 80- 100/kg locally and is mainly consumed as fresh or dried form in the local market. The species was declared as Near Threatened (NT) by IUCN in 2009.

It had a broad, flat head and body with moderately large eyes and a fairly thick and rounded snout. There is very little documented information on this shark as compared to other species. It is an egg-laying species, laying up to four eggs at a time with a preference for coral reef substratum. These shark eggs are often referred to as "mermaids' purses" and are fixed firmly to items found on the substratum or sea bed.

Being an oviparous species, the egg cases (Fig. 2) were found inside the uterus attached by an anchoring core. The uterus was found to be very thin. The keratinous egg cases were more or less rectangular in shape, strongly convex on both the broader sides, and dark brownish in colour with the eggs inside. Only one egg case was present in each uterus.The content of the egg-cases was a viscous fluid of dull white colour. As the egg is laid, salt water hardens the egg case, forming a protective exterior which contains an internal yolk that provides the developing embryo with food. Arabian carpet shark eggs hatch after 70 to 80 days of incubation. Detailed morphometric measurements of the specimen and the egg case have been given in Table 1& 2 respectively.

Fig. 2. *C. arabicum* with egg cases

Table 1. Morphometric measurements of *C. arabicum* specimen landed at Mangrol

Morphometric characters	Measurements (cm)
Total length	52.5
Body depth	5
Mouth width	2.5
Snout length	1.9
Head length	4.5
Eye diameter	0.6
Spiracle length	0.7
Snout to origin of 1st gill	7
First dorsal fin height	4
Second dorsal fin height	3.6
First dorsal fin base length	3
Second dorsal fin base length	3.3
Inter nasal	1.5
Inter dorsal	5.5
Inter orbital	2.2
Trunk length	15
Tail length	31.5
Uterus length	5.9
Ovary length	8.5
Oviduct length	6.5
Oviduct gland length	2
Ova dia in the ovary (24 eggs)	0.4-1.5
Weight (g)	405

Table 2. Morphometric measurements of the egg case

Parameters	Measurements (cm)
Width at Anterior, Posterior and Middle regions	0.6, 0.9,2.8
Total length	5.3
Maximum Thickness	1.5
Egg diameter	2.2
Length of anchoring core	5.1

Bumper catch of *Rastrelliger kanagurta* at Cochin Fisheries Harbour

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Purseseiners and ringseiners of Cochin fisheries harbor on 2/9/2013 had experienced a good haul of *Rastrelliger kanagurta*. They had gone south west of Kochi at a depth ranging from 27 to31m. The highest haul was 12,500 kg and the lowest 4500 kg. The price obtained was ₹ 45-50/kg. Along with *R.kanagurta, M. cordyla, Terapon* spp., *Alepes djeddaba* and *Lagocephalus* spp. were also caught.

A view of *R. kanagurta* at the harbour

No. of units	Average catch/unit	Average rate/kg	Total revenue realized (₹)
Day landings – 20 units	7655 kg	45/-	68,89,500/-
Night landings – 30 units	8389 kg	50/-	1,25,83,500/-

Heavy landings of *Elops machnata* from drift gill net at Tharuvaikulam landing centre, Tuticorin

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On 18th September 2013, heavy landing of the Indo-Pacific tarpon or tenpounder, *Elops machnata* (Forsskal, 1775) was observed in multiday drift gill net at Tharuvaikulam landing centre, Tuticorin. This was locally called as "Kulanchan" or "Valaya kulanchan". It is also called as Poomeen or Mooran kendai or Manna in different parts of Tamil Nadu. These fishes were actually caught approximately 65 Nm southeast of Tharuvaikulam landing centre, Tuticorin which is 23 Nm from Kannyakumari coast at a depth ranged from 40-60 m. The mechanised wooden boat of 16 m OAL and 220 HP was used for drift gill net operation. The drift gill net of mesh size 125 mm (length 2500 meter and 14 metre depth) was used. The fishing trip started in the morning at 11.00 hrs and reached the fishing ground at 19.00 hrs. After 4 days of fishing they returned back in the morning 06.00 hrs. Around 786 kg (118 no's) of *E. machnata* was landed by single unit in 4 hauls (where the operation time is mostly in the night) on that four days of fishing trip. This is the first instance of such huge landing of the *E. machnata* at Tharuvaikulam, Tuticorin.

E. machnata is a eurythermic tropical species found widely in subtropical and warm temperate regions. This is also a euryhaline species having a wide salinity tolerance i.e., 0 to 90 ppt and mostly found in turbid waters (Whitfield, 2005; Whitfield *et al*. 2006). Juveniles are common in warm, turbid

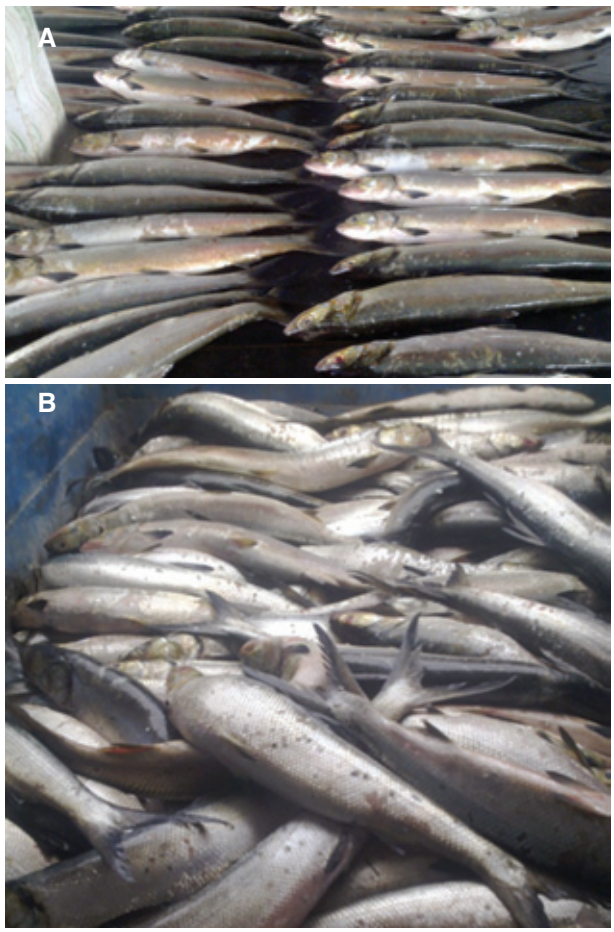

Fig. A, *B. Elops machnata* landed by drift gillnet at Tharuvaikulam, Tuticorin

estuaries on which they are dependent as nursery areas (Mann and Radebe, 1999) whereas adults are probably spawn at sea, but the transparent leptocephalus larvae migrate to inshore areas and often found in brackish water (Kottelat *et al.*, 1993). The unusual landing is a fish in the sea is related to certain physical and chemical parameters of the water. It was presumed by the fishermen that cold wind coupled with turbid water favours the fish species to congregate in a particular location may be for breeding where the fishes are caught but during the other periods these fishes are generally caught as single.

In addition to *E. machnata* other species landed were *Thunnus albacares* (120 kg), *Euthynnus affinis* (60 kg), *Katsuwonus pelamis* (20 kg), Carangids (4 kg) and Scomberoides (6 kg). The observed length classes are ranging from 930 to 1050 mm weighing 4 to 7 kg. These fishes were sold at a price ranging from 70 per kg. These fishes are edible, but not tasty and full of bones so it was not locally consumed mainly used as dry fish transported to dry fish market at Melayapalayam, Tirunelveli. The total revenue earned from sale on the single unit on the day was ₹ 63,190.

Unusual landing of the sharks at Sassoon dock landing centre, Mumbai

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On 5th June 2013, unusual landing of the tiger shark (*Galeocerdo cuvier*), the spot-tail shark (*Carcharhinus sorrah*), the bull shark (*Carcharhinus leucas) and* the blacktip shark (*Carcharhinus limbatus*) belongs to the family Carcharhinidae was observed at Sassoon dock (Fig. 1). About 4 tonnes of sharks of the above species in the length range of 1.5 – 3.25 m and weight ranging from 50 to 120 kg were landed by trawler. The fishermen from Thoothoor, Tamilnadu operated hook line consisting of 1,200 to 1,300 hooks in the North-West direction off Mumbai coast at a distance of 100-150 km from

Fig. 1. Unusual landing of sharks at Sassoon dock, Mumbai on 5th June, 2013

the coast. These sharks were landed in stray numbers by mechanised gillnets, hooks and line units in combination. This is the first time bulk landing of shark was observed at Sassoon dock and sharks were sold out @ ₹ 157/- per kg. The fishermen in the area operate 2 to 3 different types of gear to catch the fish in the same boat, which is attributed to rising fuel cost and scarce catch in far off waters.

The IUCN has assessed the tiger shark, the spot-tail shark, the bull shark and the blacktip shark as Near Threatened, noting its numbers are dwindling due to increasing levels of unregulated fishing activity across its range. The slow reproductive rate and limited habitat preferences of species renders sharks populations vulnerable to overfishing.

Heavy landing of needle fish, *Ablennes hians* (Valenciennes,1846) at Sassoon dock, Maharashtra

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On 4th October, 2013 there was an unusual landing of needle fish, *Ablennes hians* (Valenciennes, 1846) by multiday purse seiners at Sassoon Dock (Fig.1). Approximately 8 tonnes of needle fish were landed by 16 purse seiners on the day. Such a heavy catch of needle fish is a rare phenomenon at Mumbai where these fish are landed only occasionally. These fishes are reef associated and highly pelagic. By observing the structural morphology of beak like jaws and teeth it appears that they are highly predaceous and feeds on smaller organisms. As per the information, the fishes appeared as a large shoal near the shore and were caught by multiday purse seiners fishing at depths of 10-15 m off Raigad district of Maharashtra. The fishes were sold for ₹ 80/- per kg and all the catch was bought by traders from Kerala through local venders. The fish is greenish in colour and its flesh and vertebral column appears bluish green even after cooking. Therefore there is no local demand for this fish in Maharashtra.

Fig. 1. Heavy landing of needle fish, *Ablennis hians* at Sassoon Dock, Mumbai

Random samples were collected from Sassoon dock and brought to the laboratory. The total length and total weight of the fishes were measured and biological studies were carried out. The average weight of fishes was 500-800gm and the length ranged from 600-800mm with the modal length group of 700-730mm. The gonadal examination showed both males and females were in immature stage with a sex ratio of 1:1. It was noticed that in these fishes the gonads were unequal in size; the left lobe was bigger than the right one. Most of the

Fig. 2. Gonad and gut of needle fish

guts were in half filled state consisting of semi digested fish, cephalopods and crustaceans (Fig.2).

