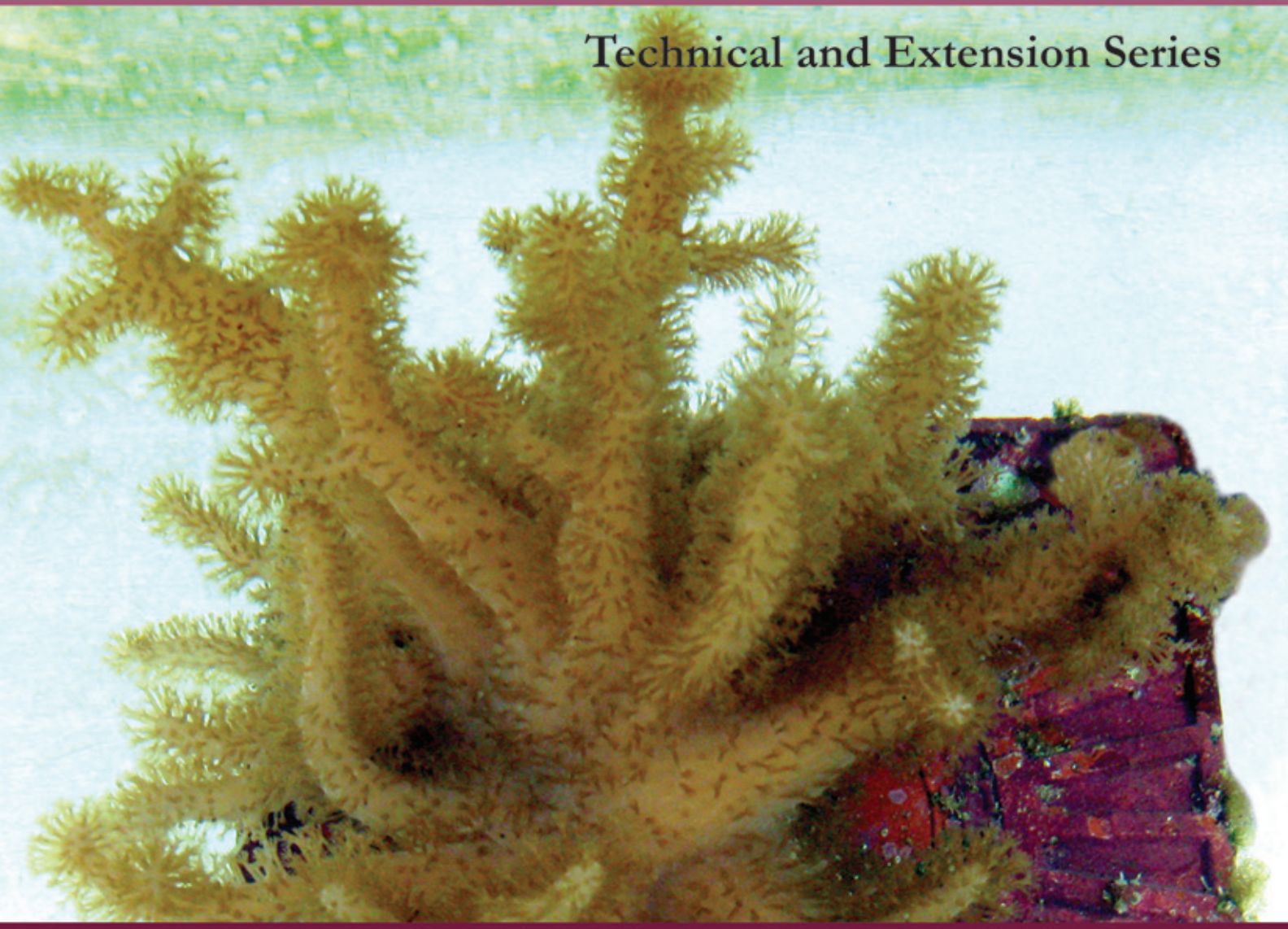
ISSN 0254-380 X

No. 222, October - December 2014

Marine Fisheries Information Service

Technical and Extension Series



Indian Council of Agricultural Research
CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
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Marine Fisheries Information Service

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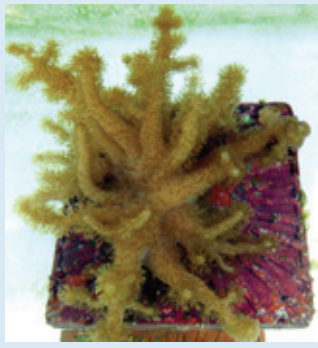

Front Cover : *Artificially propagated soft coral Sinularia kavarattiensis on a red clay tile*

Back Cover : *Traditional gillnet fishermen of Mumbai*

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

From the Editorial Board.....

Warm greetings to all

Coral reef ecosystems harbor rich marine biodiversity while corals itself are an important source for marine drugs and bio-active compounds besides forming a significant component of the marine aquarium trade. However, in the recent past the global warming phenomenon and increase in ocean acidification have been reported to cause damage to coral reefs.This can adversely affect the invaluable ecosystem services the coral reefs provide. As this problem is widespread in the ocean realm, coral restoration programs and supporting research activities are gaining importance globally. In this context, the technology developed by CMFRI for artificial propagation of soft corals is highlighted in this issue with a specific study on *Sinularia kavarattiensis*. Articles on the bio-fouling in seagrass beds, sea turtles, rare marine organisms as well as fishery resources recorded from various parts of the country are also included in this issue. Tunas are an important component of the Indian marine fisheries sector and a brief review of the publication 'Tuna Fishery, Biology and Management' is also provided for the benefit of researchers on the topic.

