ISSN 0254-380 X

No. 204
April-June 2010

Marine Fisheries Information Service

Technical and Extension Series

भाकृ अनुप
ICAR

Central Marine Fisheries Research Institute
(Indian Council of Agricultural Research)
Post Box No. 1603, Cochin - 682 018
www.cmfri.org.in

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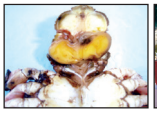
Marine Fisheries Information Service

No. 204 * April-June, 2010

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

CONTENTS



Sacculina on crab along with attached *Lepas*

Gastropod shells embedded on compound walls

Sepia elliptica

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.

Marine fisheries in Kerala - an overview

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The state of Kerala, located at the extreme southern narrow strip of the Indian sub-continent is wedged between the Arabian Sea to the west and the Western Ghats to the east. It is lying between 8°18', 12° 48' north latitudes and 74° 52', 77° 22' east longitudes. Kerala coast runs for about 590 km with 190 landing centres spreading over nine coastal districts.

Fishery is one of the major activities which plays a vital role in the economy of the state. The continental shelf of the coast is about 40,000 km^2 of which 13% is within 18 m depth range, 64% between 18-73 m and the remaining is within 73-180 m depth zone. As per the Marine Fishery Census 2005, about 1.20 lakh fishermen families were there in the state living in 222 fishing villages along the coast. The state's fish production is estimated to be about 20 to 30% of the all India fish production, though the coastline of the state is only one tenth of the entire coastline of India. The gear operations in the fishery is confined to the depth range of 2-60 m.

There are regional variations in the artisanal fishing fleet of Kerala due to differences in the oceanographic features followed by technological interventions over time and the global market demand for particular varieties of finfish and shellfish. Kerala's southern coast which is otherwise called the Travancore coast, is famous for its kattamarans. Kattamarans are suitable for the surf ridden and deep waters. The central coast of Kerala (Cochin coast) is famous for the plank-built canoes and the northern Malabar coast is known as the dugout canoe belt. The calm sea prevailing in the Cochin belt enables the introduction of plank-built canoes of much larger size. The clayey sea floor and good access to low saline backwaters attract and sustain crustaceans and has made Cochin and Malabar coasts among the richest prawn fishing grounds of the world.

The Government of Kerala imposed a trawl ban from 1988 onwards along the entire coast line of the state for a period of 45 days with effect from 15th of June in order to conserve the fishery wealth and thereby protect the interest of the persons engaged in fishing, particularly those engaged in fishing using traditional fishing crafts as well as to regulate fishing on a scientific basis.

Mechanisation of craft and gear started in the early fifties in Kerala. During the sixties, cotton webbing paved way to nylon webbing. Commercial purseseining started during the late seventies at Cochin. Motorisation of country crafts started in eighties. During nineties, multiday fishing and targeted fishing for prawns, squids and cuttlefishes were the main changes in the fishing scenario. There were significant changes in gears used by the artisanal sector. Boatseines have been converted into ringseines and the country crafts were cut into two similar halves and fitted with outboard engines to carry minitrawls to the sea. Thermocol boats were employed in the artisanal sector of Alappuzha District from which dinghivala is operated.

After the experimentation of mechanisation in the fishing industry in late fifties, more number of mechanised crafts, including those crafts fitted with outboard and inboard engines were used by the fisherfolk in the state. A large number of country crafts used were gradually converted into motorised crafts in the later period of eighties. Many modifications were done by introducing fibreglass boats which withstand rough conditions of the sea. Electronic gadgets and life saving equipments are also used by the fishermen of the state.

As per the estimated marine fish landings by CMFRI, 94% of the fish landings was accounted from the mechanised and motorised sectors during the two decades starting from 1985. During 2005-2008 period, the percentage contribution got raised to 98%. From the research findings of CMFRI (Production pattern of marine fisheries in Kerala, 1999) it was observed that about two thirds of fish landings of the

state was accounted by artisanal sector till 1979. After the mechanisation of country crafts, many fishers switched over to it, expecting good fish yield. Thanguvallom fitted with outboard engine employing ringseines for fishing, played a vital role by dominating in the fish production and became a boon to the fisherfolk of the state from 1986 onwards. This resulted in the depletion of artisanal gears and their catch to an extent of 2%.

The tsunami of December 2004 has dealt a severe blow to the coastal marine fishery sector causing huge loss of lives, fishing crafts and gears in the state especially in Thiruvananthapuram, Kollam, Alappuzha and Ernakulam districts. As per the official figures released by the Ministry of Home Affairs, the number of losses or missing of human lives was 176, population affected was 2,470, villages affected were 187 and 11,832 dwellings were also affected in Kerala. Immediately after the tsunami, fishing operations along the coastal regions came to a stand still. Few fishermen who ventured into fishing restricted their activities near to the shore.

While comparing the landings along the tsunami affected districts during January – March 2004 with the corresponding period of 2005, a vast difference of nearly 20,000 t was observed. The same level of depletion in the unit operations was also reflected. Even though marginal increases of oilsardine, other sardines, *Stolephorus* spp. and other tunnies were noticed in the catches, threadfin breams, carangids, penaeid prawns, non-penaeid prawns and cephalopods showed a decreasing trend. The unit operations of mechanised and motorised driftnets increased in 2005, but catch was more or less the same resulting in lower catch per unit effort. Mini-ringseines (discovala) with mesh size 10 mm of Alappuzha District, only could reverse the situation by harvesting the fingerlings of oilsardines. Nearly 87% of the mini-ringseine landings was constituted by the juveniles of oilsardines. These young sardines, after sundrying, were exported to Tamil Nadu for making poultry feed. Landing pattern along the tsunami affected coastal belt of Kerala before and after the havoc is given in Table 1.

Table 1. Marine fish landings of tsunami affected coastal belt of Kerala during pre- and post-tsunami period

Name of gear	2004 (January - March)		2005 (January - March)	
	Landings (t)	Effort (Units)	Landings (t)	Effort (Units)
Mechanised				
Multiday trawlnet	19363	17588	5771	7500
Trawlnet	5429	10945	1364	6577
Hand trawlnet	181	2586	300	3586
Purseseine	198	244	1	5
Driftnet/gillnet	225	187	409	362
Hooks and lines	422	443	230	144
Ringseines	5690	1905	2428	1170
Motorised				
Driftnet/gillnet	1950	43763	1949	47650
Gillnet	6675	42285	7953	34726
Hooks and lines	3927	67588	1854	54195
Ringseines	2572	1412	415	281
Boatseines	333	588	79	203
Mini-ringseines	1971	2381	14953	16356
Trawlnet	1372	17238	801	10983
Others	0	0	1	23
Non-mechanised				
Gillnet	1134	58143	1097	80394
Shoreseines	7939	14067	119	6455
Hooks and lines	102	28591	145	38394
Others	16	1240	55	4207

Marine Fisheries Census 2005

Marine Fisheries Census with funding support from Department of Animal Husbandary and Dairying (DAHD), was conducted by CMFRI during 2005. The statistical highlights of the state as per the above census, is given in Table 2.

Twenty three percentage of the fishermen population in Kerala were active fishermen. About 88% of the active fishermen were engaged in full time fishing, 8% were doing part time fishing and 4% were occasionals. Full timers number was higher in Thiruvananthapuram District. Nearly 12% of the fisherfolk earned their livelihood from allied activities like marketing, making/repairing nets, curing/ processing, peeling, labour and other fishery related activities. Sharing pattern also existed among fishermen and it was more visible in seines, trawlnets and driftnets. Electronic gadgets and life saving equipments were owned by 4.4% of the fisherfolk community. There were about 414 curing yards, 320 ice factories, 153 peeling sheds, 112 boat yards and 56 freezing plants in different fishing villages of the state. Nearly 66% of the fisherfolk families of the state involved in fishing possessed neither craft nor gear.

Table 2. Statistical highlights of the Marine Fisheries Census, 2005

Fishing villages	222
Fisherfolk families	120,486
Fisherfolk population	602,234
Male	304,308
Female	297,926
Sex ratio (females/1000 males)	979
Active fisherfolk	
Full time	124,103
Part time	10,488
Occasional	5,463
Fishers engaged in allied fishing activities*	
Male	35,622
Female	35,452
Crafts in the fishery	
Mechanised	5,504
Motorised	14,151
Non-motorised	9,522

*Allied fishing activities includes making and repairing of nets, peeling, curing, processing, labour and other fishing related activities

Trends in marine fish landings during 1985-2008

For a comparative study of different features of fishing scenario, the 24 year period starting from 1985 to 2008 was divided into five year periods namely 1985-'89,1990-'94, 1995-'99, 2000-'04 and 2005-'08. It was observed that there was a remarkable increase in the landings since the upgradation and mechanisation of country crafts in the state and the landings from the non-motorised sector became very nominal.

During 1985-89 period, the landings touched 6.6 lakh t (Fig. 1) owing to motorisation of country crafts and heavy landings of oilsardine and mackerel by purseseines and ringseines. During this period, oilsardine landings was 19% of the total landings followed by penaeid prawns 11%, carangids 10%, perches 9%, Indian mackerel 8% and *Stolephorus* spp. 8%. The minimum landing during the above period was in 1987 with 3.03 lakh t. This fluctuation can be attributed to the reduced operations of purseseines, driftnet/gillnets, boatseines and minitrawls. Though boatseines were replaced by ringseines, the change was at a slow pace.