Analysis of total catch of needle fishes in Maharashtra showed an increasing trend from 2000 onwards (Fig. 3). The species contributing to the needle fish fishery in Maharashtra are *Ablennes hians* (44%), *Tylosurus acus* (28%), *Strongylura leiura* (11%), *S. strongylura* (10%) and *T.crocodulus* (7%). They are usually caught by gill nets, purse seines and trawl nets.

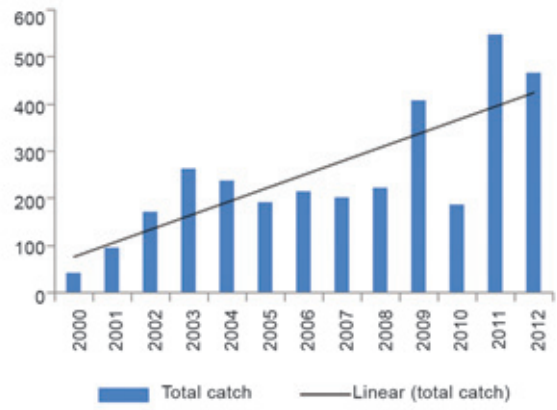

Fig. 3. Trend of needle fish fishery in Maharashtra

Heavy landings of mobulids reported at Cochin Fisheries Harbour, Kerala

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Heavy landings of mobulids was seen for four days during 19 - 22 August and again during 31 August - 3 September 2013 at Cochin Fisheries Harbour. During the first phase, around 600 mobulids (16 tonnes) were landed by gillnetters which operated off the coast of Vizhinjam, Kovalam and Colachel. The vessels operated for a period of 5-7 days in the fishing ground $08^0$14'N; $76^0$33'E at a depth of 15 -30 m. The gear used was "*ozhukkuvalai*" with a square mesh size of 80 - 150 mm. On an average, 15 – 30 numbers of mobulids were landed per boat. The three species which were landed were Sickle fin devil ray *Mobula tarpacana*, Spine-tail devil ray *Mobula japanica* and oceanic manta ray *Manta birostris*. On 19 August, 2013, around 3.5 tonnes of mobulids were landed. *Mobula tarpacana* dominated the landings followed by *Mobula japanica* and *Manta birostris*. On 20th August, *Mobula japanica* was the dominant species; two numbers of *Mobula tarpacana* were also landed. On 21st August, 115 numbers of mobulids were landed. *M. japanica* was the dominant species landed; besides, 4 numbers of *M. tarpacana* and 1 *Manta birostris* was landed. On 22nd August around 150 numbers of mobulids were landed with *Mobula japanica* dominating the landings followed by 2 numbers of *Mobula tarpacana* and 1 *Manta birostris*.

The second phase of heavy landing started on 31 August and extended upto 3 September 2013. During the period, around 300 numbers of mobulids were landed by around 24 units daily. The fishing ground was located $08^0$31'N; $76^0$51'E at a depth of 180 m to $08^0$44'N; $76^0$45'E at a depth of 190 m. The mobulids were caught as bycatch during tuna fishing; the ground had a heavy population of tuna, mobulids and sharks. The fishery coincided with the full moon and landings reportedly decrease with the onset of new moon. (pers. comm).

The disc width of the *Mobula japanica* landed ranged between 67 - 304 cm with body weights 35 kg -300 kg; *Mobula tarpacana* landed had disc width 206 – 297 cm and body weight 150 -450 kg ; *Manta birostris* had disc width 226 -280 cm and body weight 320 -400 kg.

Details of heavy landings of mobulids at Cochin fisheries harbour

Date	Total catch	Total mobulids	*Mobula japanica*	*Mobula tarpacana*	*Manta birostris*
19/08/13	3.7 ton	140	135	4	1
20/08/13	3.2 ton	120	116	4	*
21/08/13	3.8 ton	130	126	3	1
22/08/13	3.3 ton	120	119	*	1
31/08/13	14 ton	300	278	20	2
2/9/2013	12 ton	280	230	50	*
3/9/2013	10 ton	220	216	4	*

The mobulids were auctioned at ₹ 5000 - ₹ 9000 per boat; the fishes were first cut to remove their filter plates and the meat sold separately. The filter plates were removed from the brachial apparatus and sorted grade wise in the harbor itself. Prices of the gill plates are based on the grades – First Grade consists of the gill plates of *Manta birostris* which are larger in size, black in colour; Second Grade consists of the gill plates of *Mobula tarpacana* which are large in size, with an inner white and outer black colour and Third Grade which consists of the gill plates of *Mobula japanica* which are smaller in size, with black colour and pointed tips. Meats of manta and mobulid rays are mostly sold in local markets in Central Kerala in fresh form or as salted chunks. Fresh meat fetches only ₹150 kg^{-1}. The filter plates are sun dried and sent to Chennai where they are further processed before export. Dried filter plates of *Mobula diabolus* fetches upto ₹ 9,000 kg^{-1}; 'white' filter plates fetch upto ₹ 8,000 kg^{-1} dry weight while black fetches upto ₹ 2,000 kg^{-1} dry weight.

The Mobulidae are zooplanktivorous elasmobranchs, found circumglobally in tropical, subtropical and temperate coastal waters. It comprises two recognized species of manta rays (*Manta* spp.) and nine recognized species of devil rays (*Mobula* spp.). Fisheries for mobulids are considered to be unsustainable because of large, directed catches coupled with the very low fecundity, long gestation period and conservation life history of this group (Couturier *et al*. 2012). Manta rays are assessed by the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species as Vulnerable globally. Manta rays bear only one pup on average every two to three years, which makes them highly vulnerable to overexploitation. They are killed as bycatch and in targeted fisheries throughout the Atlantic, Pacific, and Indian Oceans. Manta rays and the rest of family Mobulidae have been highlighted by the CITES Animals Committee as a "taxonomic group that contains a significant proportion of species subjected to unregulated, unsustainable fishing pressures, leading to severe stock depletion, and whose high value products enter international trade in large numbers." The retention and/or trade of manta rays is specifically prohibited in regulations adopted by the Maldives, Philippines, Mexico, Brazil, Ecuador, Yap, Australia, New Zealand, the European Union, and Hawaii (USA). The giant manta was listed under Appendix I and Appendix II of the Convention for the Conservation of Migratory Species (CMS) in 2011. These designations signal international recognition of the need for cooperative conservation measures and strict species-specific protections. So far, however, few fishing regulations have resulted from the CMS listing. There are no binding, manta-specific measures under the various Regional Fisheries Management Organizations. The sudden increase in landing of mobulids seems to have a link to the international trade in the gill rakers as the meat does not have a high value even in the local market.

An instance of unusual feeding habit of the Indian Mackerel, *Rastrelliger kanagurta* from the Mangalore Fishing Harbour

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The Indian mackerel, *Rastrelliger kanagurta* contributes significantly to the pelagic fishery catch of Dakshina Kannada coast. The fishing season extends from Aug. to May with peak landings during September-November and April-May. Fishing is done by purseseiners, trawlers, gillnetters, ring seiners and indigeneous non mechanized crafts.

Studies have indicated mackerel primarily as a plankton feeder. In general the food mainly consists of copepods, diatoms like *Coscinodiscus, Fragilaria, Rhizosolenia* and *Nitzschia*; dinoflagellates like *Peridinium and Ceratium*. But instances of *Fragilaria* sp. exclusively forming an item of food is quiet rare and has not been reported so far for the Indian mackerel. During the analysis of mackerel gut collected recently (Aug-Sept /2013) from the catch made by the trawlers of Mangalore fishing harbour, the stomachs contents predominantly contained *Fragilaria* sp. (Fig. 1)

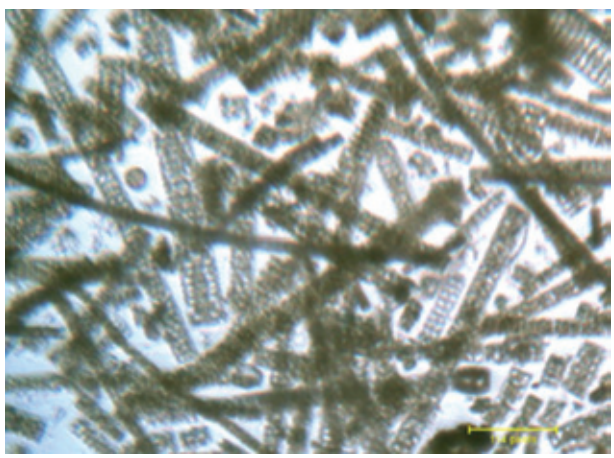

Fig. 1. *Fragilaria* in the gut of *R. kanagurta*

A total of 147 specimens were randomly collected from Mangalore fishing harbour on 14th August and 3rd september 2013 and stomach contents of 100 specimens were analysed in detail. The specimens ranged in size from 105 to 236 mm in total length (Fig. 2.) and weighed 89-170 gm (wet weight). All the fishes were mature with gonad either in stage VIIa, b or IIb.

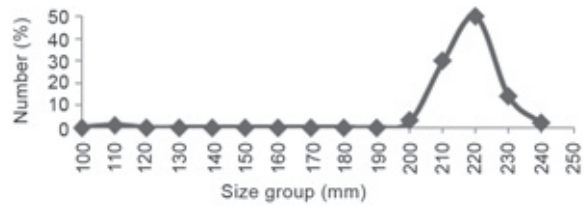

Fig. 2. Percentage composistion of length group of mackerel

Of the 100 specimensfor fullness, 7% had empty stomach, 39% fishes had just traces of food items in them, 28% were with 1/4th condition, 25% were with ½ stomach and 1% with 3/4th condition. The volume of food varied from 0.1 to 1.2 ml. The contents were diluted to a known volume and observed under the binocular microscope in 10x magnification. The food composed exclusively of *Fragilaria* sp.(on an average of about 5,00,000 cells/ml) with traces of *Coscinodiscus, Peridinium, Protoperidinium, Ceratium* and semidigested parts of copepods. Studies on the specimens that were collected from trawl nets during the months of Aug-Sept 2011 and 2012 have shown that it feeds mainly on copepods and *Coscinodiscus*. Earlier studies have also indicated that copepods formed the major food item of the Indian mackerel. But the present study on the extensive feeding on *Fragilaria* sp. indicates that mackerel can modify its diet to a large extent depending on the availability of different organisms present in that area.