Marine Fisheries Information Service

No. 222 * October - December 2014

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

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Artificial propagation of soft coral *Sinularia kavarattiensis* (Octocorallia: Alcyonacea) in India

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The soft corals which belong to the order Alcyonacea are important members of the coral reef ecosystem. They are found widely distributed in the tropical waters and play a significant role in the global reef ecology. They are colonial forms akin to scleractinian corals and are the most beautifully coloured components of the coral reefs. Most of the species are found in the continental shelf and slope; however a few are also found at great depths. The Alcyonaceans appear in varied shapes, sizes and colours. The shapes range from tree-like branching encrustations to lamellate, disc-like and plate-like forms. The polyp bearing portion is usually restricted to the terminal parts of the colony called capitulum, lobes and lobules, while the basal portion of the colony is a sterile stalk without polyps.

The coral reefs of the Indian waters are also known for its rich diversity of soft corals. The soft corals are a rich source of biologically active compounds as most of them are found to possess anti-bacterial, anti-inflammatory, anti-tumour and cytotoxic properties. The discovery of prostaglandins from a Caribbean gorgonid *Plexaura homomalla* in 1969 and from the soft coral *Sarcophyton crassocaule* in the year 2000 triggered off a global search for alcyonaceans of pharmaceutical value.

The dynamic appearance and colouration have also made them important additions in the marine aquarium, particularly in the reef tanks which is gaining lot of popularity the world over. However, most of the soft corals used in the marine aquarium trade are collected from the wild, which in the long run will not be sustainable. The propagation and culture of soft corals in captivity is the only solution to meet the demand of the hobbyists. The propagation in captive conditions also helps in restoration of degraded reefs.

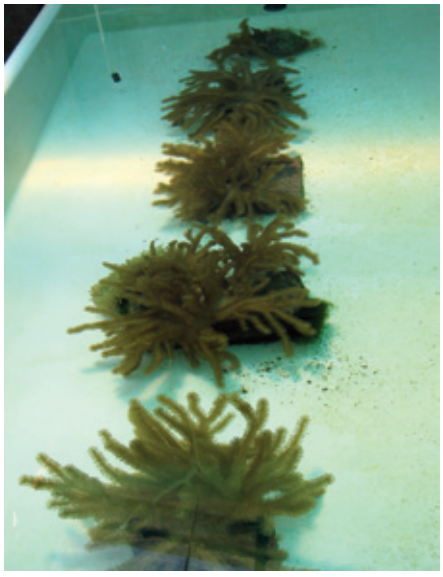
Culture potential of *Sinularia kavarattiensis*

The soft coral *Sinularia kavarattiensis* was first reported from the Gulf of Mannar region by Rani Mary George *et al*. (2007) who also gave a description of this species in the light of scanning electromicrographs of the sclerites, to facilitate easy identification. This species contain bioactive compounds such as sesquiterpene which has anti-fouling properties and furano-sesquiterpene which can inhibit the proliferation of several human cancer cell lines. Besides, *S. kavarattiensis* can also add value to the reef tanks due to its beautiful tree-like and branched appearance. The development of suitable propagation technique is therefore imperative to ensure a steady supply of raw material to the pharmaceutical industries and more so for replenishment in areas where the reefs are degraded.

Maintenance of parent colonies of *S. kavarattiensis*

The propagation studies on *S. kavarattiensis* were carried out in the wet laboratory at the Mandapam Regional Centre of CMFRI. The broodstock or the parent colonies were maintained in 1 tonne capacity rectangular FRP tanks, using filtered seawater. The level of water in the culture tank was maintained at about 45 cm. Water exchange was done at the rate of 10 % daily and the broodstock tanks were well aerated. Supplementary feed was not provided since *S. kavarattiensis* is a photosynthetic soft coral and harbor symbiotic algae called Zooxanthellae in their

tissues. The water temperature ranged from 24-31°C, salinity from 32-34 ppt and the pH ranged from 7.9 to 8.1 during the culture period.



Parent colonies of *Sinularia kavarattiensis*

A close view of the parent colonies with extended polyps

Fragmentation

The fragmentation or cutting is done either by slicing down to the base of the colony and removing small portions along with the base, or alternatively by removal of only the lobes which subsequently attaches and develops into new colonies. In the former method, the attachment is achieved much faster *i.e.* in a span of two weeks, since the fragment has a base. In the case of lobes, the time taken for attachment is about 3 to 4 weeks. Only healthy parent colonies are used for the removal of explants. The fragmentation of lobes was done by two methods:

(i) ***Fragmentation using scissor***: In this method, the lobes of the parent colonies were removed using a sharp sterilized scissor.

(ii) ***Fragmentation by tying noose***: In this method, noose was made around the lobes using cotton thread. The noose was tightened on alternate days and the lobe got detached from the parent colony in about 20-25 days. The advantage in this method is that it leaves no injury to either the parent or the lobe that was removed.

A total of 20 fragments along with the base were removed from four parent colonies. The fragments that were removed from the parent colony were maintained in FRP tanks with clean filtered seawater and ample aeration. The injury in the cut areas of the parent colony as well as of the detached fragment was found to completely heal in about 20 days.