During 1990-94 period, heavy landings was recorded in 1990 when ringseine operations picked up momentum. Lean landings were observed during 1992 with 5.61 lakh t. During this five year period, oilsardine constituted 13%, carangids 13%, Indian

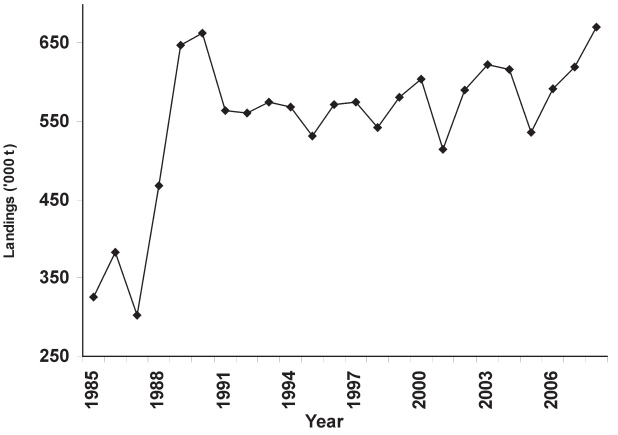

Fig. 1. Marine fish landings of Kerala during 1985-2006

mackerel 12%, perches 10% and penaeid prawns 9% of the total landings. In 1994, influenced by the high income generating catches such as shrimps and cephalopods, fishers extended their area of operation of the trawlers and started targeted fishing. Oilsardine fishery witnessed a heavy depletion in 1994. Trawl landings and the effort expended was maximum during 1994. The increased use of trawlnets caught more ribbonfishes, mackerels, penaeid prawns and cephalopods. Maximum number of minitrawl, were operated during this period.

During the next five year period 1995-99, a constant trend with an average catch of 5.6 lakh t annually could be noticed. Major contributors were Indian mackerel (16%), oilsardines (13%), carangids (12%), perches (9%), penaeid prawns (9%) and cephalopods (6%). The maximum landings of mackerel was in 1996 with 1.28 lakh t. Oilsardine was keeping an increased trend during this period. During 1996, trawl operation was reduced to half compared with 1988, even though a 27% hike was observed in the trawl landings. This was the effect of multiday trawl operations. Purseseine landings, after a break of six years, crossed 8,100 t in 1996 with increased operation of units, resulting in less catch per unit effort. At the end of this period non-motorised landings got reduced to 26% of that of 1985.

During the period 2000-04, the average annual landings crossed 6 lakh t except in 2001. Major components which contributed heavily were oilsardine (38%) followed by perches (9%), carangids (6%), Indian mackerel (6%), penaeid prawns (7%) and cephalopods (5%). Oilsardine landings crossed 2 lakh t

during this period. A remarkable decline was noticed in the penaeid prawn landings during 2004 resulting in 30.6 thousand t which was almost equal to that of 1989 landings of the resource whereas cephalopods landings crossed 41 thousand t for the first time in 2004. This was the main effect of targeted fishing for squids and cuttlefishes for they got access in the export market.

During 2005-08, the average annual landings of the state was 6.04 lakh t and the peak landing was observed in 2008 with 6.70 lakh t. During 2005, the landing was 5.36 lakh t which was the minimum of that period. The important groups landed heavily were sardines (38%), mackerels (9%), perches (7%), other clupeids, penaeid prawns, carangids and ribbonfishes (6% each), cephalopods (5%), tunnies (4%) and flatfishes (3%), in the order of abundance. In the mechanised sector, trawlnet, driftnet/gillnet, hooks and lines and ringseines showed a decreasing trend during 2007 and purseseines and multigear operations showed manifold improvement. Considering the motorised sector, gillnets, ringseines and minitrawlnets contributed heavily while the landings of hooks and lines and boatseines showed a decreasing trend. During 2008, heavy landings of *Stolephorus* spp. by ringseines and penaeid prawns by trawlnets were noticed. Among seerfishes, the king seer ranked first in the state even though stray catches of *Scomberomorous guttatus* and *Acanthocybium* spp. occurred throughout the year.

As per the marine fish landings estimate, landings varied from 3.25 lakh t in 1985 to 6.70 lakh t in 2008. It was observed that there was a steady increase in the fish landings till 1990, except the year 1987 where a drastic decline was experienced in the landings when compared to that of the previous year. The estimated fish landings of the state were more than 5 lakh t from 1989 onwards and it showed a tremendous improvement in the fishery sector of the state. Maximum landings was estimated to be 6.70 lakh t during 2008 due to heavy exploitation of small pelagics especially oilsardine and mackerel by the ringseiners along the southern coastal belt of the state.

Motorised sector dominated the fish landings when compared to the mechanised sector. During 1996-2000, the average fish landings of motorised sector was high with an estimated yield of 3 lakh t. Sectorwise average landings in Kerala during the five year periods from 1985-89 to 2005-08 is given in Fig. 2.

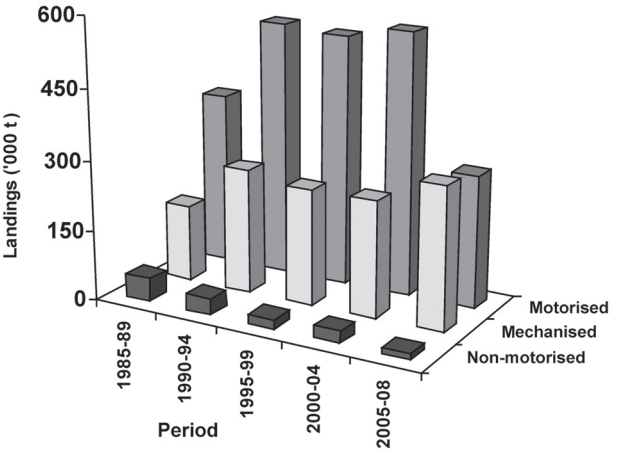

Fig. 2. Sector-wise average marine fish landings in Kerala during 1985-2008

The contribution of pelagic fishery resources *viz*., oilsardines, mackerels, scads, tunnies, ribbonfishes *etc*. were dominant. Other important resources which contributed remarkably to the landings of the state were penaeid prawns, threadfin breams, *Stolephorus* spp., cephalopods and soles.

Crafts and gears

During 1985, the main craft used for the exploitation of resources were trawlers, driftnet/ gillnetters and purseseiners in the mechanised sector; plank-built canoes and thanguvalloms in the motorised sector and country crafts like valloms, kattamarans and canoes in the non-motorised sector. Trawlnets, purseseines, driftnet/gillnets, bottom-set gillnets, hooks and lines and boatseines were major gears operated in the coastal waters. During 1986, ringseines came into the scene with much improved landings of small pelagics like oilsardines, *Stolephorus* spp. and mackerel. Table 3 shows the average effort ('000) expended in terms of unit operations, by different gears of Kerala, during 1985-2008.

Catch per unit of trawlnet increased during these years and reached the maximum of 621 kg in 2006 whereas catch per hour was reduced to 39 kg during 2007 due to the targeted fishing by multiday operations. Catch per unit of purseseiners was

Table 3. Average effort ('000 units) expended in terms of unit operations by different gears of Kerala during 1985-2008

Gear	1985 -89	1990 -94	1995 -99	2000 -04	2005 -08
Mechanised					
Trawlnet	564	592	553	357	295
Purseseine	2	3	3	2	0
Driftnet/gillnet	61	15	9	4	2
Hooks and lines	2	3	4	4	1
Ringseines	0	0	0	9	45
Others	2	0	0	1	4
Motorised					
Driftnet/gillnet	441	576	906	584	669
Ringseines	113	251	229	207	168
Boatseines	199	46	43	55	73
Hooks and lines	160	134	310	290	302
Trawlnet	7	105	165	181	99
Others	14	1	2	15	0
Non-motorised	1365	1055	876	520	484

maximum in 1989 with 2,929 kg and at present it is 2,180 kg. Catch per unit effort of driftnet/gillnet touched one tonne due to the expansion of the area of the fishing ground and multiday fishing. From 2001 onwards, the exploitation by a single hook and line unit crossed one tonne. In 2008, the catch per unit effort of hooks and line reached 2,121 kg. During the late nineties, minitrawl operations started along the Kerala coast mainly in Alappuzha District where the fishermen always took interest in the changes of fishing practices. Catch per unit of the motorised ringseines during 2000-'07 was more than one tonne even though slight variations was visible during 2006 and 2008, whereas the same for motorised boatseine was reduced to 86 kg during 2000-'04 from 655 kg during nineties, which increased to 404 kg during 2008. Catch per unit of mechanised ringseiner was nearly three tonnes after its inception during the early twenties and the present level is 2,444 kg.

Mechanised sector

The mechanised crafts are operated with engine capacity upto 190 HP for propulsion and fishing. The important gears operating in the mechanised sector are trawlnets, driftnet/gillnets, purseseines, hooks and lines and ringseines. For the period 1985-2004, mechanised sector's contribution was 43% of the total landings, followed by motorised sector (51%) and non-motorised sector contributing only 6%. During 2005-'08, the contribution of the mechanised sector got raised to 51%, followed by the motorised sector (47%) and the non-motorised sector formed only 2%. Percentage contribution of different gears during the period under study is given in Table 4.

Table 4. Percentage contribution of different gears in Kerala during 1985 - 2008

Gear	1985 -89	1990 -94	1995 -99	2000 -04	2005 -08
Mechanised					
Trawlnet	35.33	44.35	42.57	36.00	29.09
Purseseine	1.11	0.95	0.96	0.57	0.15
Driftnet/gillnet	2.02	0.35	0.32	0.44	0.42
Hooks and lines	0.12	0.14	0.42	0.63	0.16
Ringseines	0.00	0.00	0.00	4.41	19.58
Others	0.02	0.00	0.01	0.29	1.81
Motorised					
Driftnet/gillnet	7.93	7.29	9.28	9.39	9.86
Ringseines	19.12	33.95	34.36	36.73	29.10
Boatseines	18.72	3.85	2.63	1.40	3.45
Hooks and lines	2.77	1.93	3.62	2.76	3.35
Trawlnet	0.14	1.42	2.28	2.76	1.12
Others	0.96	0.01	0.05	0.25	0.02
Non-motorised	11.76	5.76	3.50	4.37	1.89

Trawlnet

Mechanisation of indigenous artisanal fishing crafts and introduction of mechanised fishing vessels started during the first five year plan period *i.e.*, 1951-'55. During the initial period of mechanisation, fishermen were weary of accepting modern methods of fishing and other related activities. A beginning was made with small mechanised boats of low cost on which traditional gears could be successfully employed. This was followed by introduction of bigger boats and new types of gears. Experimental trawling with small mechanised boats was carried out even during 1954-'59 by the Indo-Norwegian Project in the shallow waters along the Kerala coast.