A note on the targeted fishery for deep-sea Oil Sharks at Cochin Fisheries Harbour

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Since 2002, due to heavy demand for the deep-sea shark liver oil from pharmaceutical companies and foreign nations, a targeted fishery for the deep-sea gulper sharks (*Centrophorus* spp.), which is locally called *mullan sravu* (vernacular for shark having spines) or *enna sravu* (oil shark) was observed from the landings at Cochin Fisheries Harbour. During this period, deep-sea chondrichthyans other than gulper sharks like the bramble shark *Echinorhinus brucus* and chimaera *Neoharriotta pinnata* were also landed as by-catch in the deep-sea shrimp trawl fishery which were was also utilized similarly for oil extraction (Fig. 1). Squalene (a highly unsaturated aliphatic hydrocarbon) rich liver oil from the gulper sharks is used in health products, commercial skin creams and moisturizers, with fishermen themselves often using the crude liver oil for winter issues and skin problems. When landed in large quantities, they were taken to nearby processing centres,andprocessed for its meat by filleting and salting and also sold locally. The large livers were removed, oil extracted and stored in large barrels to be either distributed to pharmaceutical companies or sold to exporters and local merchants. Shark jaws were also sold or exported to souvenir collectors abroad and in 2009-10, there was a demand for *E.brucus* jaws which were exported from Cochin to USA. Certain online stores showed a rate of $10-15/per jaw which are removed from head without damage, keeping intact shape (Fig. 2). The fins which have lesser value compared to coastal sharks are also used. Deep-sea sharks like *Echinorhinus brucus*, *Hexanchus griseus*, *Alopias supercilious*, *Centrophorus* spp,, *Squalus* spp., are being used for dried salt meat preparation with the last two also gaining in consumer preference for fresh meat of late. The high water content in *E.brucus* and *H.griseus* are considered as drawbacks while using it for food in fresh condition. Shark cartilage in general is a good source of chonrdroitin and glucosomine sulfate and used as food, in pharmaceutical industry etc in various parts of the world. However, deep-sea shark cartilages are soft and are normally cut with meat and not used seperately.

Fig. 2. Processed jaws of *E.brucus*

Fig. 1. Processing of catches

The market driven significant increase in the deep-sea chondrichthyans landings at Cochin especially during 2002-09.Since 2009there were only occasional landings of deep-sea sharks and chimaeroids and the targeted fishery never achieved the levels reached as during 2002-2008 period. Personal interviews of long line fishermen at Cochin in 2012 and 2013 revealed that targeted deep-sea shark fishery on the west coast has slowed down due to small size of sharks available, varying prices and coastal teleost fishes getting higher price making targeted deep-sea shark fishing less profitable. However, on 10.12.2013 two multi-gear steel vessels operated off Munambam by longlines at 300-400 m depth landed 350 kg of gulper sharks dominated by *C.atromarginatus* and 28 tonnes of *E.brucus* (Fig.3).

Deep-sea chondrichthyans are characterised by slow growth, low fecundity, long time to reach sexual maturity, long gestation period. Recent studies from Indian waters revealed that fecundity of deep-sea sharks are very low as in *C*. cf. *granulosus* (2), *E.brucus* (32), *C. atromarginatus* (2), *Cephaloscyllium silasi* (2), *Eridacnis radcliffei* (2), *Bythaelurus hispidus* (2), *Alopias superciliosus* (1) and *Heptranchias perlo* (7) compared to millions of eggs in teleost fishes. This ascertains the need for a precautionary approach in targeted elasmobranch fishery and need for monitoring the by-catches also.

Assessment of low-value bycatch (LVB) in bottom trawl landing at Kasimedu, Chennai during 2006-2011

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Non-targeted resources that occur in the commercial fish landings, generally referred to as by-catch, form about 65-70% of the average annual bottom trawl landing at Kasimedu Fisheries Harbour, Chennai. By-catch includes adults and juveniles of commercially exploited resources other than the targeted fishery, non-conventional fishes which occur in the fishery at random and also low-value by-catch (LVB). The LVB is mostly composed of undersized or poor quality marine organisms, which have very low market value.

A study of LVB in the bottom trawl landing at Kasimedu Fisheries Harbour, Chennai was conducted during the period January 2006 to December 2011. Out of the 1,39,986 t of marine resources landed at Chennai 22,337 t was LVB (16%). The proportion of LVB in the total trawl landing fluctuated between 8.3% (2010) and 21.8% (2009) (Fig. 1).

The average monthly catch of LVB was high during the month of June (16%), followed by December (14%) and July (12%) (Fig. 2). The average LVB catch in April

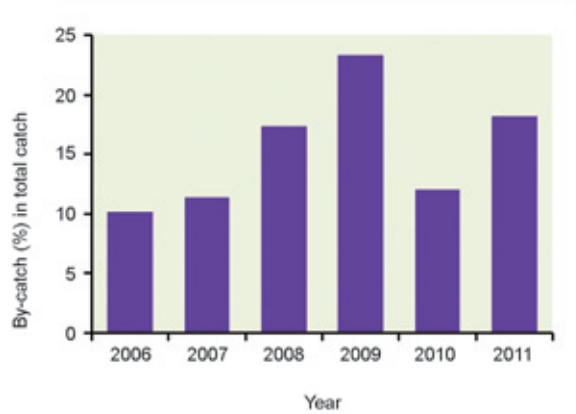

Fig. 1. Annual proportion of by-catch (%) in total trawl catch during 2006-2011 at Chennai

formed only 3% of the average annual, the trawl fishery being restricted to the first fortnight only in April. There is no information available for the month of May on account of the 45-day trawl ban (15 April to 30 May) that prevails along the Tamil Nadu coast. Increase in LVB during the month of June can be attributed to revival of trawl fishing after the ban period, when there is a spurt in single-day and short

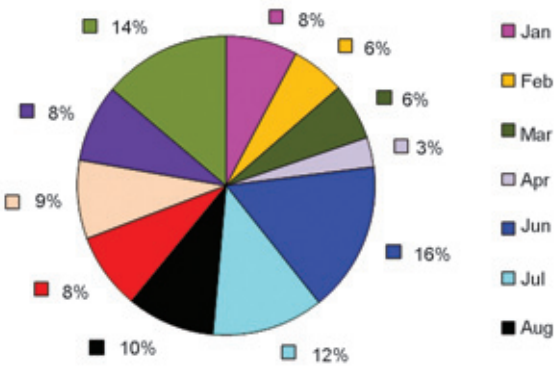

Fig. 2. Month-wise share of LVB (%) in total by-catch (average for the period 2006-2011)

multi-day (3-4 days) fishing in the coastal waters. Seasonal analysis revealed that the proportion of LVB tended to be more from June to December and relatively less from January to April (Fig. 3).

Fishes formed 62.8% of the annual average trawl by-catch at Chennai during 2006-2011, followed by crustaceans (30.6%) and molluscs (4.9%). Other groups like echinoderms and sponges formed 1.7% (Fig. 3).

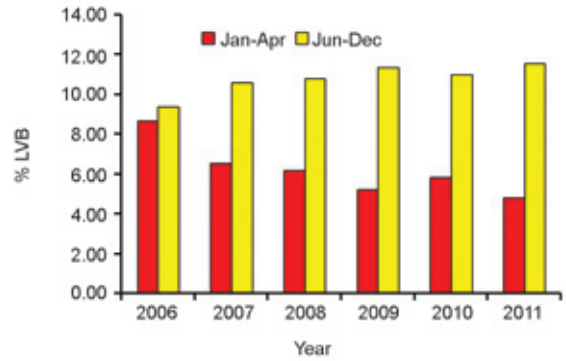

Fig. 3. Seasonal trend in share of LVB (%) in total by-catch during 2006-2011

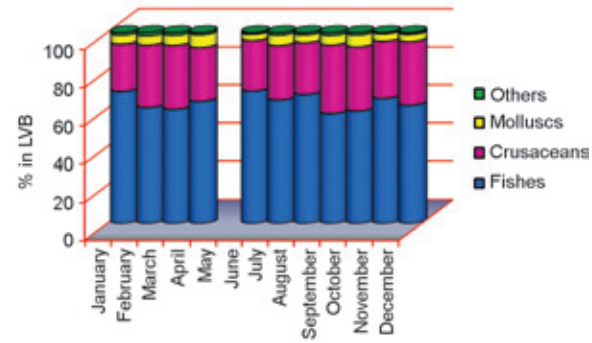

Fig. 4. Average monthly group-wise composition (%) of LVB at Chennai during 2006-2011

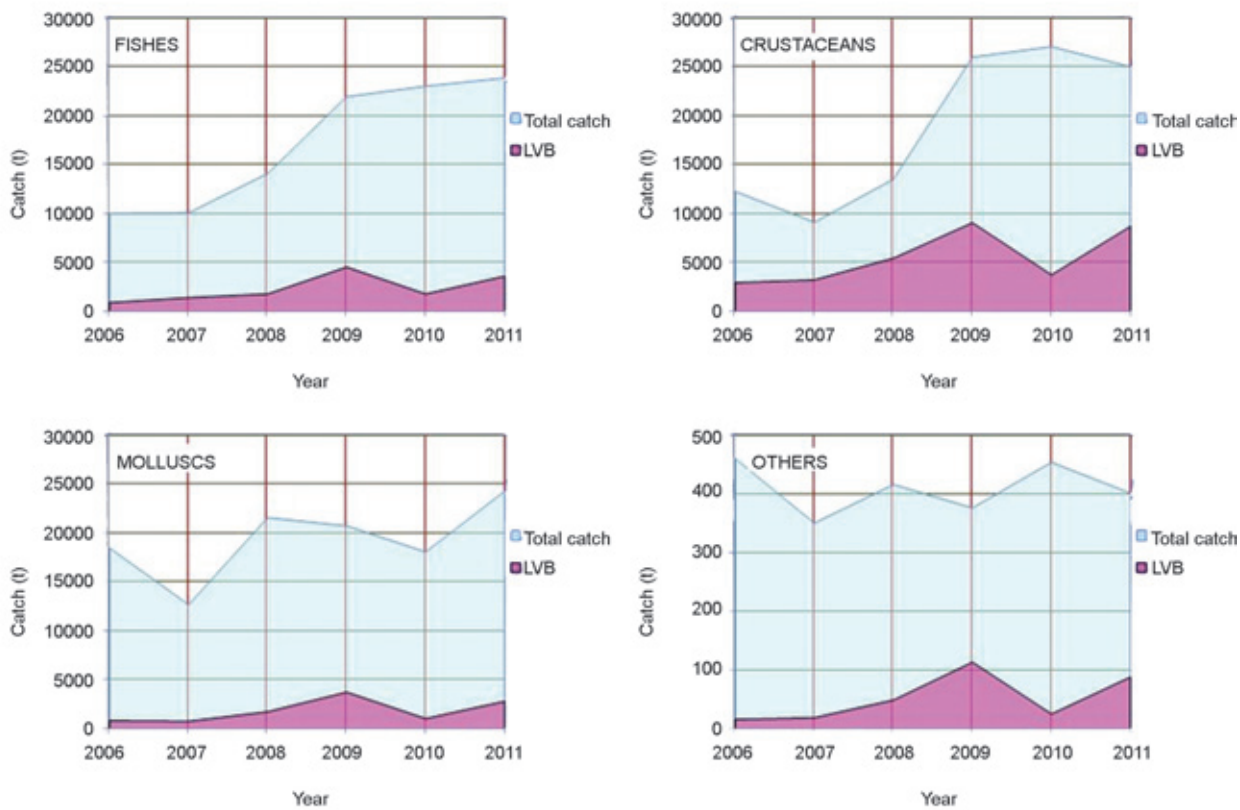

Fig. 5 Group-wise proportion of LVB in total (group) landing (tonnes) at Chennai during 2006-2011

Within each group, the contribution of LVB to the total trawl landing of that group was highest in crustaceans. The lowest ratio between total catch and LVB was seen in molluscs (Fig. 5). The crustacean LVB landed at Chennai formed about 30% of the total landings of crustaceans by trawl nets at the centre during 2006-2011; in the case of fishes, mollusks and others the contribution was about 14%, 10% and 13% respectively.