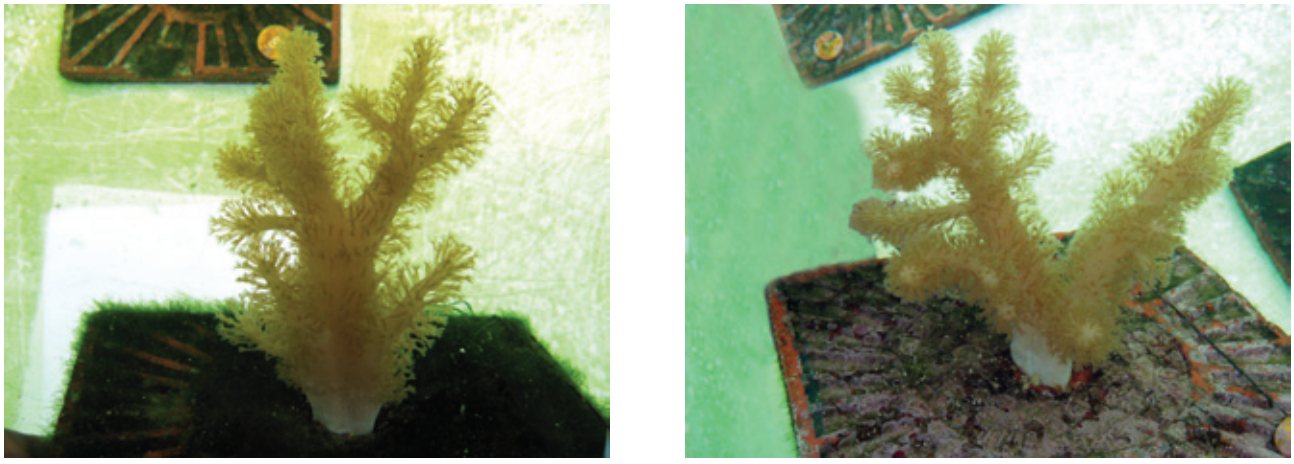
Planting and attachment

Two types of substrata were used for the attachment of the fragments namely the compressed red clay tile and concrete blocks. A small depression was made at the centre of the substrata and the fragments that were removed were placed in the depression, one on each substratum. In the present study, no adhesives were used for the attachment of fragments. The substrata with the fragments were then placed in rectangular FRP nursery tanks of 1 tonne capacity with a water level of 45 cm. About ten percent of water was exchanged daily. The time taken for attachment did not vary with the two types of substrata studied. The fragments were found to attach to the substratum in about 2 weeks.

Growth of fragments in laboratory conditions

The basal circumference and the number of lobes were the parameters used for estimating the growth of the soft coral colonies. The growth was assessed

Newly developed colonies of *S. kavarattiensis* using fragment detached from the base on compressed red clay tile



Newly developed colonies of *S. kavarattiensis* developed from the detached lobes on compressed red clay tile

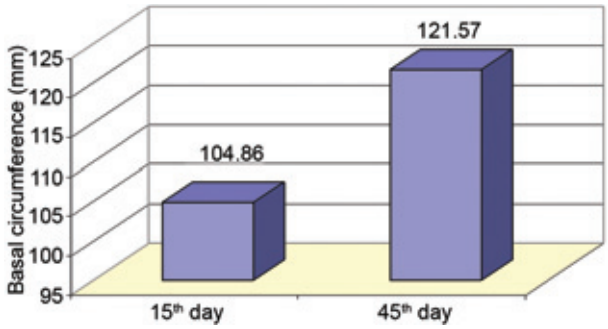


Fig. 1. Increment in basal circumference of *S. kavarattiensis* colonies cultured in the laboratory

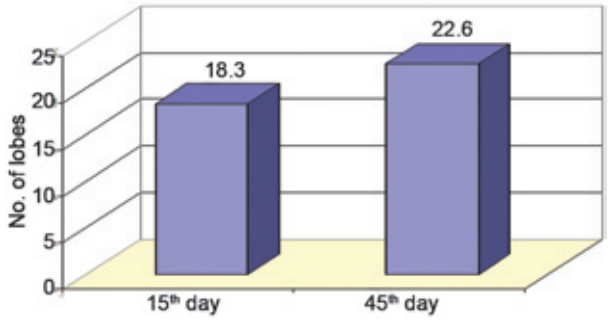
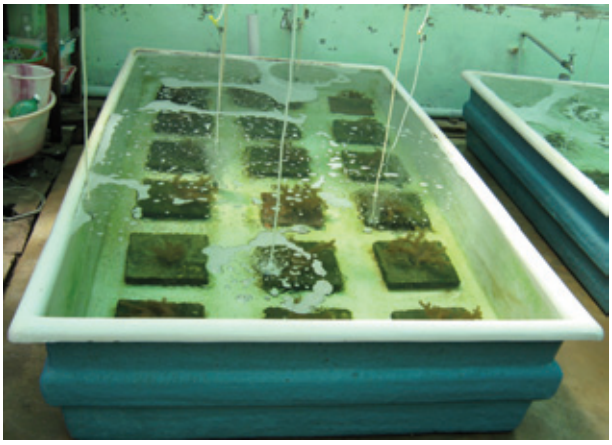


Fig. 2. Increment in the number of lobes of *S. kavarattiensis* colonies cultured in the laboratory

and recorded once in a fortnight. The mean increase in basal circumference was 16.71 mm in 30 days and the mean increment in the number of lobes was 4.3 in 30 days period. A survival rate of 100% of the newly developed colonies was obtained in the laboratory conditions.