Beamtrawl was in operation for some time. To increase the efficiency in capturing prawns, a tickler chain was attached to the beamtrawl. This resulted in better yield of prawns. Twoseam trawlers were used for shrimp catch and fourseam trawls for fish catches. Fishermen made single day cruises starting from the base early in the morning and returned in the evening after making 3-4 hauls of about one hour duration each. Mechanised boats were constructed in timber, fibreglass and steel. Multiday operations of trawlers and multigear operations are the new trends in the trawlnet fishery. The fishing units are having

sophisticated equipments like GPS, radar system and giant fish holds to keep the catch for days without any spoilage. From 1999 onwards, deepsea trawlers began to harvest the depth zones upto 400 m to exploit deepsea resources during November-February period. Main crustacean species caught from the deeper sea were *Aristeus alcocki, Heterocarpus woodmasoni* and *H. gibbosus*. The present mechanised trawler fleet in Kerala is medium sized having 8-49 m length with 45-190 HP engines. Man power employed in multiday trawlers is in the range 5-13 and in single day trawlers it is 3-7. Number of hauls per unit operation varies between 1-7 for single day trawl units and it is between 5-31 for multiday trawl units.

Major resources landed in the trawlnets were penaeid prawns, threadfin breams, cephalopods, scads and soles. Penaeid prawns landed maximum in the trawlnet with 20% of the total trawl landings in 1994. Similarly threadfin bream landings were maximum in 1993 forming 18%, cephalopods were maximum with 17%, scads were maximum with 10% and soles were maximum in 1999 with 10% of the total trawl landings of the corresponding years. Annual landings of the trawlnets operated in Kerala and their catch per unit effort is depicted in Fig. 3.

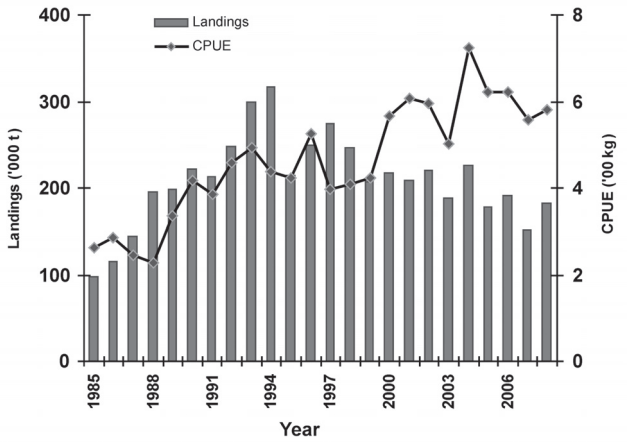

Fig. 3. Annual landings and CPUE of trawlnets in Kerala during 1995 - 2008

Purseseine

Commercial purseseining started in the state by the end of 1979 with a small fleet of 20 purseseiners. By 1980, the number rose to 80 and the period 1981-'85 was the golden era of the purseseine operations. At present there are only 54 purseseiners in the fishery as per the Marine Fisheries Census 2005, confined only to Ernakulam District. During 2005, the operations of purseseines came to a heavy depletion with 88 units and at present the unit operations have increased to 778 per annum. Purseseining is mainly used to harvest the pelagic shoals like oilsardine, whitebaits, other sardines, mackerel, carangids and tunnies. Stray catches of demersals are also seen along with it. Manpower employed in the purseseiner is between 20 and 32. During the monsoon season, fishing is generally closed for this gear. On an average, 40% of the purseseine landings was constituted by Indian mackerel.

Gillnet

Mechanised gillnetter which operates passive driftnet/gillnet is more fuel efficient than the mechanised trawler. Gillnet can be operated as anchored floating nets for midwater fish and as free driftnets for the surface as well as midwater fishes. Gillnet is used as an encircling net for large shoals of fishes like the mackerel. In the encircling nets, the foot rope touches the bottom at lower depths. Some important driftnet/gillnets used along Kerala coast are echavala, chalavala, kachavala, kangoosevala, pattuvala, ozhukkuvala, discovala, edakettuvala, noovala, thappuvala, ralvala, thirandivala, ayilavala, mathivala, avolivala, chemmeenvala, silkvala, mullanvala, pachuvala, mathikettuvala, chittenvala and kanthavala. The efficiency of the present day driftnet/gillnet has increased several times owing to replacement of natural fibres by synthetic fibres, especially by transparent monofilaments. Mode of operation changed to either driftnet/gillnet or bottom-set gillnet. Most of them have been mechanised or motorised and some are still in the non-motorised sector. The present driftnet/gillnet fishery of the mechanised sector depends only on ozhukkuvala. Mesh size is the most important aspect influencing the efficiency of this gear. Mesh size varies from 5-150 mm and depth of operation varies from 3-50 m. Manpower is in the range 3-8 in the mechanised sector, 2-7 in the motorised sector and 1-4 in traditional sector. At present, China engines are employed in the mechanised driftnet/gillnet operations. Elasmobranchs (13%), catfishes (7%), seerfishes (20%), little tunas (24%), carangids (5%), mackerel (6%), and *Auxis* spp. (6%) were the main components of mechanised gillnet catches.

Hooks and lines

Hook and line fishing for 'kalava' existed in Kerala for a long time. Kalava fishing along the rocky outgrowths of Kerala coast was known to local fishermen. It was a seasonal fishery from December to March period. Off Cochin, grounds were very productive for hook and line fishery followed by Chettuva and Ponnani grounds where depth range is between 75-125 m. Migratory fishermen from Kanyakumari and Colachel engage in kalava fishing with the help of small mechanised boats using hooks and lines. The exploitation of sharks was mainly undertaken by long lines from the offshore waters. These gears mainly landed demersal group of fishes.

After the imposition of partial ban on trawling, there was an increasing trend in landings of mechanised hooks and lines in Kerala. Presently, some trawlers and driftnet/gillnetters are doing combined gear operation with hooks and lines and their catch per unit is nearly 3 t during 2008. Hook and line operation in the mechanised sector is restricted to Ernakulam and Kannur districts. Manpower employed is 4 to 10 persons per trip. Maximum landings were observed by this gear from the depth zone beyond 50 m. Some longliners went upto Lakshadweep for fishing near Lakshadweep waters and came back after many days.

New addition to the longline fishing, is the Dory Fishing Scheme introduced by Mastsyafed, the co-operative apex federation of primary level co-operative societies engaged in the welfare of fishing communities. Alleged looting of the fish wealth by foreign trawlers, compelled the state government to go for Dory fishing [*The Hindu, Dory fishing peps up traditional sector*]. The Financial Express dated 17.2.2010 affirm that Kerala's Dory fishing poses challenge to mechanised trawlers. It is understood that the maiden Dory fleet returned to Thankassery Harbour after a five day deepsea expedition.

Ringseine

Mechanised ringseine operations started during 2001 in Kerala. Nearly 350 units landed with a total catch of 154 t during that year. The landings as well as effort increased periodically and during 2008, the maximum catch of 1.44 lakh t was achieved with nearly 59,000 units. CPUE of this gear at present is 2,444 kg. The mechanised craft used for ringseining, is having a length of 22 m employed with 120 HP engines. Manpower ranges from 30-40. These crafts are equipped with high capacity fishhold and winches to operate the gear. These are mainly operating along Kollam - Kannur districts.

Motorised sector

Large scale motorisation of country crafts in Kerala began in early eighties by the fishermen of Alappuzha, Ernakulam and Kollam districts. At present, country crafts fitted with < 50 HP engines (both outboard and inboard) are used for fishing with boatseines, ringseines, driftnet/gillnets, hooks and lines and minitrawlnets. More than 50% of the marine fish landings in Kerala was carried out by the motorised sector. Main gears operated in this sector were driftnet/gillnets, boatseines, ringseines and minitrawlnets.

Driftnet/gillnets

Outboard driftnet/gillnet operations started in Kerala during 1984. Maximum landings by this gear was noticed in 2007 (80,000 t) and lean landings recorded during 1985 (22,000 t). Major groups of fishes landed by this gear were elasmobranchs, catfishes, other sardines, big-jawed jumper, mackerel, seerfishes and tunnies. Contribution of pelagic fishes was more in all the years when compared to that of demersal group. At present, less capacity engines along Kollam - Vizhinjam area, are employed for navigation in gillnet operations. Outboard driftnet/ gillnet exploited oilsardine (22%), elasmobranchs (2%), sharks (2%), carangids (8%), mackerel (21%), tunnies (14%), soles (3%) and penaeid prawns (2%).

Boatseine

Motorised boatseine operation started in the state during the second half of 1980. During 1985-'86 period, the average annual landings with this gear crossed one lakh t. The increasing trend was noticed in the landings of the gear till 1986. Then onwards, a heavy depletion was witnessed in the boatseine landings of the motorised sector. This was mainly due to the introduction of the new gear, ringseine during the latter half of 1986 along the entire Kerala coast from Kollam to Kasargod districts.