The dominant fishes observed in the LVB were – silverbellies (25-30%), cardinal fishes (20-25%), flatheads (8-10%), scorpionfishes (6-8%), lizardfishes (4-6%), whitebaits (5-6%), anchovies (6-7%), carangids (3-4%), threadfin & monocle breams (3-5%), pufferfishes (3-4%), flatfishes (2-4%), dragonets (2-3%), glass eyes (2-3%), rays (1-2%), eels (1-2%), filefishes (1-2%) and goatfishes (1-2%). Among the crustaceans crabs were the dominant group, forming 51-54%, followed by stomatopods (21-23%), shrimps (18-20%) and lobsters (7-8%). The bulk of the crabs in the LVB were juveniles of commercially important species like *Portunus sanguinolentus, P. argentatus, P. gladiator, Charybdis lucifera and C. hoplites*. Others include *Calappa sp., Dorippe frascone, Arcania heptacantha, Liagore rubromaculata* etc. Shrimp in the LVB was mainly represented by

Fig. 6. Glimpses of the low-value by-catch in trawl landings at Chennai

juveniles and damaged adults of *Metapenaeopsis stridulans* and *Parapeneus longipes*. Stomatopods, another important constituent in the LVB, were represented by several species like *Oratosquillanepa, O. woodmasoni, O. gonyptes, Harpiosquilla harpax, H. annandeli, H. raphidae* etc. Lobsters in the LVB were comprised of the scyllarids *Petractus rugosus* and *Thenus unimaculatus*. Gastropods contributed to 70-73% of the molluscan component in the LVB while bivalves formed 14-16% and cephalopods formed 11-12%.

While almost 70% of the total LVB was comprised of juveniles, the proportion of juveniles was higher in the months of December, July, August and October. Spawning and recruitment of many species, particularly demersal fishes like threadfin breams and croakers follow a seasonal preference for the monsoon months (particularly NE monsoon) and the period immediately after (November-December); this is probably reflected in the occurrence of juveniles in the LVB below the length of recruitment to the commercial fishery.

Data collected at the landing centre during 2007-2011 has revealed that the value of the LVB has been steadily rising. Based on the sorting that is done locally at Chennai Fisheries Harbour, the LVB could be categorised as -

A. *Low value by-catch comprising fishes in an advanced state of spoilage, not fit for human consumption; utilized for fish meal preparation*

B. *Low value by-catch comprising fishes which are sorted, cleaned for drying and sold in local markets for human consumption*

C. *By-catch comprising fishes which seldom form part of the regular trawl landings like sand perches and sand lance*

D. *By-catch comprising fishes which occur regularly in trawl landings, but are non-targeted groups (many species of crabs)*

E. *Juveniles of major fish groups*

The upper price limit of some categories of fishes in the LVB has risen to > '200/ kg, making the term "Low-value by-catch" sound mismatched (Fig. 6)

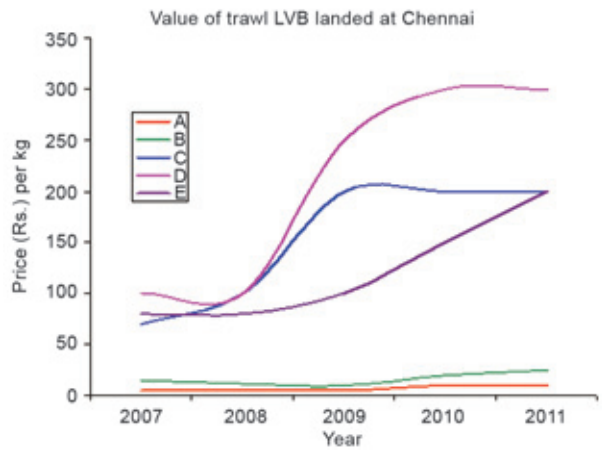

Fig. 6. Group-wise proportion of LVB in total (group) landing (tonnes) at Chennai during 2006-2011

A Note on deformity in Narrow barred Spanish mackerel, *Scomberomorus commerson* (Lacepède, 1800)

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A deformed specimen of Narrow barred Spanish mackerel, *Scomberomorus commerson* (Lacepède, 1800) was observed at Aligadda beach, Karwar on 15th September 2013. It was caught off Karwar by gillnet (*beedu bale*) operated at around 30 m depth.

The specimen had a deformed body with a large ventral and a dorsal curvature on the abdominal region. Although the mouth of the specimen

Fig 1. Deformed specimen of *S. commerson*

was normal and well-formed, malformations in the vertebral column could be the reason for the abnormal shape of the specimen. The specimen had a total length of 64 cm and weighed about 2.1 Kg. This is the first report of morphological abnormalities in Narrow barred Spanish mackerel along the Indian coast. This specimen was landed along with normal specimens of *S.commerson*, *Rachycentron canadum*, *Sphyrna sp*, *Makaira indica*, *Arius* sp and *Coryphaena hippurus*.

Preliminary observations on broodstock development and spawning of Indian Halibut *Psettodes erumei* (Bloch & Schneider, 1801) in captivity

Joe K. Kizhakudan, Shoba Joe Kizhakudan, Joseph Xavier, V., Krishnamoorthi, S., Yousuf, K.S.S.M., Sundar, R., Manibal, C., Ponniah, R., Pakkiri, D., Janakiraman, A., Chandrasekharan, S., Chakrapani G. and Chandrashekaran, M. P.
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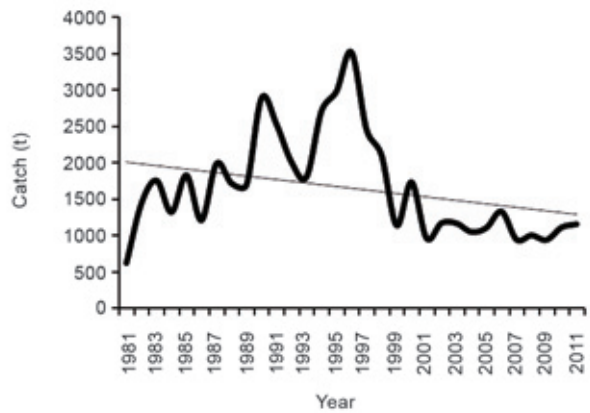
The Indian halibut *Psettodes erumei* (Bloch &Schneider, 1801) is a typical tropical bottom dwelling, piscivorous marine flat fish distributed all along the coastal waters of India (5-50 fathoms). It is a highly valued table-fish with high white meat yield for fillet. The meat yield (%) is known to vary between 42-49%, which is comparable to some of the best white meat fish species cultivated globally. The fish is locally called as *Hario* (Gujarati), *Bhakus/ zipli* (Marathi), *Boxlep* (Konkani), *Ayirampalli* (Malayalam), *Erumeinakku* (Tamil) and *Norunalaka* (Telugu). It is also called the 'Australian Halibut' and 'Pazifischer steinbutt' in international markets. There is a huge demand for flat fish in U.S/ Europe/ Japan. A lot of development has taken place in temperate and Mediterranean countries like Norway, Spain, France and Israel in domestic rearing and large scale aquaculture of temperate halibut and sub-temperate turbots. Attempts to domesticate this species in India are now being made in CMFRI's Kovalam Field Laboratory to establish a viable rearing technology and supplement the falling production of this commodity in the wild.

While domestic consumption in India was initially restricted to the peninsular states of Kerala and Karnataka, increase in trawling/mechanized fishing brought in larger quantities and slowly the fish qualified as a good table fish in the coastal states of northwest and southeast India also. Published literature documents these fishes to be seasonal spawners, spawning once annually, with low fecundity, relatively bigger oocytes at spawning. They are dioecious with external fertilization.

Fishery

Bottom trawling and bottom set gill net operations in coastal waters are the main source of halibut landing along the coast. Halibut production in the country was about 620 t in 1981, which increased to 3516 t in 1996; thereafter it has exhibited a steady declining and the production in 2011 was 1154 t (*Source: National Marine Fishery Resources Data Centre of CMFRI, Kochi*). While it formed 0.05% of the total marine fish landings in 1981, the contribution in 1996 was 0.15% while in 2011 it is only a mere 0.03%. Rapid stock assessment



Annual landing of *Psettodes erumei* in India (1981-2011)

(Mohamed *et al.*, 2010) based on the ratio of the recent 3-year average (2009-2011; 1067 t) over the historic maximum recorded for the species during the period 1981-2011 (3516 t) indicates that the stock is "Declining." At Chennai, the landing of *P. erumei* has averaged around 140 t annually during the period 2007-2012, forming about 0.46% of the total landings. Maximum landing of 206 t was recorded in 2009 and the landing in 2012 was 99 t.

The bottom set gillnet (*naakkuvalai*/*tharavalai*) are predominantly used for flatfish fishing in the coastal waters along the Chennai-Puducherry stretch at a depth of 15-25 m during May-July. It is a well known fact among the fishers that during upwelling and mixing of the turbid waters during July-August (*vandal thanni* - south to north currents) from the deep, these fishes tend to aggregate in the coastal habitats; possibly increased demersal fish assemblage and turbidity provide excellent feeding grounds. This periodic movement of the fishes to a flat sandy terrain every year also makes them vulnerable to targeted fishery.