Growth of explants in open sea

A total of ten well established colonies of *S.*



Newly developed colonies of *S. kavarattiensis* on concrete blocks suspended in an FRP tank

Boxes with developed colonies on concrete blocks being suspended in the Bay for culture

kavarattiensis attached to the concrete blocks were cultured in plastic boxes in open sea for a period of 80 days to assess the survival and growth. The colonies used for the study were 45 days old after fragmentation. The plastic culture boxes (64 cm length x 44 cm breadth x 32 cm height) which are perforated with slit-like openings on all sides and open on the top, allows free movement of water. The top portion of the box was covered with a net to prevent the entry of seaweeds/seagrasses which comes along with the waves and water currents. The culture boxes were suspended in the Palk Bay off Mandapam using nylon ropes tied to the casuarina poles at a depth of around 4 to 5 m. The boxes were periodically observed and cleaned to remove the fouling organisms. Supplementary feed was not provided and the growth was monitored once in a fortnight. Although all the culture boxes were suspended in the same locality, it was observed that the growth of all the colonies was not uniform. A survival rate of 100 % was achieved during the culture. The minimum increment in the basal circumference of *S. kavarattiensis* was 8 cm while the maximum increment was 13.5 cm during a culture period of 80 days (Fig. 3). Similarly, the minimum increment in the number of lobes was 33 while the maximum increment was 98 numbers during 80 days culture period (Fig. 4).

The study has shown that after an initial nursery phase of about 45 days, the well established colonies of *S. kavarattiensis* can be transplanted in areas wherever restoration is required. Since this species

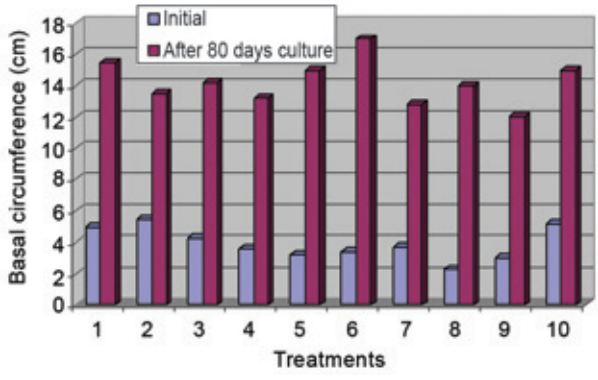


Fig. 3. Increment in basal circumference of *S. kavarattiensis* colonies cultured in open sea

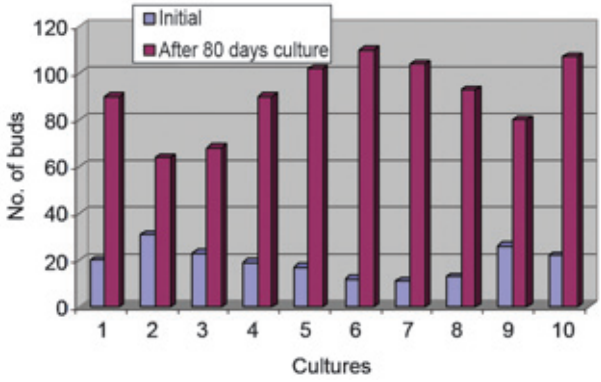


Fig. 4. Increment in the number of lobes of *S. kavarattiensis* colonies cultured in open sea

is a photosynthetic Alcyonacean, they can be maintained in the culture systems without supplementary feeding and therefore is less cumbersome to maintain for a longer duration. The success achieved in developing new, healthy coral colonies of *S. kavarattiensis* has proved that large number of colonies can be produced using simple propagation methods.

Report on widespread occurrence of colonial epizoan ascidian *Didemnum* sp. in the seagrass beds of Gulf of Mannar

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ICAR-Central Marine Fisheries Research Institute, Kochi

The seagrass beds of Gulf of Mannar are one of the major habitats of the Sea cow *Dugong dugon*. This species is a herbivore that has become more vulnerable in the recent decades caused by habitat degradation due to anthropogenic activities. Ecologically, seagrass beds play several roles such as primary producers, food for herbivores, trapping sediments, preventing erosion and providing shelter for juvenile fishes. Seagrasses also serve as a substrate for fouling organisms, usually epiphytes such as barnacles, polychaetes, ascidians etc. Unlike fouling on hard non-biotic substrates like pipelines and cages, the fouling on seagrass blades is not intense.

Fig. 1. Colonies of *Didemnum* sp. (white colour) attached to the blades of seagrass

During an underwater survey for dugongs conducted in the Gulf of Mannar during November, 2014, unusual widespread occurrence of colonial ascidians were observed in the seagrass beds on the shoreward side of Vedhalai (9°15'38N; 79°54'24E) near Mandapam. Ascidians, commonly called sea squirts or tunicates are chordate filter feeders with wide distribution in most marine habitats. Two types of ascidians, namely solitary and colonial are present in the marine ecosystem. In this particular case the ascidian was identified as *Didemnum* sp. belonging to the family Didemnidae under Order Aplousobranchia. The *Didemnum* sp. colonies were found attached to the blades of the seagrass *Cymodocea serrulata* and *Syringodium isoetifolium* during the survey. All the colonies were white in colour and formed a thin encrusting sheet or mound on the seaweeds (Fig.1).

The Sea cow mainly feeds on *S. isoetifolium*. The shoot density of *C. serrulata* observed was 54 to 160 numbers and that of *S. isoetifolium* 40 to 96 numbers. It has been reported that colonial ascidians often occur in areas with high levels of suspended organic particles and pollution. During monsoon, heavy freshwater run-off from shore brings in lot of nutrients to the near shore seagrass beds which might be one of the reasons for the abundance of ascidians.