Oilsardine, other sardines, whitebaits, croakers, ribbonfishes, carangids, silverbellies, big-jawed

jumper, mackerel and penaeid prawns were the major group of fishes caught by boatseines. Contribution of pelagic group of fishes was more in this gear than that of demersal group. During 1987-2008, maximum contribution of this gear was 88,000 t in 1988 and the minimum was nearly 4,000 t in 2004. Boatseine operations took a momentum again, along the Kerala coast especially in the Malabar region.

Motorised boatseine landings comprised oilsardine (35%), *Stolephorus* spp. (16%), croakers (4%), ribbonfishes (5%), carangids (13%), mackerel (8%) and penaeid prawns (5%). During 2000-2004 period, ribbonfish landings on an average was 25% of the total boatseine landings.

Ringseine

Ringseine operation started during the third quarter of 1986. It is a mini-purseseine mainly operated with plank-built canoes. The size of the gear is 18-22 mm mesh of nylon knotless webbing mainly used to catch the pelagic shoals like sardines and mackerel. Ringseines with mesh size of 12 mm (mini-ringseine) targets small species like whitebaits and are operated in shallow waters. Length of the gear ranges between 150-800 m. Ringseines replaced two major artisanal gears *viz.* kollivala (boatseine) and thanguvala (encircling net). Ringseiners use carrier boats these days to ferry their catches to the shore. Ringseines are popular as ranivala among Kasargod fishermen. Fishermen of Calicut and Kannur districts resisted the new technology for a long time and they engaged in fishing with kollivala. But later, they also started using ringseines and now the technology is adopted throughout Kerala except in Thiruvananthapuram District. There are 443 ringseiners in the fishery of Kerala State out of which a lion's share is operating along the coastal length between Alappuzha and Kozhikode districts. At present, 828 ringseines are owned by Kerala fishermen out of which 48% are in Malappuram and 25% in Alappuzha District. During the period under study, 67% of the total oilsardine catches and 53% of the total mackerel catches of the state were from motorised ringseine operations. The catch composition of ringseines were: oilsardine (46%), mackerel (20%), carangids (10%), *Stolephorus* spp.(7%), other sardines (6%) and penaeid prawns (3%).

Minitrawl

With the advent of motorisation of traditional crafts, many fishing techniques of industrial fisheries were adopted by the traditional fishermen. Trawling with outboard engine fitted country craft was one among them. Motorised trawlnet (minitrawl) operation started in Kerala during 1987. Excluding the southern kattamaran belt of the state, minitrawl operation was being practised throughout Kerala. Croakers, soles, penaeid prawns and stomatopods are the major groups landed by this gear. During 1991, the minimum catch of 3,000 t was noticed in this gear. The maximum landings by this gear (24,000 t) was noticed in 2003 due to the heavy landings of oilsardine from the inshore waters. During 2005-'08 period, the average annual landings by this gear was reduced to 6753 t. Using smaller mesh size gear, the juveniles were exploited in large quantity from the inshore waters. Trawling in the coastal waters created several environmental problems and stock recruitment maladies to the fisheries sector. Hence, it is alleged that minitrawl operation is harmful to the flora and fauna of the coastal shallow waters and is considered as one of the most destructive gears in the artisanal sector. The composition of different resources in the minitrawl landings were: oilsardine (6%), croakers (3%), soles 31%, penaeid prawns (30%), crabs (3%) and stomatopods (16%).

Non-motorised sector

To catch pelagic, mesopelagic and bottom dwelling fishes, Kerala fishermen developed many primitive gears and fishing practices along the entire coastal belt of Kerala. There were active gears like the seinenets and trawl type nets and passive gears like traps and driftnet/gillnets. Seinenets were used for bulk fishing of pelagics and were operated in shallow coastal waters. Shoreseines were widely operated in the southern part of Kerala. Due to the heavy landings by shoreseines during July, 2002 - March, 2004, the percentage contribution of the artisanal sector improved in the five year period, 2000-'04 and during 2005-'08, the average landings by these gears was 11,395 t. They were used to catch high quality fishes. Hooks and lines and katchal (scoopnets) were some other gears in non-motorised sector. After the introduction of motorisation in the fishery sector, the landings by traditional sector were

decreasing. During 1985, the contribution of non-motorised sector was 78,000 t which was nearly one fourth of the annual landings of the state. The landings by the sector reached 8,000 t in 2005 witnessing 80% depletion.

The main contributors to the non-motorised sector during the period under study were, oilsardines (15%), carangids (14%), other sardines (7%), ribbonfishes (7%), mackerel (7%), cephalopods (4%), penaeid prawns (2%), tunnies (3%) and silverbellies (2%).

Resources contributing to the fishery

Oilsardine, Indian mackerel, penaeid prawns, carangids, perches, cephalopods, tunnies and ribbonfishes were some of the major resources of Kerala fishery. Yields of major commercially important resources during different periods are given in Table 5.

Table 5. Yields of major resources ('000 t) in Kerala during 1985 - 2008

Resources	1985 -'89	1990 -'94	1995 -'99	2000 -'04	2005 -'08
Oilsardine	410	391	359	1107	927
Indian mackerel	179	341	433	167	222
Penaeid prawns	238	277	246	218	154
Threadfin breams	154	222	162	173	115
Scads	103	260	212	96	91
Stolephorus spp.	171	202	150	116	116
Cephalopods	69	139	177	159	126
Soles	63	96	89	90	68
Tunnies	70	90	74	92	93
Ribbonfishes	68	41	79	103	75

The contribution of oilsardine (*Sardinella longiceps*) landings varied between 0.78 lakh t in 1985 and 2.64 lakh t in 2003 and the share of outboard ringseines to this effect was about 1.89 lakh t. Motorised ringseines played a major role in the landings of oilsardine with maximum of 1.98 lakh t in 2000. Mackerel landings during 1985 was 18,000 t and the maximum landings was 1.28 lakh t in 1996. Motorised ringseines contributed 68% of landings of this resource during 1996. It was observed that the contribution of Indian mackerel was minimum in the non-motorised sector.

Carangid landings in the state varied between 13,000 t in 1985 and 1.03 lakh t in 1995, the peak during the period under study. During the period 2005-'08 the average landings of carangids was 37,854 t. Major gears employed in capturing this resource were trawlnets, seinenets, driftnet/gillnets and hooks and lines. About 66% of the landings of carangids was by motorised ringseine and 21% was by mechanised trawlnets in 1995. Scads, trevallies and queenfishes are important species caught under this group.

The landings of tunnies was about 10,000 t in 1985 and 15,000 t in 2004. The maximum landing of 33,000 t of this resource was attained in 1990. During 2005-'08 period, the average landing of this resource was 23,187 t. Major gears used to exploit this resource were trawlnets, driftnet/gillnets and hooks and lines. About 32% of the landings of tunnies in 1990 were from motorised driftnet/gillnets, 21% from motorised hooks and lines, 7% from mechanised driftnet/gillnets and the remaining from other gears. About 5% of the landings of tunnies was from non-motorised sector during 1990. Little tuna, frigate tuna, yellowfin tuna, longtail tuna and bullet tuna are some of the major species landed in this group.

Ribbonfish landings varied from 25,000 t in 1985 to 32,000 t in 2001. During 2006, ribbonfish landings in Kerala was 40,715 t, the all time record of these resources. Major contributors of this resource were trawlnets, seinenets and driftnet/gillnets. About 72% of the landings of this resource was contributed by mechanised trawlnets during 2001. Major species in this group were *Trichiurus lepturus, Lepturacanthus savala, Eupleurogrammus intermedius* and *E. muticus.*

The contribution of perch landings varied from 31,000 t in 1985 to 75,000 t in 1993. The estimated perch landings during 2008 was 49,000 t. Major gears employed in capturing these resources were trawlnets, hooks and lines, seinenets and driftnet/gillnets. Major species landed were *Nemipterus japonicus, N. mesoprion* and *Epinephelus diacanthus*. About 90% of the landings were contributed by mechanised trawlnets during 1993.

Penaeid prawn landings in the state varied from 27,000 t in 1985 to 72,000 t in 1994. During 2008, the landings of penaeid prawns was 42,000 t only. A major contribution of 62,000 t towards this landings during 2001 was by mechanised trawlnets. The major species in this group were *Parapenaeopsis stylifera, Metapenaeus dobsoni, M. monoceros, M. affinis, Solenocera crassicornis, S. choprai, S. indica, S. hextii* and *Fenneropenaeus indicus.*

Conclusion

It was observed that the operation of ringseines in the state started in 1986 and with the introduction of this gear there was great improvement in the fish landings which varied from 22,000 t in 1986 to 3.42 lakh t in 2008.

The major contribution in the total landings of the state during the two and a half decades starting from 1985, were from motorised sector which accounted 51% followed by the mechanised sector with 47% and the remaining 2% by the non-motorised sector. While analysing the gearwise contribution of the motorised sector, 62% of the landings were contributed by ringseines and the other 37% were by driftnet/gillnets, minitrawls, boatseines, hooks and lines and others. The contribution by driftnet/gillnets was also remarkable in the landings which varied from 22,000 t in 1985 to 80,000 t in 2007. As a whole, the contribution of ringseines dominated the motorised sector with 30% of the total landings in the state during 1985-2008.

The contribution by the mechanised trawlnets was about 92% of the total landings of the mechanised sector during 1985-2004, which varied from 97,000 t in 1985 to 2.26 lakh t in 2004. During 2005-'08, trawl contribution reduced to 57% while the ringseines contributed 38% and multigear operations (trawlnets and hooks and lines, driftnet/gillnets and hooks and lines) contributed more than 3% towards the mechanised sector. Mechanised ringseines contributed 3%, purseseines 2% and the remaining 3% was by other mechanised gears in the state.