Broodstock development

Preliminary studies on live collection, quarantine and holding was carried out from 2012. A substantial number of juveniles and maturing specimens were collected live from bottom set gill net landings off Kanathur, Kovalam, Chemmenchery and Cuddalore Chinnakuppam to the south of Chennai. The size range of the fishes was 130-555 mm TL and 40-2500 g weight. The percentage of adult males was very less in fishes obtained from the wild in sizes beyond 400 mm. After several trials, standards were developed for transportation and conditioning of these fishes to laboratory holding. Fishes brought up by the gill nets were sorted without much physical damage and kept in seawater-filled containers on board FRP boats and brought to the shore. The fishes so collected were brought to the lab and shifted to dark coloured quarantine tanks of 1m depth with sand substratum. They were observed for wounds, scale loss, and behavior and treated with 50-250 ppm formalin depending on the intensity and size of the animals, for 3 consecutive days. The healthy ones were shifted to the grow-out and maturation facility developed in the lab. Since these fishes tend to remain buried in the sand, their skin and respiratory surfaces are quite vulnerable to external parasites and trematodes. With periodic treatment with formaldehyde and de-worming agents, the fishes survive exceedingly well.

Behaviour and biology

These fishes are mostly sedentary, nocturnal, photophobic, bury in sand, swim vertically up occasionally and rest of the time moves horizontally with flat white ventral surface beneath. They exhibit high levels of camouflage when live and normally their colour and pattern resembles that of the fine sand bottom. If probed and handled the band pattern turns deeper and brownish and when taken out the dorsal skin color turns dark brown. They are hardy to handle, scale are firm and can remain outside water for several minutes. After repeated trials it was understood that theses fishes prey upon only fishes that inhabit the lower strata of the water column like tilapia, cardinal fishes, eels, silverbellies, threadfin breams, lizardfish, anchovies and milkfish. We therefore conditioned them to feed on tilapia fry which is easily available in the backwaters of Kovalam-Muttukadu area. The fishes have so far not responded to artificial and inert diets or raw fish meat. Cannibalism has not been noticed. They remain buried in the sand and wait for the prey to come within close range, then snap the fish with wide open flexible jaws bearing large number of teeth and swallow it. The fish capture one or two fish at a time depending on the size of the prey and then retreats into the sand. They do not normally feed continuously and these activities are quite restricted. Through the wave like oscillatory movement of dorsal and ventral fins (lateral) the fish propel the body inside the sand with gentle slope towards the caudal side and normally remain buried. Handling these fishes need special care as the jaws have plenty of sharp teeth and the oral cavity is very big and flexible, it has also been observed that these fishes tend to turn back and attack the probing stimulus using their sharp dentition. Juveniles when stocked with larger

size group exhibited aggressive behavior and smaller animals were injured and starved due to competition for food.

Observation on adult female fishes sampled from the fish landings at Kovalam indicated size range from 255-545mm with fecundity ranging from 19740 to 300699. Depending on the ovarian maturation stage, the number of eggs per gram ranged from 1420 to 3850 in the wild sample, in fishes in maturity stages III and above. Sacrifice of nearly 30 fishes, for anatomical observation on gonadal maturity, have indicated that the fishes mature in the grow-out facility, with 30% of the stocked fishes entering into early stages of maturation.

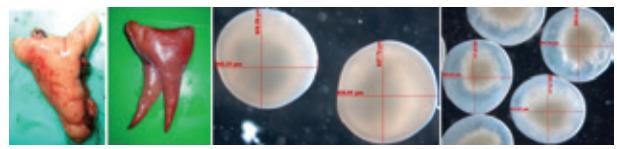
Spawning in captivity

Volitional spawning was observed in one of the broodstock tanks in August 2013. A female halibut weighing 1870 gms spawned in a 2 ton black FRP broodstock tank in the early morning hours, releasing approximately 60,000 eggs, and the male in the tank responded simultaneously. The floating single granule eggs (1540-1630µm) were collected and distributed into different incubation systems – dark coloured circular round tanks, with reduced and normal photoperiodicity. While early cell division was noticed, beyond 16 hours, the eggs turned opaque and settled at the bottom of the tank. The fishes were not induced to spawn by any hormones or chemicals. The salinity of the holding water was 36 ppt and temperature ranged between 28-29ÚC. The release of only nearly 60,000 eggs indicated that these fishes are multiple spawners, releasing eggs in frequent intervals during a single spawning season.

Halibut broodstock raised from juvenile sizes at Kovalam Field Laboratory

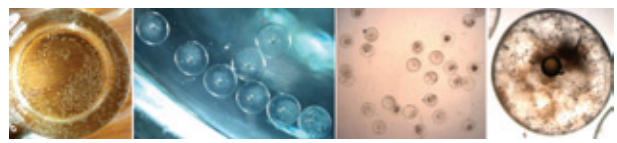
Change in external appearance in dead specimen gonads

Adult female with ripe



Developing testes and ovary

Intra-ovarian oocyte development



Spawned eggs

Eggs showing early development

Observations on spawning activity of green mussel *Perna viridis* in relation to surface water temperature in Pulicat Lake and Ennore backwaters

Shoba Joe Kizhakudan, Raja, S., Gupta, K. S., Thiagu, R., Sethi, S. N., Joe K. Kizhakudan, Geetha, R., Vivekanandan, E. and Zacharia, P. U.*
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The green mussel *Perna viridis* is an important bivalve species in India that is farmed in good quantities in few parts of west coast of India. These mussels are found to inhabit marine intertidal and subtidal zones with rocky patches favouring spat settlement. Protected estuarine and backwater

habitats have been reported as potential sites owing to their high natural productivity and sheltered environment. While a lot of study has been carried out on the wild population of green mussels and their amenability to culture along the west coast of India, this resource has not gained the same attention along the east coast. Some studies conducted in the past show the suitability of several localities along the east coast of India as ideal for green mussel culture. Ennore estuary, Muttukadu backwaters, Edaiyur backwaters and Palar estuary along the north Tamil Nadu coast have been reported as potential sites with seed resources available. A preliminary study was conducted under the project on National Initiative on Climate Resilient Agriculture (NICRA), on the availability and distribution of *P. viridis* in the backwaters of Pulicat (13° 25' 31.0 N; 080° 18' 55.3 E) and Ennore (13° 15' 49.9 N; 080° 19' 52.9 E) (Fig. 1) during the period February 2011 to January 2012.

Fig. 1. Map showing sites of green mussel collection

Length composition, sex ratio and reproductive phases of the mussels were studied across the months. The male-female sex ratio was 1:1.15 and 1:1.1 at Pulicat and Ennore, respectively. Total length ranged from 11 to 120 mm at Pulicat and 26 to 95 mm at Ennore (Fig. 2).

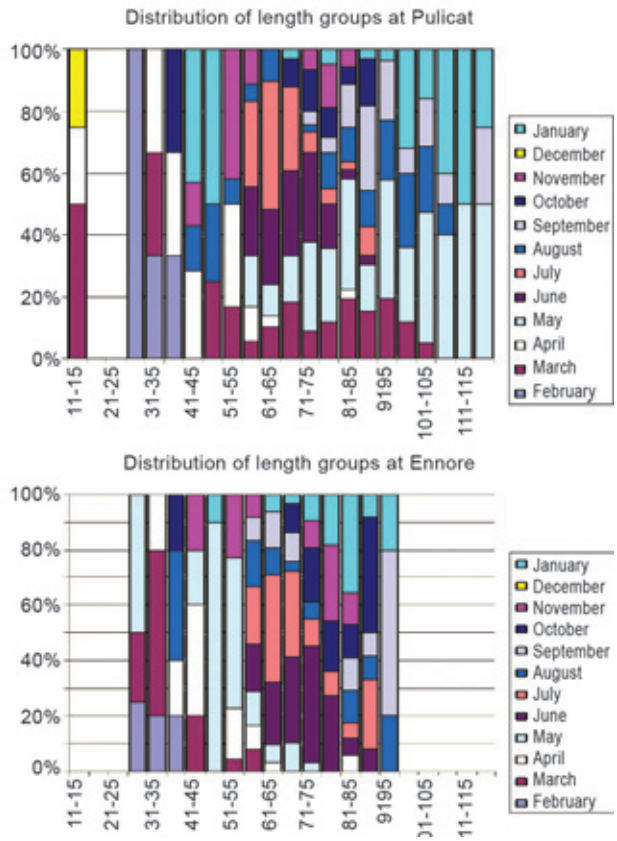

Fig. 2. Monthly size frequency distribution of *P. viridis* in Pulicat and Ennore waters

The availability of marketable sizes of 51-75 mm and above was found to be higher during April-July and again during September-January (Figs. 1&2). Two spawning peaks were observed at both stations, one in May and one in September. Earlier studies report two spawning peaks for *P. viridis* (May-June and October-November) in the Edaiyur backwaters and indicate that the reproductive activity of the mussel is directly linked to water temperature. The surface temperature profile in the two water bodies in the present observation showed two well defined maxima: one in May-June and the other in September-October, coinciding with the spawning peaks. Temperature ranged from 28°C (February, August and December) to 30.2°C (May) and 30.5°C (September) at Pulicat and from 28°C (December and January) to 30.1°C (May) and 30.5°C (September) at Ennore (Table 1).

Table 1. Surface Temperature profile of Ennore Estuary (in earlier studies and present study) (yellow boxes indicate temperature peaks)

	TEMPERATURE (°C)		
	1960-1961 (*Chacko and Rajagopal, 1962*)	**2009**(*data collected at CMFRI, Chennai*)	**2011-2012** (*present study*)
FEBRUARY	28	29	28
MARCH	29	28	29
APRIL	28.5	30	30
MAY	31	30.5	30.1
JUNE	31.25	30	30
JULY	30.5	26.5	28.5
AUGUST	30.5	30	29
SEPTEMBER	28.5	30	30.5
OCTOBER	30	29	30
NOVEMBER	27	27.5	27.5
DECEMBER	26.5	28.4	28
JANUARY	27.7	26.4	28
AVG	29.0	28.8	29.1

While earlier reports indicate high annual salinity fluctuation in Ennore Estuary during 1960-'61, observations made in the present study show that the average salinity is higher at present (32.38 ppt) than about fifty years ago (29.05 ppt). There is a perceptible increase in salinity maxima from 1960-'61 to 2011-'12 (Fig. 3).