The environmental parameters were also

collected during the survey. The atmospheric temperature (27°C), Sea Surface Temperature or SST (26°C), salinity (24 PSU), pH (8.0) and sea bottom temperature (25.5°C) was recorded. Generally, the sea is very calm during the months of October to February in Gulf of Mannar. The SST of the area is very low during November and December while in the rest of the months it is 29 to 34°C. Low salinity observed during the study indicated land runoff due to rainfall. The low temperature coupled with nutrients may have favoured the growth of *Didemnum* sp. Also, overharvesting of fishes by shore seines may have caused the decline of predatory fishes which could be another reason for the proliferation of ascidians.

The occurrence of ascidicans colony on the seagrass blades may not affect the ecological functioning of the seagrass beds. This could be a seasonal blooming and the colonies may wilt off once the environmental conditions change. However, if they persist for a long period, they can inhibit photosynthesis. Increased biomass of ascidians can lead to wilting of sea grass blades and finally degradation of the seagrass beds leading to reduction of ecosystem services. Chances of a bloom of ascidians directly affecting the dugongs is negligible but needs further investigation. On the other hand, many bioactive compounds such as cytotoxic didemnins, lipids, aplidine, peptides, tamandarins etc. have been isolated from the species belonging to the genus *Didemnum*. Therefore, screening of the *Didemnum* sp. in the Vedhalai area may provide information on unique bioactive compounds present. After understanding the bloom triggering parameters, artificial substrates can be placed for large scale collection of ascidians from natural beds for utilization as a source of bioactive compounds.

Fish Cutting Centres of Karnataka: An ancillary small scale industry for *Surimi* production

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Fish processing plants/industries add value as well as shelf life to the harvested fish. Such plants have facilities for curing, drying, freezing, filleting, canning etc. Processing of fish includes the preparation of minced fish meat which forms the raw material for various ready-to-cook and ready-to-eat products. The minced fish and fish paste is used in the domestic markets for preparation of various culinary products and also has a very good export demand in the form of *Surimi*. This export market provides an opportunity for preparation of high quality fish paste, through utilization of small fishes with low or no value in the domestic markets. *Surimi* is prepared from small sized fishes of good quality having reasonably high gel strength. The threadfin breams (*Nemipterus* spp.), lizard fish, (*Saurida* spp.), croakers (*Johnius* spp.) ribbonfish (*Trichiurus* spp.), lesser sardines (*Sardinella* spp.) and goatfish (*Upeneus* spp.) are used for the preparation of *Surimi* which is a Japanese term that literally means “ground meat”.

As the *Surimi* produced is meant only for export, strict hygienic conditions are maintained in the plants with the fish being brought here in a partially pre-processed stage. This pre-processing includes beheading, removal of scales and viscera, washing etc. This activity is carried out in cutting sheds which have grown as an ancillary industry engaging a large work force dominated by women. Presently, in Karnataka there are 25 fish cutting sheds located in Mangaluru, Malpe, Kundapur and Karwar. These

Women engaged in processing of fish in Fish Cutting Centre at Malpe

centres procure raw fish directly from the fishing boats and send the pre-processed fishes to the *Surumi* plant while the waste generated is sent to fish meal plants, where it is converted to protein rich powder and used in the preparation of aqua feeds.

During peak fishing season, the Fish Cutting Centres have the capacity to produce 10-15 tonnes (t) of pre-processed fish daily. Availability of raw material used for the preparation of *Surimi* is maximum during September to December. The pre-processing centres generates enormous amount of waste, being approximately 20 - 30% of total fish weight, based on the species of fish being processed. The waste thus generated during the processing is transported to nearby fish meal plants. Majority of the fish cutting centres operate for about 6 - 8 months in a year, depending on raw material availability. Whenever there is no demand for the pre-processed fish from the *Surimi* plants or scarcity of a particular fish, these cutting centres procure oil sardine and process it for canning factories on request.

Each Fish Cutting Centre employs around 80-100 women and the 25 functional pre-processing sheds provide direct employment to around 2500 women living in the coastal area. They are initially trained in hygienic processing of the fish. The cutting tables and other equipmments have been modified accordingly to facilitate a comfortable working environment for the women employees. While processing the fish the women squat down and cut fishes using sickles. To suit this method of cutting, the height of regular processing tables have been decreased and sickles mounted on the edges. Thereby the women can sit comfortably on special platforms above the wet floor and cut the fish with ease. The trained women can process around 100 - 150 kg of fish every day and are paid on a daily basis at the rate of ₹ 2 per kg of processed fish.

These centres thus provide direct employment to the fisherfolk by playing a crucial part during the pre-processing phase of *Surimi* production.These pre-processing centres are indirectly responsible for boosting the export earnings of the country from fisheries. *Surimi* is mainly exported to European countries, Japan and South-East Asian countries and annually about 10,000 to 12,000 t is being exported from India. In addition, oil sardine processed from these centres are being used along with other highly priced fishes for export.