During the seventh five year plan period, the following major development thrusts were given in the marine fisheries sector :

- New chartering policy of 1989
- Development of deepsea fishing
- Substantial growth in motorised artisanal fleet of ringseiners and
- Coastal shrimp aquaculture

Electronic gadgets and other equipments came into wide use among fishermen during the period. Many major and minor fisheries harbours were constructed at Vizhinjam, Sakthikulangara, Neendakara, Cochin, Munambam, Azheekode, Chettuva, Ponnani, Beypore, Puthiappa, Chombala, Azheekal and Cheruvathur during the period under review. Introduction of many logistic facilities like berthing, landing, auctioning, processing and transportation along with other infrastructure facilities in the harbours has resulted in enhanced fish landing, facilitating the movement of the landings in fresh condition to the end users. Besides these major developments, targeted fishing for shrimps and cuttlefishes was carried out to fetch high monetary value. Fishing grounds were extended to exploit the deepsea resources in addition to combined gear operation for increasing the yield.

New distributional record of the insular shelf beauty *Symphysanodon typus* Bleeker, 1878 (Family: Symphysanodontidae) from Indian waters

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The family Symphysanodontidae comprises of small to medium sized bony fishes commonly known as banquelovelies, slopefishes and insular shelf beauties. They are caught in trawls operating in depths from 50 to 500 m, mainly on the continental shelf and slopes. Earlier these fishes were included as a separate genus variously under Acropomatidae, Serranidae and Lutjanidae. Formanouir (1981) designated it as a separate family as it had characters which were unique and not shared by the other families under which it had so far been included. Presently the family is comprised of ten extant species, namely *Symphysanodon andersoni, S. berryi, S. katayamai, S. parini, S. mona,*

S. maunaloae, S. octoactinus, S. rhax, *S. typus* and one yet to be named species known only from the stomach contents of *Latimaria chalumnae*. Despite their attractive colouration, the insular shelf beauty is not taken as a preferred aquarium species perhaps due to its planktivorous feeding habit.

Distribution

S. typus is known with certainty from the Pacific Ocean, from Indonesia to Hawaii. Eshmeyer (2009) gives its distributional range as eastern Indian Ocean and Western Pacific. The presence of *S. typus* in the western Indian Ocean has long been suspected (Allen, 1984). The present record is the first confirmed occurrence of the species from Indian waters. The specimen (Fig. 1) was collected from trawlnet as by-catch landed at Neendakara, Kerala, on the west coast of India on 19.11.2005 from a depth zone of 60 m. It has been housed in the Designated National Repository at CMFRI, Kochi under the Accession Number GB 31.146.1.6. Subsequently, three years later one of the authors (Sijo Paul), observed large quantity of (28 kg) of *S. typus* in the same month in 2008 (24.11.2008) in the trawl catches off Cochin at the landing centre, Munabam.The holotype of the species is preserved at the Universität Hamburg Biozentrum Grindel und Zoologisches Museum, Ichthyology, Hamburg, Germany under the catalogue number ZMH H398. Two syntypes of *Propoma reum* (BMNH 1879.5.14.164-5), and the holotype of *Rhyacanthias carlsmithi* (USNM 84099), were found to be conspecific with the holotype kept in Hamburg (Anderson, 1970). The morphometric measurements given in Table 1 under Anderson (1970) are based on the examination of all the above specimens.

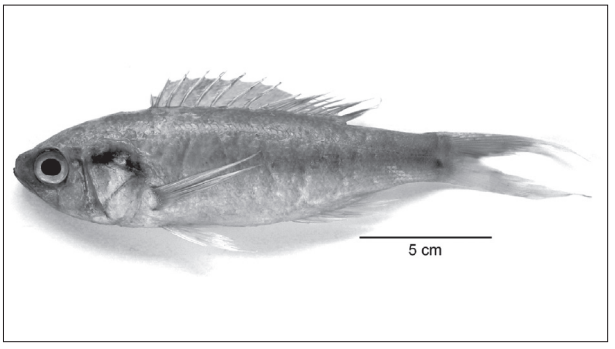

Fig. 1. *Symphysanodon typus* Bleeker, 1878 (208.6 mm TL) landed by trawler at Neendakara Fisheries Harbour, Kollam, Kerala

Taxonomic profile - familial diagnosis (monotypic genus)

Pre-maxillae incised, forming prominent symphysial notch receiving the anterior ends of dentaries. Teeth at the anterior end of dentary fits into symphysial notch when mouth closed. Two opercular spines. Dorsal fins usually with IX spines and 10 soft rays. Ctenoid scales present on head, cover maxillae and dentaries. Caudal fin deeply forked. Eyes usually large, diameter equal to or more than snout length; suborbitals very narrow. Vertebrae 25.

Species diagnosis

Species of *Symphysanodon* are mostly distinguished on the basis of the number of scales on the lateral line, number of gill rakers and pelvic and caudal fin morphology. Characters typical of *S. typus* are lateral line scales 49-55, 10-12 gill rakers including rudiments on upper limb, 25-28 on lower limb, 36 - 40 total on first gill arch. Length of anal fin base 15-21% standard length. Pelvic fins 22-26% standard length. Caudal fin lobes slightly produced. Pectoral fin rays usually 16, can be 15-18.

Colouration

Body bright fuscia or orange red with a broad mid-lateral yellow band. Dorsal fin yellowish. Upper lobe of caudal fin orangish red while lower lobe conspicuously yellow. Current specimen was photographed in fairly fresh condition. The colour fades quickly in alcohol preserved specimens with the body becoming brown and the fins acquiring transparency.

Meristic characteristics

Single continuous dorsal fin, unnotched, dorsal spines IX , 10 soft rays , anal III spines and 7 soft rays, pectoral soft rays 16, I pelvic spine and 5 soft rays, caudal rays 17, 9 upper and 8 on lower lobes.

The specimen was identified with the help of the key provided by Anderson and Springer (2005). Morphometric characters of *S. typus* prescribed by them are as follows: Length of anal-fin base 15–21% SL. Length of depressed anal fin 27–34% SL. Length of first anal-fin spine 4.8–7.2% SL. Scales 49–55. Gillrakers 36–40. Sum of scales plus gill rakers of individual specimens is 86–94. Pectoralfin rays 15–18, most frequently 16 (rarely 18). First segmented ray of pelvic fin only slightly produced,

usually not extending to the origin of anal fin. Caudal fin lobes produced, but apparently never produced into extremely long filaments. Hypurals 1 and 2 represented by a single plate. Parapophyses present on first caudal vertebra.

Morphometrics of the current specimen is largely in agreement with the above mentioned species diagnosis with minor differences which are as follows: length of anal fin base is 14.5% SL which is below the prescribed lower limit of 15% SL. Also the sum total of gill rakers including rudiments on the first gill arch and number of lateral line scales is 95 which exceed the upper limit of the prescribed 94. However, in the light of all, other characters are being compliant with the species diagnosis of the above mentioned key, the fish was confirmed as *Symphysanodon typus* Bleeker, 1878. Minor differences are also seen with regard to head depth, snout length and cheek height.

Table 1. Comparative morphometrics of *Symphysanodon typus* Bleeker, 1878 in percentage of total length (TL), standard length (SL) or head length (HL)

	Fishbase, 2009	Anderson, 1970		Naomi *et al*., 2010	
Total length (mm)	552 pixels	–	–	–	208.55 mm
Standard length (mm)	73.0 % TL	50- 80 mm	105-165 mm	156.22 mm	74.9% TL
Fork length	77.5 % TL				79.7% TL
Head length	18.7 % TL	32.2-33.5% SL	27.2-32.2% SL	34.2% SL	25.59% TL
Pre-dorsal length	22.8 % TL			35.9% SL	23.8% TL
Pre-pelvic length	21.4 % TL			39% SL	26% TL
Pre-pectoral length	19.6 % TL			33.9% SL	22.5% TL
Pre-anal length	42.0 % TL			73% SL	48.5% TL
Body depth	21.0% TL	22.1-26.5% SL	26.7-29% SL	27.5% SL	20.6% TL
Caudal peduncle depth		9.9-10.7% SL	10.6-12.1% SL	11.4% SL	8.5% TL
Caudal peduncle length				24.4% SL	18.3% TL
Anal fin base, length		14.7-20.8% SL	15.6-20.8% SL	14.5% SL	10.8% TL
Anal fin length				11.1% SL	8.3% TL
Length of depressed anal fin			27.5% SL		
Pectoral fin, length				26% SL	19.4% TL
Pelvic fin length				22.3% SL	16.7% TL
First dorsal spine length			4.9-6.3% SL	3.6% SL	2.8% TL
Third dorsal spine length			10.8-13.6% SL	10.5% SL	7.9% TL
Fourth dorsal spine length		11.2-14.6% SL	11.2-14.6% SL	11.6% SL	8.7% TL
Last dorsal spine length		11.2-13.4% SL	11.2-13.4% SL	11.1% SL	8.3% TL
Longest dorsal spine length		11.9-14.6% SL	11.9-14.6% SL	12.1% SL	9.1% TL
First anal spine length		5-6.2% SL	5-6.2% SL	3.7% SL	2.8% TL
Second anal spine length		9.5-10% SL	9.5-10% SL	6.7% SL	5.1% TL
Third anal spine length		12.3-13.1% SL	10.8-12% SL	9.2% SL	6.9% TL
Head depth		19,1-24.2% SL	21-24.2% SL	26% SL	76.15% HL
Snout length			6.1-8.2% SL	5% SL	14.54% HL
Fleshy orbit diameter	36.9% HL	11.1-12% HL	8.1-11% HL	8.4% HL	24.56% HL
Post-orbital head length	15.5 % HL			19.8% HL	57.94% HL
Sub-orbital width		0.7-1.3% HL	0.7-1.3% HL	1.1% HL	3.20% HL
Cheek height		4.2-6.2% HL	4.2-6.2% HL	3.4% HL	10% HL
Upper jaw length				14.3% HL	41.9% HL
Lower jaw length				7.4% HL	21.75% HL
Gill rakers (upper)			10-12 (11)	12	
Gill rakers (lower)			25-28 (26)	28	
Total on first gill arch			36-40 (37)	40	
Lateral line scales			52-54	55	
Gill arch + lateral line scales			89-94	95	
Fin formula			DIX,10; AIII,7; P15-17;V I,5; C 9,8	DIX,10; AIII,7; P16;V I,5; C 9,8	

TL - Total length; SL - Standard length; HL - Head length

Anderson (1970) has established that differences in morphometric characters within the species are pronounced which compelled him to segregate samples into two groups *viz.,* those within 50-80 mm SL and 105-165 mm SL. The current specimen is the largest recorded so far (208.6 mm TL). Minor differences in morphometric parameters may be taken as a function of growth.