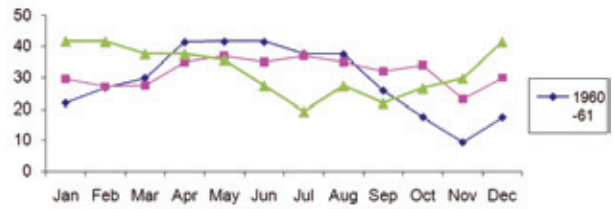

Fig. 3. Annual salinity profile in Ennore estuary - a comparision between 1960-'61 and 2009

Although a relation between spawning activity and salinity fluctuations could not be established, and the influence of rainfall anomalies need to be assessed, this study indicates the resilience of these mussels to variations in the natural environment. In the light of growing concern over negative impacts of climate change on the existence of several aquatic resources, the persistence of the green mussel in Pulicat and Ennore waters is a positive indication of the ability of the species to survive transient habitat conditions. Further studies are being carried out on the performance of other physic-chemical parameters and biological associations between these mussels and other fauna and flora present in the two ecosystems.

Dry cephalopods - A new market

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Cephalopods contribute 15.5% towards the marine fish landings in Maharashtra (CMFRI, 2013). The major cephalopod landing centres of Maharashtra namely New Ferry Wharf, Sasoon Docks and Versova are situated in Mumbai and they account for nearly 60% of landings in the state (Annam and Sindhu, 2005). There are about 45 municipal fish markets in Mumbai and more than 20 dry fish markets are located in Mumbai at various locations such as Worli, S ewri, Crawford market, Khar, Versova, Sion etc.

Fish being a highly perishable food item, it is preserved traditionally by sun- drying, smoking and salting. The oldest traditional way of preserving fish was to sundry it. Dried fish has been relished as food all along the coastal states of India and there is a tradition to consume it during special functions, especially among the lower strata of the society. It is widely consumed in the interior parts of India since availability and transport of fresh fish was poor. Dried fish is also used as a supplemental food for pets, which is a growing industry.

In Mumbai dry fish mainly belong to the species *Harpadon nehereus* (Bombay duck), *Lepturacanthus savala, Trichiurus lepturus, Eupleurogrammus muticus* (Ribbon fish), *Acetes indicus* (Paste Shrimp), *Bregmaceros mcclellandi* (Unicorn cod), *Coilia dussumieri* (Gold-spotted grenadier anchovy), *Lactarius lactarius* (Whitefish) and *Rastrelliger kanagurta* (Mackerel). As far as prawns are concerned they mainly belong to the species *Parapenaeopsis stylifera* (Kiddi Prawn) and *Exhippolysmata ensirostris* (Hunter Shrimp). Dry fish and dry prawns are observed regularly as it forms a very lucrative industry but dry cephalopods have never been reported. The activity of drying cephalopods that started off as a subsistence form of occupation is now slowly developing.

Largesized cephalopods are mainly exported while small size cephalopods are used as animal fodder and most of the times they discarded in the sea. But with the scope in dry cephalopod markets they are now dried. The oldest traditional way of preserving fish was to let the wind and sun-dry it and the same method is used by Worli fishermen to dry cephalopods. Cephalopods are sun-dried wholly without using salt which is cheap. It takes about 2-4 days for complete drying. All members of fishermen family are involved and there is a ready market available for dry cephalopods now. As mechanised trawling is suspended from 10th June to 15th August, due to southwest monsoon and restrictions on fishing imposed by the government of Maharashtra, the demanding main market for dry fish, prawn and cephalopods are during this period.

Two species of cephalopods are used for drying namely *Loliolus investigatoris* (Plate 1) commonly known as 'Investigator squid' and small sized 'Spineless cuttlefish' *Sepiella inermis* (Plate 2) both are exploited by *dol* netters and the fresh catch is used for drying. *L.investigatoris* is a small sized squid with maximum dorsal mantle length 55 mm and *S. inermis* ranging in dorsal mantle length between 20-40 mm are considered for drying.The price of dry *L.investigatoris* ranged between ₹ 20-30/kg whilethe price of *S. inermis* ranged from ₹40-50/kg in local markets. Being relatively cheaper it is economical for the buyers too as alternative to fresh fish and meat.

Fig. 1. *Loliolus investigatoris* placed for sundrying

Fig. 2. Dried Cuttlefish *Sepiella inermis*

Locally fishermen use the sun dried cephalopods in the preparation of dry gravy known as 'Makul korma'. It is prepared by adding dry cephalopods along with oil, onion, ginger-garlic paste, coconut etc. in a frying pan and mixed well to sauté in oily mixture of masala. When the water has almost dried up, green chillies and the 'Kewra flower' (a local spice) are added and heated in simmering flame. When the oil begins to float on top the dish is ready to serve.

The method of cephalopod drying can also be emulated by other coastal states of India. Cephalopod drying is cheap and easy and identifying clean fish drying yards near to the fishing harbor will go in a long way in improving the quality of fish, prawn and cephalopods dried and also increase utilization of dry fish for human consumption.

Drifting container with thin plastic carry bags cast ashore at Kampuram beach near Calicut

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One transhipment container (12x5 m) marked TCKU 336399[4] was seen washed ashore at Kampuram beach (11° 16' 773" N & 75° 45' 673" E) near Calicut at 06.00hrs on 1-8-2013 (Fig 1). The container was packed with 12-15 tonnes of thin (below 15 micron) polythene carry bags of 20 litre capacity printed as RUBIN (Fig. 2 & 3). An array of plastic carry bags folded as a long belt was rolled together and packed inside the container. Around two tonnes of these carry bags were found scattered along the entire beach and many were seen floating in the intertidal waters imparting yellow colour to the seawater. On the same day similar containers were also reported to be landed at Thrikkanad beach near Kasaragod (Fig. 4), and at Edakazhiur beach near Thrissur. Sources from the print and visual media reported that these containers were part of the consignment on board the MV *MOL Comfort*. MV *MOL Comfort* sank off 840 nautical miles west of Mumbai at 14° 26' N & 66° 26' E on 27June 2013 after developing a catastrophic crack to her hull ten days before. This 316 m long container vessel was carrying a cargo of more than 1,700 containers from Singapore to Jeddah. Due to the crack in the hull the ship broke into two before sinking in the Arabian Sea. The outer surface of the container landed at Kampuram beach had settlement of some barnacles confirming that the container was drifting in water for more than 30 days. This information is significant to understand the direction and velocity of the current from the sinking site. It is feared that the ill-fated vessel had 1500 metric tonnes of oil (fuel) besides the cargo containers.

Fig. 1. Container washed ashore at Kampuram beach;
Fig. 2. Scattered carry bags from the container being collected.

Fig. 3. Plastic covers washed ashore at Kampuram beach (Calicut)

Fig. 4. Carry bags landed at Thrikannad beach (Kasaragod)

Mass envenomation during Ganesh idol immersion at Girgaum-Chowpathy beach, Mumbai, Maharashtra

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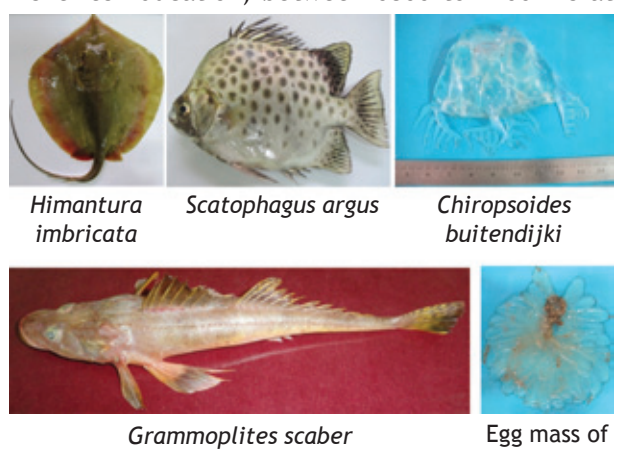
At the end of South-West monsoon along Mumbai coast a swarm of the box jelly fish, *Chiropsoides buitendijki* was observed during Ganesh idol immersion at Girgaum-Chowpathy beach, Mumbai on 10th September, 2013. The occurrence of such large number of jelly fishes coincided with Ganesh idol immersion, perhaps for the first time in Mumbai waters. Several devotees of Ganesh who congregated at Girgaum-Chowpathy beach for immersion ritual of Ganesh idol were stung by the jelly fish. According to the news paper reports, the devotees moved with the idol in ankle-deep water for immersion and immediately thin tentacle-like threads pierced legs and ankles causing severe burning sensation. When the victims reached the beach, swelling, blister, bruises and severe pain was reported and about 60-75 victims were hospitalized for the treatment. At the same time many people had sting bite of Whiptail ray, *Himantura imbricata*. The local news papers and TV channels broadcast the news that sting ray and eel were the causative agents for the incidence.

Knowing the expertise of CMFRI, Commissioner of Maharashtra State Fisheries Department contacted Scientist-in-Charge of Mumbai Research Centre to conduct a survey of the beach and near shore waters. On 11-9-2013 CMFRI scientists and technical staff carried out expeditious survey of the beach and near shore waters in early morning hours by shore seines (drag netor *yendi* net and *pera* jal in Marathi) and fishing nets. The survey revealed presence of stings rays, box jelly fish, flat head, spotted scat and eels in shallow water at the beach (Fig. 1). The honourable Chief Minister Prithviraj Chavan called the CMFRI team to appraise about the organisms that caused the panic and hospitalization of the victims. He showed keen interest in the causative organisms and instructed the team to carry out onshore and near-shore surveys on 13-09-2013 and 18-9-2013 (5th and 10th day of Lord Ganesh immersion) to give pre-immersion alert and warnings.

On 13th and 18th September 2013, surveys were carried out by 3 teams between 0700 and 1200 hrs. One team visited Girgaon Chowpatty and the other Juhu-Versova beach. The first team carried out 3 onshore surveys using beach seine operation of fishing nets in 0.5-1.5 m depth at Girgaon Chowpatty. Second team combed the beach from Juhu to Versova and observed many indigenous fishing boats and trawlers fishing very close to the beach in 1-5 m depth. The fish nets showed presence of edible fish and prawns in the near shore waters. But, presence of banana prawn *Penaeus merguiensis* in large congregation in shallow depths was conspicuous for which about 50-70 indigenous boats carried out fishing. There were no dangerous jelly fish and sting rays in the water on either day. Third team carried out boat survey in the sea 1.5 km away from the coastline from Versova to Cuffe Parade. Three trawling operations were carried out by M.F.V. Narmada (fishing vessel of Central Institute of Fisheries Education) between 0800 to 1200 hrs at



Himantura imbricata | *Scatophagus argus* | *Chiropsoides buitendijki*

Grammoplites scaber | Egg mass of Cephalopods

Fig. 1. The specimens collected during survey of Girgaum-Chowpathy beach, Mumbai

Verova-Juhu, Dadar-Worli and off Malabar hill and Cuffe Parade. The fishing surveys showed usual fishes such as sole, anchovy, cat fish, prawns and Bombay duck; no potentially dangerous organisms were noticed in trawl catch in the near shore waters on either day. Neither jelly fish nor sting ray was noticed in the fishing operations and beach survey.