On a small scale targeted fishery for White sardine and Goldspotted grenadier anchovy along the Maharashtra coast

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Marine fish landings of Maharashtra during 2014 were estimated at 3.44 lakh tonnes (t) with the pelagic resources contributing a major share (42%). Of this, more than 60 % were small pelagics namely, Bombay duck, clupeids and anchovies. These fish have been targeted by coastal fishermen using

Bhiljee fishery actvities at Mumbai

Fishing boats with outboard engine Fishing boats with inboard engine Non-motorized boat

traditional fishing methods for their livelihood and sustenance since several decades. Fishing operations which are mainly in the near shore areas are declining due to the coastal pollution and developmental activities. Yet for many of these traditional small-scale fishermen, alternate livelihood options are limited.

In Maharashtra especially in the suburbs of Mumbai city (Versova, Cuffe Parade, Madh, Vasai, Alibaug) an exclusive targeted fishery exists for white sardine, *Escualosa thoracata*. This fishery has been in existence for the past four decades and is conducted by local fishermen. Locally this fish is called *Bhiljee* due to its silvery-white shiny appearance. Nearly 20-50 small motorized or non-motorized canoes (15-20 feet), small boats with inboard/outboard engines (16-26 feet, 1-2 cylinder) conduct fishing in the near shore areas (within 2-5 km) at depths of 2-8 m using special small meshed (18 - 22 mm mesh size) drift gillnets called "*bhiljee jaal*". Length of the net ranges from 40 -100 m with a height of 1.1 to 1.3 m. Each boat has a crew of 2 - 5 people. Each boat takes 8 -15 nets depending upon the number of crew. They venture into sea early in the morning around 0400 am and set the nets by 0500 am. Net is hauled after 2-3 hours and catch brought to the shore by 0930 am. Sorting ofthe fish catch is done at the beach and all family members including women and children participate in the process. Mostly the catch will be exclusively of *E. thoracata*. Occasionally catfishes, flying fishes, fullbeaks, halfbeaks, polynemids and clupeids are also caught which gives the fishermen higher returns. Length of *E. thoracata* landed ranges from 48 -114 mm in total length (TL). Catch depends upon season, area and tide. When the *Bhiljee* catch is low these fishermen use gillnets of mesh size 50, 90, 100 and 140 mm for other fishes. The *Bhiljee* fishery forms the main livelihood avenue for some fishermen during the monsoon season. On a good day, catch may be 30 -50 kg, which is sold at ₹ 100 -180 per kilogram. During monsoon season, the price obtained will be higher due to fishing ban and non-availability of other fishes.

In 2014, the Goldspotted grenadier anchovy *Coilia dussumieri* contributed 4.0 % (14,056 t) to the total marine fish landings of Maharashtra, showing a 43 % increase over the last year. Bag nets were the major contributor to this fishery followed by trawlnets and gillnets. Alibaug in the northern part of Mumbai has been a major hub for small pelagic fisheries since a very long time. *C. dussumieri* locally known as *Mandeli*

Gill net catch at Alibaug

Marketing of *Mandeli* catch

is a small engraulid with a maximum size of 21 cm TL. A targeted seasonal fishery is conducted by local fishermen of Alibaug with a special gillnet of 80 -100 m length with a height of 2 m and mesh size of 25 mm. In peak season nearly 60 boats (18 -25 feet) with inboard engines operate for fishing *Mandeli*. Fishermen venture into sea at 05 00 am and conduct fishing for 3 hours after which they reach landing centre around 11 00 am. More than 90 % of the catch consists of *C. dussumieri* and by-catch includes *Pellona ditchela, Sardinella* spp. and other clupeids. According to the fishermen, winter season is good for *Mandeli* fishery. The catch is sorted on the beach by the fishermen's family. Women exclusively deal with fish sales. Due to demand for fresh fish, most of the catch is sold off on the beach itself. In the landing centre *Mandeli* is sold in baskets each costing ₹ 200-300.

Two instances of gonadal abnormalities in Indian mackerel

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The Indian mackerel *Rastrelliger kanagurta* is known to be dioecious with male and female gonads in separate individuals. However, gonadal abnormalities such as hermaphroditism and other aberrations have been observed in a few instances. Gonadal abnormalities in mackerel observed during regular biological sampling from fish samples collected from the landing centre is reported here. For the histological analysis, the gonads were fixed in 10% neutral buffered formalin, dehydrated in ethanol series and the cleared samples were embedded in paraffin wax and made into blocks. Serial sections of 5μm were taken using a Leica Microtome and stained with Harris's Haematoxylin and Eosin.

A mackerel caught in a gillnet on 6th February 2014, had both male and female gonads which were separate. The total length and body weight of the hermaphrodite fish was 178 mm and 52 g respectively. The gonads consisted of separate testis and ovary and they were not interconnected (Fig. 1). The length of the right ovary was 33 mm while the left ovary was smaller at 22 mm. The total

Fig. 1. Hermaphrodite mackerel with male and female gonads

weight of testis and ovary were 0.67 and 2.82 g respectively. Histological analysis showed that the ovary and testis were similar to other normal gonads and they were in spent stage. The present observation was different from that of earlier records of hermaphroditism in mackerel, where in the same gonad, one part was functional as ovary and the other as testis. Parasitism may be a cause for hermaphroditism, but in the present instance parasite infestation was not observed.