Anderson (1970) has given the frequency distribution of number of fin rays as follows: D IX spines and 10 soft rays, 03 anal spines and 07 soft rays as the only combination in all specimens examined by him. The current specimen also shows this trait. In the case of gill rakers, maximum specimens analysed so far had 11 numbers on the upper limb, with 12 being rudiment as common. With regard to lower limb of first gill arch, maximum numbers had 26 gill rakers whereas a minority had 28. Current specimen has 28 gill rakers including rudiment on the lower limb. This specimen has totally 40 gill rakers when counts of upper and lower limb are combined which is the upper limit prescribed for this species. The specimen also has a well developed spine at the angle of pre-opercle which is representative of *S. typus* species over 80 mm SL. The present record confirms the presence of *Symphysanodon typus* Bleeker, 1878 in Indian waters and also the Western Indian Ocean.

First record of threadfin bream, *Nemipterus zysron* (Bleeker, 1857) from Andhra Pradesh Coast

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Threadfin breams, a major demersal resource of Visakhapatnam region is represented by a single genus *Nemipterus* and is fished extensively by trawlers. Five species of this genus *viz*., *Nemipterus mesoprion*, *N. japonicus*, *N. delagoae*, *N. luteus* and *N. tolu* generally contribute to the fishery of the region. A sixth species, *Nemipterus zysron* was collected and identified from the catch at Visakhapatnam Fishing Harbour on 15th July 2008. *N. zysron* is being recorded in the catch for the first time along Andhra Pradesh coast and was observed as a stray catch along with other commonly occurring threadfin breams. The species popularly known as slender threadfin bream had been misidentified and known with the following synonyms - *Synagris metopias* Gunther, 1859; *Dentex metopias* Bleeker, 1857; *Dentex zysron* Bleeker, 1857; *Heterognathodon petersi* Steindacher, 1866; *Nemipterus metopias* (Bleeker, 1857); *Nemipterus nemurus* (Bleeker, 1857) and *Nemipterus petersi* (Steindachner, 1866). However, none of these names are valid now (Fishbase). *N. zysron* was easily identified in the field by the slightly elongate body as compared to other *Nemipterus* species and the presence of yellow stripes in front of eye through nostrils and from

Fig. 1. *Nemipterus zysron*

upper lip to beneath the eye (Fig. 1). Other diagnostic features observed were the presence of a single dorsal fin with ten spines and ten rays, anal fin with three spines and seven rays. Upper lobe of caudal fin produced into a long yellow trailing filament. Body colour is reddish in the upper part, silvery below; sides below lateral line with distinct yellow stripes along the middle of each scale row. Head pinkish suffused with mauve on the snout. Dorsal fins pale yellow with a bright yellow margin. Pelvic fins hyaline with a yellow axillary area and axillary scale. Caudal fin pinkish, upper and lower

lobes pale yellowish, filament yellow (Fig. 2). Though the species is reported (FAO Fisheries Synopsis No. 125, Vol. 12) to have a widespread distribution in the Indo-Pacific from north-western Australia, the Indo-Malay Archipelago and Andaman Sea, it is being reported for the first time along Andhra Pradesh coast. The total length of specimens collected ranged from 18.0 cm to 21.5 cm and is known to attain a maximum length of 25 cm (Fishbase). The collected specimens have been preserved in formalin and kept in the Marine Museum of the Visakhapatnam Regional Centre of Central Marine Fisheries Research Institute.

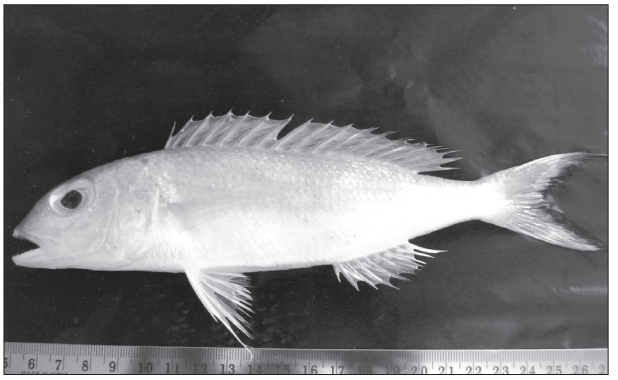

Fig. 2. *Nemipterus zysron* collected from Visakhapatnam Fishing Harbour

Record of cuttlefish, *Sepia elliptica* Hoyle, 1885 off Maharashtra coast

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Cephalopods have a good export demand and is the second most sought after commodity next to prawns by trawl operators. With the increased exploitation and expansion of fishing grounds, new records of cephalopods are being reported from various places all along the Indian coast.

A new entrant in to the cuttlefish fishery at New Ferry Wharf, Mumbai, Maharashtra is *Sepia elliptica* Hoyle, 1885 (Fig. 1). The species constituted the fishery during December-February with peak landings in January. This species is commonly known as 'oval bone cuttlefish' and locally all cuttlefishes are called as 'goti'. The mantle length of the species landed at New Ferry Wharf ranged from 87 mm to 118 mm with corresponding weight ranging from 82.6 to 182.4 g. The depth of operation was about 30-40 m at 70-80 km north off Mumbai coast. The occurrence of *S. elliptica* is reported for the first time from Maharashtra waters.

Some of the important distinguishing characters of *S. elliptica* are as follows: The mantle is oval with the dorsal anterior margin triangular. The arm length is sub-equal and the arm suckers are tetra serial. Club sucker-bearing surface flattened, with 10-12 minute suckers in transverse rows. Swimming

Fig. 1. *Sepia elliptica* Hoyle, 1885

keel of the club extends well proximal to carpis. The cuttlebone is oval and angular 'V-shaped' anteriorly, bluntly rounded posteriorly and the dorsal surface is greyish white (Fig. 2 and 3).

S. elliptica is often misidentified as *Sepia esculenta*, world over. In *S. esculenta*, the inner cone ledge is thick and directed anterior ventrally and it also has prominent lateral stripes on the dorsal surface and they are commonly called as 'golden cuttlefish' due to its distinct colouration. They seem to get confused with *Sepia aculeata* and because of

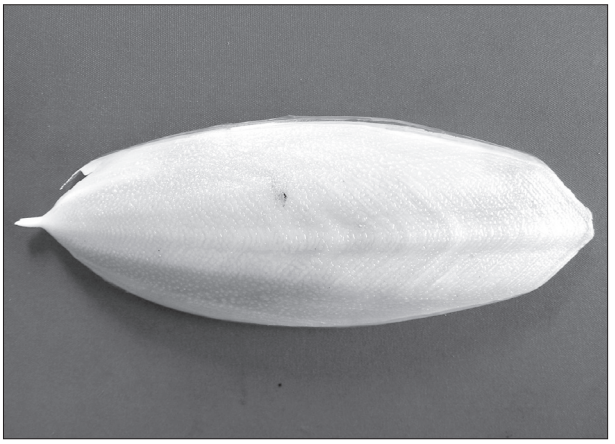

Fig. 2. Dorsal view of cuttlebone of *S. elliptica*

Fig. 3. Ventral view of cuttlebone of *S. elliptica*

this, they may not have been reported from Maharashtra waters. *S. elliptica* can be easily identified from *S. aculeata* by its cuttlebone which is distinctly shaped and also by the presence of prominent markings on all the arms (Fig. 4).

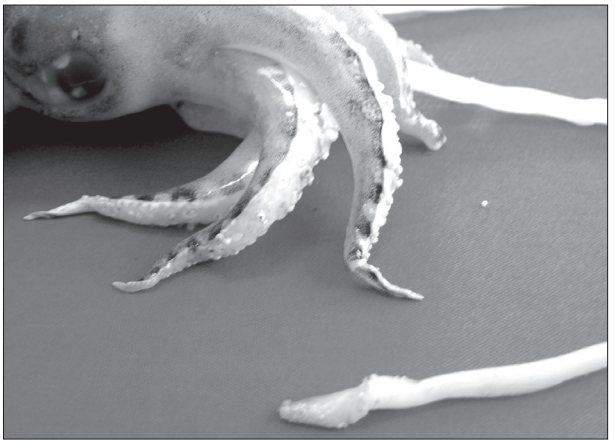

Fig. 4. Distinct markings on the arms of *S. elliptica*

S. elliptica is a tropical Indo-Pacific species extending from northern to western Australia, Exmouth Gulf, Queensland, Capricorn Island group, Gulf of Carpentaria and Vietnam and occur mainly in coastal waters at a depth range of 16 to 142 m (Jereb *et al.,* 2005). According to Jereb *et al.* (2005), the occurrence of this species from Indian waters is doubtful. However, Silas *et al*. (1985) has reported the occurrence of this species from Indian waters.