However, on 18-9-2013 the beach surveys at Girgaon Chowpatty showed presence of 12 sting ray babies in 1-1.5 m depth from 3 beach seine operations. Assuming uniform distribution of sting rays, it was estimated that there were nearly 6,000 sting ray juveniles in the entire Girgaon Chowpatty bay area of 3.1 Sq km. Their sting is potentially dangerous to the devotees entering the sea, therefore based on CMFRI report the Municipal Commissioner gave warning to the public and devotees against the sting ray bites even in knee deep water during entire immersion event.

The sting ray was identified as *Himantura imbricata* and eel as *Gymnothorax* sp. All the sting rays were new borns young ones in the size range 75-140 mm in disc diameter and possibly they entered the bay area for feeding on intertidal molluscs. But presence of such large number of juveniles of the demersal fishes in shallow waters may be related to oxygen minimum layer that to the shore surfaces along Maharashtra coast by September, the anoxic layer rising pushed them to nearshore waters and topographic currents aggregated them in the bay. Despite being juveniles and new born babies, the stings of the rays were powerful enough to cause severe pain and wounds.

The box jelly fish was identified as *Chiropsoides buitendijki*. Although it is not highly dangerous like *Chironexfleckeri* which is deadly and cardio-toxic, it has nematocysts on the tentacles which produce neuro-toxin. This neuro-toxin caused severe itching and burning sensation and the victims were treated with lime and anti-histamine injections. On 10th September the atmospheric temperature was very high and possibly the surface sea water temperature also increased, as a result the jelly fishes gathered in the bay area. However, rainfall and sudden cooling of sea water induced scattering of jelly fishes all around in shallow water bay which caused panic among the devotees.

Marine fishes *Himantura imbricata*, *Grammoplites scaber*, *Scatophagus argus* are demersal fishes move away for disturbances in the water and rarely attack the human beings or predators in self-defense. The mass envenomation to the devotees cannot be caused by these fishes and may not be the reason for hospitalization of the victims. During analysis of samples, it was found that the box jelly fish, *Chiropsoides buitendijki* and*Himantura imbricata* were the species that caused mass envenomation to the public during Ganesh idol immersion. While the box jelly fish was examined in the laboratory for the identification, accidently its tentacles touched on the right thumb of first author and immediately the microscopic nematocyst adhered to the skin and venom was injected to the local area of thumb and is got swelling. The sudden swelling of the thumb followed warm sensation at the swollen area, strained eyes and slight giddiness. The box jelly fish sting was treated with fresh lime and seawater to remove the unfired nematocysts to avoid further worsening of the sting. This incident led to declare that mass envenomation was caused by the box jelly fish, *Chiropsoides buitendijki* only, but the not other species collected during the survey.

The Scaly whiptail ray, *Himantura imbricata* often buries in sandy and muddy bottom and remains motionless until disturbed. The sting ray twists the tail upward and forward, driving the spine into victim's body when disturbed. As the sting enters the flesh, integumentary sheath of the spine is ruptured and venom comes into contact with the victim's tissues.

The phyisco-chemical parameters were also collected during the survey of Girgaum-Chowpathy beach, Mumbai presented in Table 1.

Table 1. Physico-chemical parameters of Girgaum-Chowpathy beach, Mumbai on 11th September, 2013.

Atmospheric Temperature	28°C
Water Temperature	27.7° C
pH	7.8
Salinity	32.6 ppt
Conductivity	49.7 mS/cm
DO	3.82 mg/l
TDS	34.43 ppm
Turbidity	42.3 NTU

Fibre boat fishery using combined gears

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Central Marine Fisheries Research Institute, Kochi

Fibre boat fitted with outboard engine are used for fishing with combined gears of drift gillnet and hooks & lines. In August they had gone with both the gears in the craft. The duration of absence from land had increased from 40-48 hours to 60-70 hours. The depth of operation had increased from 40m to 70m. The mode of operation while out in the sea also had some differences, that they go for drift gillnetting during evening hours and the time in between the hauls were used for hooks & lines operation. During the day also they go for hooks & lines operation in accordance with the availability of catch. The catch had more of *Xiphias gladius*, *Mene maculate* and *Mola mola* in addition to the other fishes such as tunas, sharks and billfishes. The drift gillnet operation takes 6-8 hours per haul and hooks & lines operation depends on the availability and the total average duration/ trip /unit which is between 20 and 22 hours.

Thunnus albacares caught by fibre boat using combined gear of Driftgillnet/ hooks & lines

Mola mola caught by fibre boat using combined gear of Driftgillnet/ hooks & lines

Xiphias gladius caught by fibre boat using combined gear of Driftgillnet/ hooks & lines

A comparative study of Marine Fisher-folk census 2005 and 2010 of Tamil Nadu

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The Central Marine Fisheries Research Institute regularly undertakes Marine Fisheries Censusfor all the maritime states of the country. Based on the census report of Tamil Nadu state a comparative study focusing mainly on population, fishing villages, landing centres, sex ratio, religion, BPL, education and occupation was carried out for two census period viz. years 2005 and 2010. The study was aimed to find correlational statistics, salient features and significances over the two study periods.

The Tamil Nadu coastal line extends over 1078 km and consists of 13 coastal districts. The boundary starts at Arambakkam village in Thiruvallur district in the north end and ends at Neerodi in Kanyakumari district in the south. This state is one of the foremost in India showing unfaltering increase in marine fish production and fishermen of the state are in pioneer in adopting many innovative technologies in their fishing activities. The state of Tamil Nadu has 1.9 lakh sq. km of Exclusive Economic Zone (EEZ),continental shelf of 41,412 sq. km. and 383 fish landing centers. The stateconstantly contributes more or less 10% of marine fish landings to the country and exports 77,791 mt of fish worth Rs 2995 crore.

Population: The fisher-folk population has been recorded during n the years 2005 and 2010 are 790408 and 802912 respectively. The average family size was maintained even after five year period as 4.1 and average person per village has marginally increased. Theadult population of male andfemale have increased by 3.85% and 3.4% respectively and the children population decreased andin particular thepopulation of female children decreased considerable further.Of the total fisher-folk

Table 1. Fishing Villages, Landing Centres, family size, total population

District	Landing Centres		Fishing Villages		Fishermen families		Fisher-folk population		Average Family Size	
	2005	2010	2005	2010	2005	2010	2005	2010	2005	2010
Thiruvallur	14	18	30	26	9630	7544	36775	28109	3.82	3.73
Chennai	12	14	43	44	18809	15176	75166	67464	4.00	4.45
Kanchipuram	38	42	42	42	7723	8469	27962	29974	3.62	3.54
Villupuram	19	18	19	19	4416	4720	16093	18124	3.64	3.84
Cuddalore	28	44	47	42	12840	12714	48705	48518	3.79	3.82
Nagapattinam	41	41	56	57	22643	21122	91415	84369	4.04	3.99
Thiruvarur	0	3	13	13	2956	2580	11827	9995	4.00	3.87
Thanjavur	25	25	31	31	7087	6530	30482	29489	4.30	4.52
Pudukottai	20	30	33	33	6791	6398	29921	29663	4.41	4.64
Ramanathapuram	80	90	180	178	38800	41048	175421	193413	4.52	4.71
Tuticorin	22	27	31	32	18671	19998	78487	82560	4.20	4.13
Tirunelveli	9	9	9	9	4381	6132	19615	24639	4.48	4.02
Kanyakumari	44	46	47	47	37405	40266	148539	156595	3.97	3.89
Total	352	407	581	573	192152	192697	790408	802912		

population, Ramanathapuram district has retained the first place during the periods with increase in numbersby 2%, similarly the Kanyakumari district retained the second position with same trend of increase by 1%.The Thiruvallur district was last in the listbut improved by a marginal decrease (Fig 1.).

Sex Ratio: In the year 2005, average female to maleratio was 948. The Kancheepuram district has the highest value of 1009 and the Pudukottai district has remained as last district with alowest value of 921. The average sex ratio in the year 2010 was 939, and was maximum in the Chennai district which