Another mackerel was obtained on 6th June 2014 from a ring seine catch measuring 190 mm and weighing 83 g. It had gonads where the ovary was dominant and was encircled by a thin testis like tissue. The length of the ovary was 32 mm and

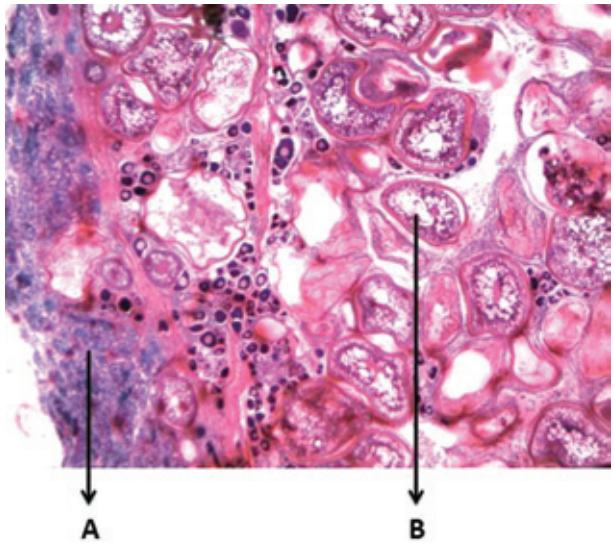

Fig. 2. Cross section of ovary showing abnormal section (A) and normal tissue with developing oocytes (B)

weighed 2 g. Histological studies showed that the female gonad was prominent and that the testis like tissue was only abnormal, hardened ovarian tissue (Fig.2).

During the period 2010 to 2014, about 36000 specimens of mackerel collected from the same landing centre have been analysed but hermaphroditism was observed only once indicating that this is an abnormality.

A note on the rare landing of the Japanese rubyfish in Gujarat

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On 3rd December, 2013, the rare landing of Japanese rubyfish *Erythrocles schlegelii* (Richardson, 1846) was observed in the trawl catches at Veraval Fisheries Harbour. Around 40 kg of *E. schlegelii*, along with *Epinephelus diacanthus* and *Pricanthus hamrur* was landed. The length range was 250 to 520 mm and weighed between 400 gms to 1.5 kg each. The landed catch was sold along with *P. hamrur* at a price ₹ 40 per kg.

From the bulk catch a single specimen of length 50.5 cm and weighing 1.102 kg (Fig. 1) was collected and the species identification was confirmed following Heemstra (1986). After detailed morphometric and meristic measurements were recorded, the specimen was preserved and kept in the museum at Veraval Regional Centre of CMFRI. Body is fusiform with a distinct morphology of the upper jaw which differentiates it from other fishes

Fig. 1. Japanese ruby fish

belonging to Perciformes. The supramaxilla is well developed, the premaxilla has a broad median ascending process joined to a large rostral cartilage, and there is a prominent midlateral process. There were no teeth in the jaw. Colouration was reddish brown dorsally and silvery white with pinkish tinge below while caudal and pectoral fins were reddish orange. The details of morphometrics and meristics is given in Table 1. The specimen was a mature male with its gut full of *Acetes* sp. The fish is known to feed on shrimp belonging to the family Sergistidae and also on small mesopelagic fishes of the family Myctophidae, Astronesthidae and Paralepididae.

Table 1. Morphometric and meristic data of *E. schlegelli*

Characters	Measure-ments (cm)	Percentage (%) of Total Length
Total length	50.5	
Standard length	42	84.1
Fork length	45	89.1
Head length	12.8	25.3
Snout length	3.5	6.9
Body depth	13.5	26.7
First Dorsal fin height	5.2	10.2
First dorsal fin base length	9.5	18.8
Second dorsal fin height	4.2	8.3
Second Dorsal fin base length	7	13.8
Pectoral fin height	7.9	15.6
Pectoral fin base length	2	3.9
Pelvic fin height	6	11.8
Pelvic fin base length	2.4	4.7
Anal fin height	3.6	7.1
Anal fin base length	5	9.9
Caudal fin length	9	17.8
Pre pectoral fin length	14.5	28.7
Pre caudal fin length	40	79.2
Pre anal fin length	30	59.4
Pre dorsal fin length	16.5	32.6
Eye diameter	3	23.4
		% of Head Length
Inter orbital space	4.3	8.5
Maxillary length	4.5	8.9
Mandibular length	5	9.9
Meristics		
Dorsal fin spine	11	
Dorsal soft rays	11	
Pectoral fin rays	18	
Pelvic fin spine	1	
Pelvic fin ray	7	
Anal fin spine	3	
Anal soft rays	9	
Gill rakers (Upper limb & Lower limb)	9 & 25	
Scales on lateral line	69	

Sea erosion and its impact on turtle nesting in Karnataka

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Sea erosion along the coast of Karnataka has resulted in the loss of valuable beaches which is important for marine turtle nesting. In Karnataka, only the Olive ridley turtle is known to nest along the coast. Also known as the Pacific ridley, this species is found in coastal waters of the tropical parts of the Pacific, Indian and South Atlantic Oceans. The three coastal districts of Karnataka such as Dakshina Kannada, Udupi and Uttara Kannada have a coastline of about 300 km of sandy

Erosion of beach at Yermal, Udupi District

beaches which are preferred nesting sites of Olive ridley turtles. Sea erosion especially during monsoon is the major reason for loss of beach in this coastal stretch. Based on the interviews of fishermen conducted during 2013 in 28 beaches of coastal Karnataka, ranks were assigned for the reasons for decline in turtle nesting (Table 1). In Dakshina Kannada district, sea erosion and seawall construction as well as lighting, human activities and litter in the beaches were ranked as important. In Udupi district sea erosion and seawall construction as well as fishing mortality was ranked first in equal number of beaches. In Uttara Kannada district. lighting, human activities and litter in the beaches was ranked first in three beaches while fishing related mortality was ranked first in two beaches.