Narasimham *et al.* (1993), Kasim (1993), Mohamed (1999) and Meiyappan *et al*. (2000) have also mentioned the occurrence of this species from Cochin and Veraval waters. Sivasubramanian (1991) has reported this species from the Bay of Bengal up to a depth of 100 m. According to Meiyappan *et al*. (2000), this species is one of the neritic species occurring in commercial catches and is recorded mainly from Veraval (Gujarat) and Cochin waters where they form significant part of the catch, especially in Gujarat. According to Meiyappan and Mohamed (2003), *S. elliptica* exhibits bathymetric distribution and they are caught along Cochin and Veraval coasts by trawling beyond 40 m depth. The catch of *S. aculeata* is comparatively very less in Gujarat contributing only 0.7% towards the cephalopod fishery while *S. elliptica* contributes 27.5% and the period of abundance of this species is between October and January (Kasim, 1993). The overall contribution of this species to the cephalopod fishery from the west coast is 2% (Meiyappan and Mohamed, 2003).

Cuttlefish landings by trawlers in Mumbai consist of resources such as *Sepia aculeata*, *Sepia pharaonis* and *Sepiella inermis*. Generally in Mumbai waters, the abundance of cuttlefishes is during the post-monsoon period (Kuber, 1987). The occurrence of *Sepia prashadi* is highly seasonal in Mumbai waters occurring only during September-December (Sujit Sundaram and Sarang, 2004), wherein they replace the species *S. aculeata* during this period (Sujit Sundaram *et al*., 2006). Similarly the species *S. elliptica* also seems to be seasonal and occurs during December-February. However they do not replace *S. aculeata*. According to Nair *et al.* (1992), *S. elliptica* was found occurring in Cochin and Veraval waters almost throughout the year.

The maximum dorsal mantle recorded for this species is 175 mm (Jereb *et al.,* 2005). The largest

sizes recorded for males and females of *S. elliptica* caught in trawlnet in Cochin area are 129 mm and 119 mm respectively (Silas *et al.,* 1985) and in Veraval waters it is recorded as 149 mm (Kasim, 1993). Sivasubramanian (1991) has reported the maximum mantle length as 130 mm from the Bay of Bengal. The maximum length recorded during the present observations from Mumbai waters was 118 mm.

Silas *et al*. (1985) studied the biology of this species from Cochin waters and Kasim (1993) reported on the age, growth and stock assessment from Veraval waters. Sixteen specimens of *S. elliptica* were analysed for gut contents of which 14 were males and all of them had empty to trace stomachs and 2 specimens were females with 'half full' stomach. This species seems to be extensively feeding on prawns. Silas *et al*. (1985) observed that penaeid prawns form the main item of this species in Cochin waters and the other food items, which occur in the stomachs, are fishes, *Acetes*, crabs and stomatopods. In general, females were observed to be broader than males and the overall dominance of males was observed in the catch from Mumbai. Similarly dominance of males is reported in Cochin waters also (Silas *et al.,* 1985). All the males examined were in second stage of maturity and the females were in third stage of maturity. Males and females of this species of Cochin area attain sexual maturity at a minimum size of 75 mm, and all individuals of the two sexes mature when they reach a size of 115 mm and spawning females as well as males were recorded from October to December (Silas *et al.,* 1985). Meiyappan *et al*. (2000) reported the size at 50% maturity in the west coast as 93 mm for males and 96 mm for females.

There is a definite migration pattern followed by cephalopods and hence further studies on this species during this period would ensure their fishery potential and trend. This being a new entrant to the cephalopod fishery off Mumbai waters, a close monitoring of this resource is essential, as they seem to contribute substantially to the cephalopod fishery in Veraval and Cochin waters.

By-catch of the gastropod *Tibia* spp. in gillnets operated along Gujarat coast

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The rocky coastal belt of Gujarat possesses an enormous potential resource of lobsters. Gillnets are regularly operated for lobster along the coast of Mangrol, Porbunder and Muldwarka. Gastropods such as *Tibia maculata* and *Tibia curta* occurred in large quantities as by-catch along with lobsters. Other gastropods such as *Archipecten* sp. and *Murex* sp. also make their occurrence in small quantities.

Mangrol

Lobster fishing is being regularly conducted using old gillnets in this area. The net is operated at a distance of 2 to 3 km at a depth of 20 to 25 m and it is allowed to remain overnight and the next day morning the fishermen usually collect the net with all the fish, lobsters and the gastropods. The gastropods living in the muddy or nearer to rocky area also get entangled with the gillnet thus forming a fishery. On enquiry, it was told that these gastropods are available in large numbers during high tide after the post-monsoon season. The catch rate was also very high ranging from 15 to 25 kg per unit during September-December (Fig. 1) and it was considerably lower during January-March with each unit bringing about 5 to 8 kg of gastropods. The gastropods are mainly constituted by *T. maculata* (Fig. 2) and *T. curta* (Fig. 3), forming about 94% while the sun shell *Archipecten* sp. and *Murex* sp. form 3% and 2% respectively and the remaining 1% by other miscellaneous gastropods. Majority (71%) of the gastropods *(Tibia* sp.) were

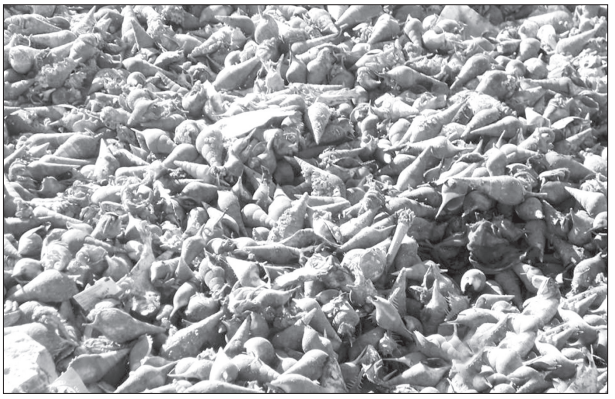

Fig. 1. Bulk landings of *Tibia maculata* by gillnets at Mangrol

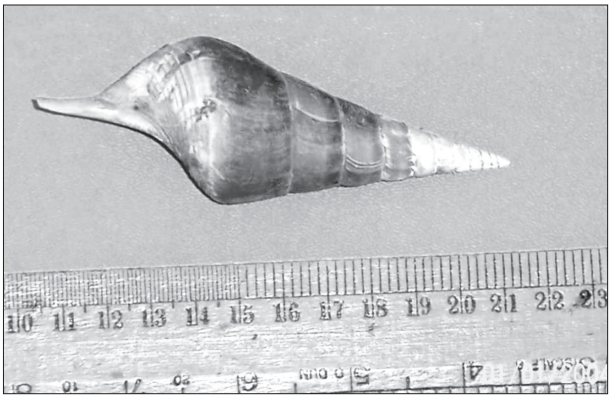

Fig. 2. *Tibia maculata* landed as by-catch at Mangrol by gillnets

Fig. 3. *Tibia curta* caught as by-catch along with lobsters by gillnetters at Mangrol

alive and 29% were dead and were mostly occupied by the hermit crabs. The size range of the gastropods varied between 71 and 136 mm with the size group 80-84 mm forming 17% and the size range 80-104 mm contributing to 68% of the population.

Porbunder

Similar observations were made on the gastropod fishery at Porbunder Landing Centre also. Majority of the gastropods recorded were *Tibia* sp. (Fig. 4) and other gastropods such as *Archipecten* sp. and *Murex* sp. were found to be in negligible numbers. In Porbunder, gillnets are operated in the morning hours and hauling is done in the afternoon after a duration of 5 to 6 h wherein lobsters are got along with fish and gastropods. The percentages of live and dead gastropods were 82 and 18 respectively. The size group of the gastropods ranged between 117 and 146 mm with the dominant size group being 140-144 mm forming 34.5%. About 79% of the gastropods were found to be between 125 and 144 mm.

Fig. 4. *Tibia maculata* and *T. curta* landed by gillnets along with lobsters at Porbunder

Muldwarka

There are about 300 gillnets in Muldwarka and 40 units are regularly deployed for lobster fishery. The fishermen usually shoot the net in the evening at a depth of 20 m and at a distance of 2 to 4 km from the shore. The net is hauled during the next day or even after two days. Regular catches were contributed by lobsters along with a by-catch of gastropods and fishes such as sciaenids, eels, *Cynoglossus*, *Lethrhinus*, *Epinephelus*, *Lutjanus*, *Thryssa*, *etc*. Sometimes the fishes were observed in putrified condition while the net was being hauled after two

days and they were discarded in the landing centre itself. The gastropods showed a similar trend as in Mangrol. The size of *Tibia* sp. varied between 76 and 142 mm with the dominant size group 85-89 mm forming 18%.

These gastropods are kept in heaps at the landing centres, sundried and after cleaning and painting they are used for aesthetic purposes. The shells are very neatly and beautifully embedded in cement on the compound walls of temples and houses in and around Mangrol (Fig. 5).

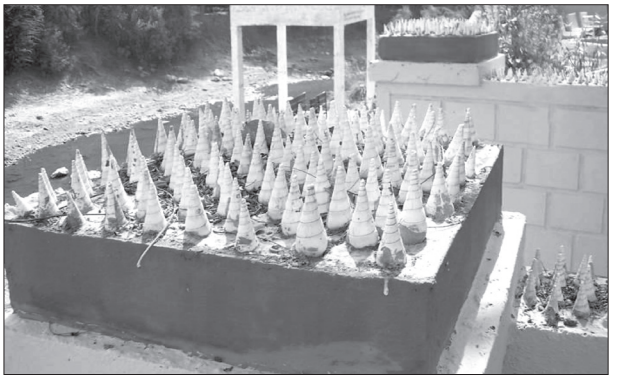

Fig. 5. Cleaned and painted shells of gastropods embedded on the compound walls of temples

Improved mechanisation in dolnetting along the Saurashtra coast

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The dolnetters of Jaffrabad, Rajapara and Nawabunder until 2000 were using engine drive for transport and other fishing operations (shooting, piling and hauling). This was done manually and required 6-9 persons per trip with increased effort and reduced catches which necessitated multiday operations and multinet/multihaul operations. Hence, from 2001 onwards, the dolnetters gradually switched over from stone pillars to portable iron pillars. Further, they used winches driven by boat engines to haul the dolnets. The winches varied in size and were applied mostly by new large vessels having OAL of 12-14 m and driven by 87-105 HP engines. They are driven by an axle rod with bearing and teeth attached to boat engine with an alternate gear regulator. The net drums are 3-4 ft in length, 2 ft in height and the axle rod diameter is 2 inches.