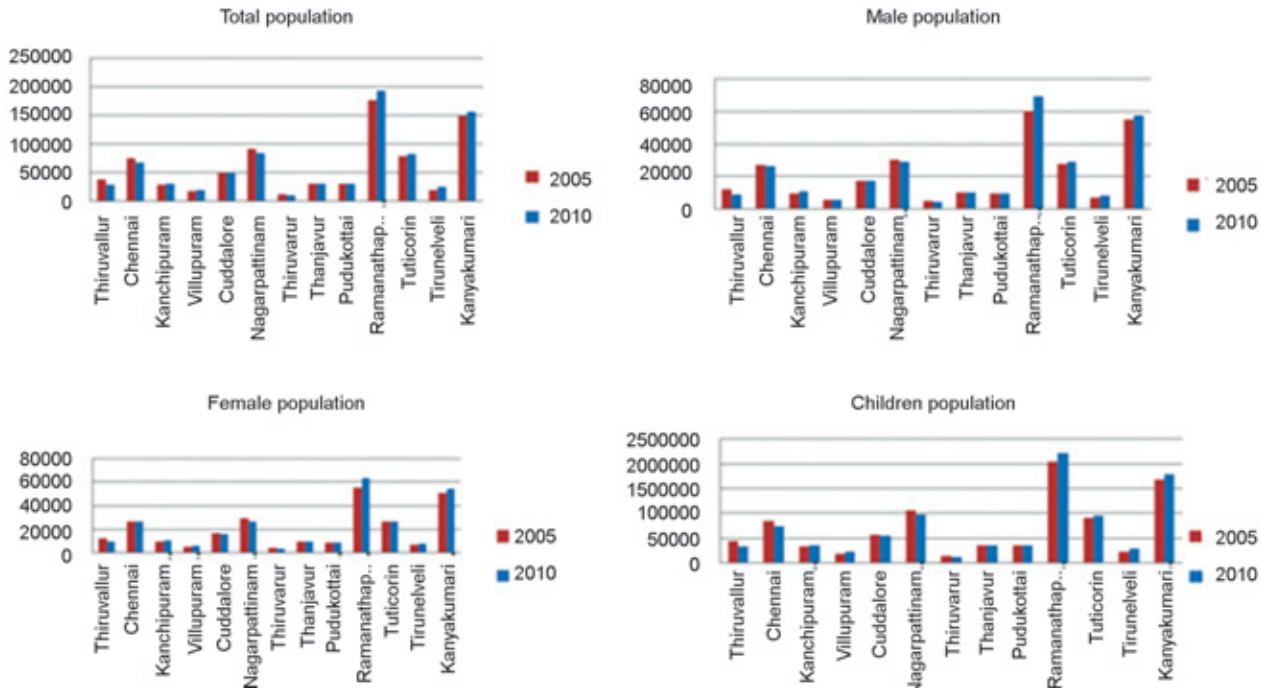


Table 2. Male, Female and Child population distribution

	Male Adult		Female Adult		Male Children		Female Children		TOTAL	
District	2005	2010	2005	2010	2005	2010	2005	2010	2005	2010
Thiruvallur	12020	9134	12014	9417	6558	4908	6183	4650	36775	28109
Chennai	27151	26475	26929	27229	10957	7118	10129	6642	75166	67464
Kanchipuram	9592	10757	10004	10478	4321	4624	4045	4115	27962	29974
Villupuram	5420	5561	5560	5736	2625	3724	2488	3103	16093	18124
Cuddalore	17227	17219	16505	16336	7695	8127	7278	6836	48705	48518
Nagapattinam	30099	28738	29050	26984	16918	14929	15348	13718	91415	84369
Thiruvarur	4648	3978	4383	3626	1388	1221	1408	1170	11827	9995
Thanjavur	10281	10215	10090	9640	5070	4785	5041	4849	30482	29489
Pudukottai	9320	9795	8478	9085	6255	5741	5868	5042	29921	29663
Ramanathapuram	60009	69338	55540	63821	31193	31648	28679	28606	175421	193413
Tuticorin	27815	28798	26391	27213	12324	13642	11957	12907	78487	82560
Tirunelveli	7117	8415	6669	7911	2991	4392	2838	3921	19615	24639
Kanyakumari	54857	57735	51234	54298	21939	23150	20509	21412	148539	156595
Total	275556	286158	262847	271774	130234	128009	121771	116971	790408	802912

recorded 1008 and minimum in Pudukottai district which was909 showing a marginal decrease by 12.

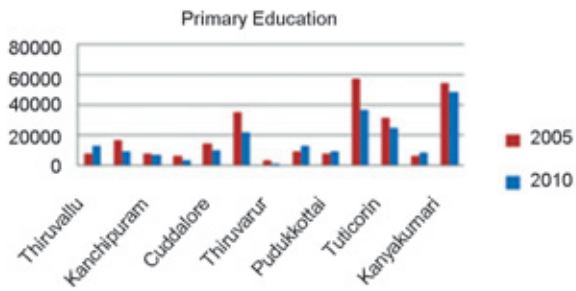
Landing Centres and Fishing Villages: A total of 581 fishing villages were recorded in the year 2005 where as in the year 2010 the number was decreased by 8. Even though the number of fishing villages has been decreased over the period, the number of landing centres have been increased by 55, making a total of 407 in the year 2010.

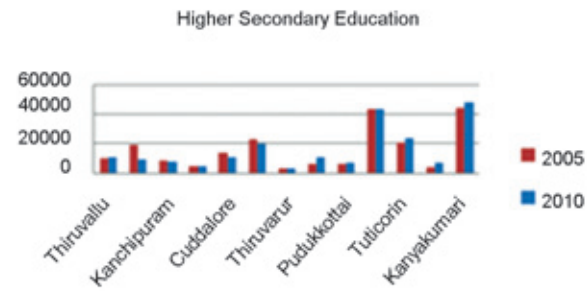
Religion: Hindus constituted 59% and 56% for the years 2005 and 2010 respectively. The Christian and Muslim population had been grouped by a cluster by marginal increase of Muslim and considerable increase of Christianity. The SC/ST population has also increased a bit by less than a percentage. The southern districts of Tuticorin, Tirunelveli and Kanyakumari fishermen are over-weighted by Christianity and rest of the districts by Hindus.

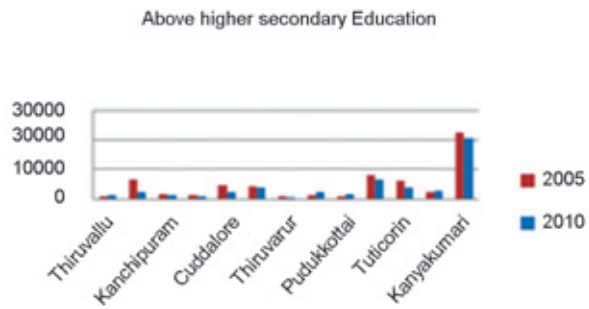
BPL: The latest survey reveals that 66% of families fall below poverty line (BPL). The Villupuram districts acquired disfavor status of first place as 99.9% followed by Kancheepuram (99.6%) while Kanyakumari district is the last with only 18.9%.The 2010 general survey reveals that 15.8% of population isBPL families in Tamil Nadu despite India estimates for the year 2011-12 was 21.9% by Planning Commission of India.

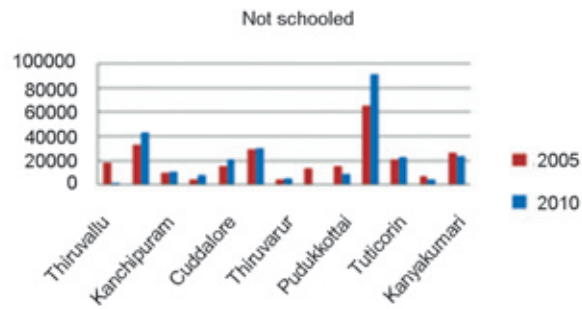
Education: The unfair curve ofliteracy shows increasing unschooled strengths in 2005 and 2010 as 33% and 37% respectively. Primary education has been decreased by 5% whereas higher secondary level increased by 2% and above higher secondary level also marginally decreased.On the whole literacy level has been decreased by 4% (Fig 2.).

Occupation: The full time fishermen density over the periods had increased from 89%to 93%,whereas the fishermen engaged in part time and allied activities were decreased by 2%. Of the total fishermen population, the active fishing activities considerably increased by 8%. The fisher-folk were found to engage in allied activities such as marketing, repairing/making nets, curing/ processing, peeling,labours and other related activities. The deviation from fishing activities in Chennai district has been reduced to 1513 persons; while in Kanyakumari district it got increased by 1731 persons (Fig. 3).









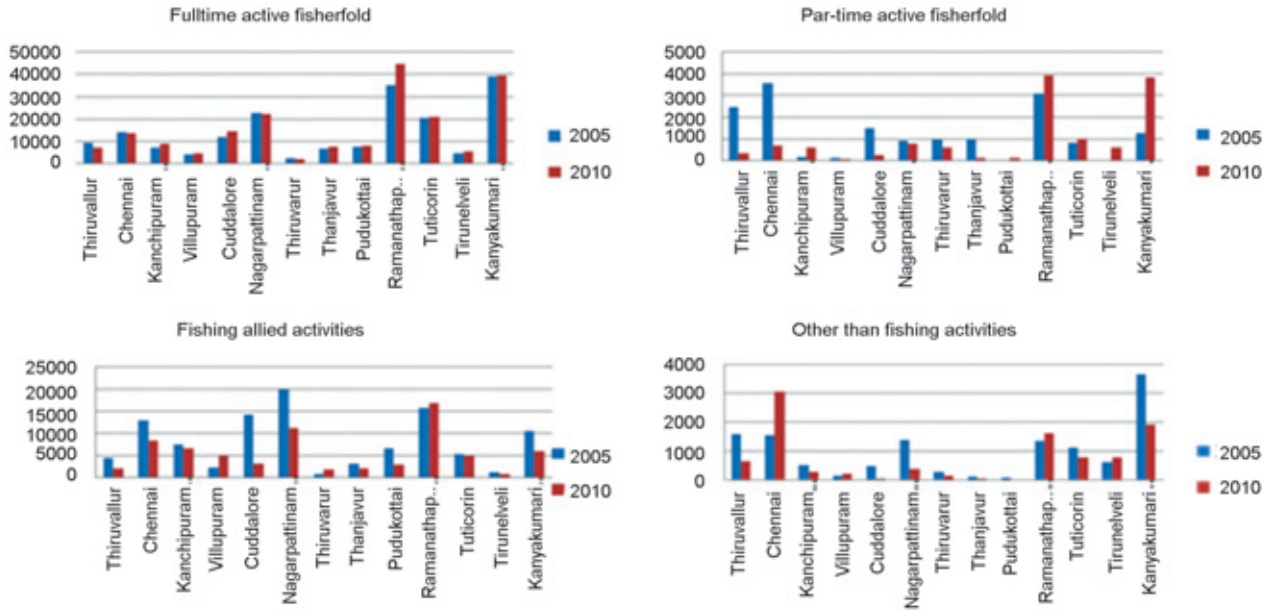


Table 3. Active fishermen

	Full Time		Part Time		Fishing Allied Activities		Other Thanfishing	
District	2005	2010	2005	2010	2005	2010	2005	2010
Thiruvallur	9346	7198	2478	328	4437	2089	1584	626
Chennai	14080	13678	3590	708	12883	8389	1551	3064
Kanchipuram	7122	8835	150	625	7580	6645	519	285
Villupuram	4152	4599	111	97	2180	4754	129	216
Cuddalore	11885	14376	1498	260	14274	3098	481	32
Nagapattinam	22470	22229	932	804	19996	11215	1388	370
Thiruvarur	2550	1975	948	612	624	1852	282	143
Thanjavur	6842	7383	1010	135	3134	2012	109	51
Pudukottai	7638	8083	12	139	6526	2935	57	0
Ramanathapuram	35174	44815	3066	3938	15826	16886	1350	1618
Tuticorin	20565	20759	844	988	5199	4836	1100	767
Tirunelveli	4651	5334	50	608	1223	808	619	758
Kanyakumari	39128	39592	1265	3836	10627	6022	3648	1917
Total	185603	198856	15954	13078	104509	71541	12817	9847

Other observations during the survey were like reduction in child population and relocation of some villagers to adjacent or nearby villages due to developmental activities in their places of origin. The number of landing centres were increased due owning of fishing boats, nets and availability of common infrastructure provided by Tsunami relief to the affected fisher-folk.

There is not much change in the number of full time active fishermen except in Ramanathapuram district. In Kanyakumari district, the part time active fishermen numberincreased more than two folds and fulltime as well as part time active fishermen considerably increased in the Ramanathapuram district. As far as the fishermen engaging in fishing activities are concerned, it is observed that many fishermen are diverting themselves away from fishing activities in Chennai district while in Kanyakumari district, a reverse trend is seen.