The advantages of this improved method are as follows:

- Saving the expense on two crew numbers
- Additional dolnet could be used with the same effort and manpower

Table 1. Percentage variation for improved mechanisation in dolnets

Centres	2001	2002	2003	2004	2005	2006	2007	2008
Nawabunder	5	8	15	20	25	40	50	60
Rajapara	10	12	18	25	40	50	60	65
Jaffrabad	25	30	40	50	60	70	75	75

Fig. 1. Improved mechanisation in dolnetting along the Saurashtra coast

- Pillar (mast) fixed at the bottom could be removed at the end of each fishing season
- Efficient handling and the provision to tow an additional net
- Heavy catch could easily be towed up
- Low maintenance charges
- Longlines and gillnet operations are also facilitated

Parasites of shrimps and crabs from the Chennai coast

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**Central Marine Fisheries Research Institute, Kochi*

Bopyrids and *Sacculina* are typical parasites of crustaceans especially in shrimps and crabs. Bopyrids form the largest family of isopods and attach themselves to the gills of shrimps. *Sacculina* belongs to the order, Rhizocephala, an order of specialised barnacles. They are found as a mass of tissue, extending from the abdomen of crabs, this portion being termed as 'externa'.

The parasites were detected during the regular weekly sampling of shrimps and crabs landed by trawl nets at Kasimedu (Madras) Fishing Harbour. Sixty five females (total length range: 63-103 mm) and 50 males (total length range: 56-95 mm) of *Metapenaeopsis stridulans*, two males of *Metapenaeopsis mogiensis* (71 and 99 mm in TL), five specimens (three females, 55-85 mm TL and two males, 70 and 72 mm TL) of *Parpenaeopsis stylifera* and one specimen of *Parpenaeopsis maxillipedo* (120 mm in TL) infected with bopyrids were obtained in trawl catches from September 2006 to March 2008. The bopyrid parasite was identified as *Epipenaeon ingens*. The female is oval in shape (Fig.1). They ranged in size from 6-14 mm in total length and 7-10 mm in breadth. Males have a longer body with minute head. They ranged in size from 2.1 to 4.25 mm. All the four species were found with 63.87% infection (38.69% females and 25.18% males), immature shrimps, contributed 45.19%, maturing, 39.08% and mature, 15.8%.

Sacculina spp. were observed in 85 specimens of *Portunus sanguinolentus* (ranging in carapace width 38-115 mm), 20 numbers of *Charybdis lucifera* (carapace width range: 52-91 mm), seven numbers of *Charybdis natator* (carapace width, 55-139 mm), 13 *Portunus argentatus* (carapace width range, 52-95 mm), 3 *Podophthalmus vigil* (carapace width range, 58-94 mm) and a single specimen of *Charybdis feriata* (carapace width 146 mm). *Sacculina* with *Lepas* attached to it was found infesting *P. vigil* (Fig. 2). One percentage of the crabs were also observed to possess two "externa". *Sacculina* were first observed in crabs in the month of June, 2005 and later it was found to be prevalent in almost all the months in different species of crabs.

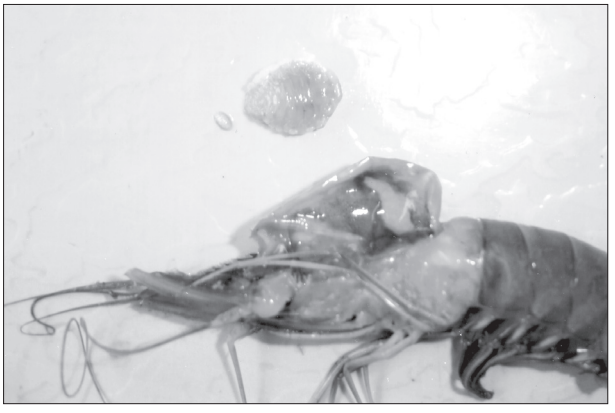

Fig. 1. Bopyrid parasites (female and male)

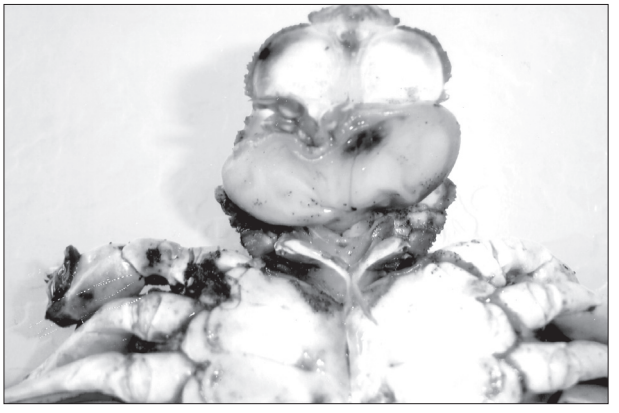

Fig. 2. *Sacculina* on crab along with attached *Lepas*

The wide prevalence of parasites noticed may be due to changes in the environmental parameters like water temperature, dissolved oxygen, salinity *etc.*, which may have an impact on the survival of these parasites. The reason for their infestation as well as proliferation and the possible effect on the hosts physiology warrants further detailed studies.

Unusual landing of *Trachinocephalus myops* by trawlers at Visakhapatnam Fishing Harbour

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On 7.11.2008 unusual landings of the lizardfish *Trachinocephalus myops* (bluntnose lizardfish) was recorded at Visakhapatnam Fishing Harbour by multiday trawlers. The lizardfish landings at Visakhapatnam Harbour is usually dominated by *Saurida undosquamis* and *Saurida tumbil*. However, other lizardfishes *viz., S. micropectoralis, S. longimanus* and *T. myops* are also recorded.

Occurrence of *T. myops* along the coast of Visakhapatnam is seasonal. During the year 2006-'07 the annual average production of *T. myops* was 2.4% of the total lizardfish production at Visakhapatnam. Females ranged in size from 136 to 228 mm and males from 142 to 145 mm in total length.

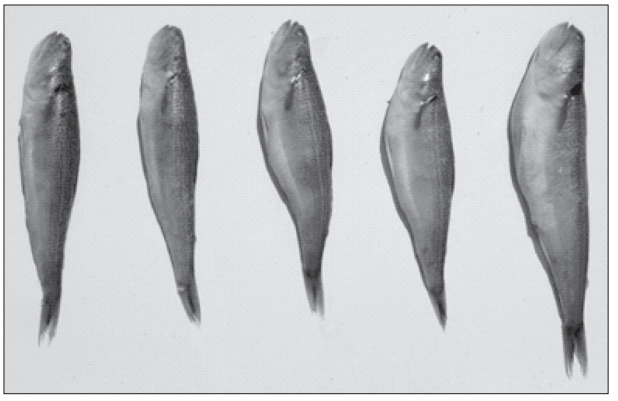

Fig. 1. *Trachinocephalus myops*

Stranding of a Dolphin (*Stenella longirostris*) at Thalikulam Landing Centre, Thrissur District, Kerala

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Central Marine Fisheries Research Institute, Kochi

A female dolphin, *Stenella longirostris*, was stranded in dead condition near Thalikulam Landing Centre (Thrissur District, Kerala) on 25.04.2009 (Fig. 1). The animal weighed around 80 kg, length of body was 198 cm and it was found in semi-decomposed condition.

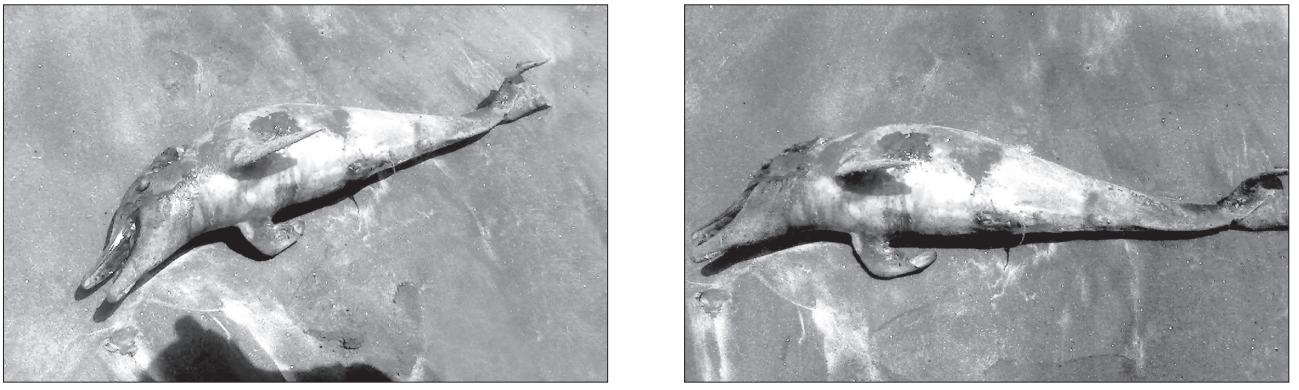

Fig. 1. Dead stranded specimen of *Stenella longirostris* at Thalikulam