Trasi beach in Udupi is predominantly sandy with sand dune plants *Ipomoea pes-caprae* on the beach and a favourable site for turtle nesting. Yet during the rough monsoon season the beach is eroded. Climate change can also bring about increased wave action on beaches and result in loss of beach width. From year 2005, a turtle hatchery was operational and regular awareness programmes used to be conducted in this beach but of late this has been discontinued. Uttara Kannada district has beaches of tourist interest as well as fishing activities. With the electrification of the beaches, the time spent by tourists and visitors to the beaches have also increased. This in turn has resulted in more litter on beaches. Turtles that come for nesting can also get entangled in the damaged fishing nets left on the beach. Marine litter on the beach, illumination of beach front and fishery linked mortality are some of the threats perceived to turtle nesting along Karnataka coast.

Table 1. Ranking of reasons for decline in turtle nesting in three districts of Karnataka

District / Beach	Reasons for decline in turtle nesting			Turtle nesting observed as before
	Erosion/seawall	Lighting/human activities/litter	Fishing activity related	
Dakshina Kannada				
Someshwara	-	-	-	yes
Ullal beach	1	-	2	-
Bengre	-	1	2	-
Thaneerbavi	-	1	2	-
Panambur	1	2	3	-
Chitrapur	-	1	2	-
Surathkal	-	-	-	yes
Shashitulu	-	-	1	-
Hejimadi kodi	1	2	3	-
Udupi				
Padubidri	-	-	-	yes
Yermal	1	-	-	-
Muloor	-	-	-	-
Kaup	-	2	1	-

Katpadi Mattu	1	-	-	-
Pitrody	1	3	2	-
Malpe	-	2	1	-
Trasi	3	2	1	-
Kilimanjeshwara				yes
Uppunda	3	1	2	-
Byndoor	-	-	-	yes
Uttara Kannada				
Bhatkal	-	2	1	-
Murudeshwara		1	2	-
Manki	-	-	-	yes
Kumta	-	-	-	yes
Gokarna	-	1	2	-
Tagore	-	1	2	-
Devbag	-	-	-	yes
Majali	-	2	1	-

Occurrence of *Mirabilistrombus listeri* off Visakhapatnam coast

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The genus Strombus is a widely distributed within the Indo-Pacific region. *Mirabilistrombus listeri* commonly known as the Lister's conch is considered to be a true conch. A deep water species, it is distributed in the Northwest Indian Ocean and Andaman Sea. However, information on *M listeri* from the Indian coast is limited and it has been reported from Dhanuskodi, Gulf of Mannar, Tamil Nadu. The occurrence of this species along the Visakhapatnam coast is reported below.

Live specimens and shells of *Mirabilistrombus listeri* (Gray, 1852) were collected from the by-catch of the shrimp trawlers operating off Visakhapatnam (17° 42' N, 83° 15' E) in the Bay of Bengal. The live specimens were maintained in the marine hatchery in 1 tonne capacity fiberglass tanks containing seawater of 32-35 ‰ salinity. The morphometric measurements and the behavior of the conch was recorded. The identification of the species was based on earlier description by Abbott (1960) and Subba Rao (2003).

Fig. 1. *Mirabilistrombus listeri*

The external surface was brown and whitish, overlaid with chestnut undulating axial stripes and speckled bands; periostracum was yellowish and very thin. Winged shell, 136.75 mm in shell length and 55.61 mm shell width was rather thin but strong, with a high pointed spire and a long and narrow

body whorl. Outer lip a little quadangularly expanded with the thickened edge almost parallel to the columella, posteriorly forms a round ended projection extending almost on the level of the suture above the penultimate whorl; anterior canal well developed, stromboid notch very deep and u-shaped. The head bears long and muscular eye peduncles; each peduncle giving rise to a fairly long tentacle a little below its distal end. Eyes are well developed and have colorful irises. Foot is narrow, very muscular bearing the operculum. Operculum is curved, almost crescent shaped, brown; serrated on one of the margins: proboscis is long and thin; penis open grooved and long; the conch moves or jumps with a leaping motion.

The shells are of great ornamental value and highly priced due to their rarity. Decorative items are made from the shells and are sold as curio items. The occurrence of shells and live specimens of *M listeri* has been observed in the trawl by-catch landed in the Vishakhapatnam Fishing Harbor in recent months and therefore it may be assumed that a very small stock of *M listeri* has probably established itself off Visakhapatnam. It is possible that the Visakhapatnam coast provides a natural habitat (sandy-mud substratum) for *M. listeri*, along with many other gastropod species occurring in the bed. This is a new distributional record for the species.

Observations on the unusually heavy landings of oil sardine at Karwar

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Oil sardine (*Sardinella longiceps*) forms one of the most important pelagic resource landed along the Karnataka coast. The annual oil sardine landings during the year 2013-2014 was 9522 tonnes (t) in Uttar Kannada district of Karnataka. Baithkol is the major mechanised landing centre here. At Karwar, oil sardine landing is generally observed from August to May and the peak season is from October to March. During 2014, soon after the Monsoon Fishing Ban period, the oil sardine fishery by the purse seine boats started on the first of August, 2014. On 13th October 2014, unusual heavy landings of oil sardine by purseseiners was observed at Baithkol landing centre. The heavy landings started from morning 11 00 hrs and continued upto 18 00 hrs on that day. About 35 purse-seiners landed catch ranging from 5 to 6 t per boat with the total catch landed during the day being 193 t. The total length of oil sardine landed ranged from 15 to 17 cm. The entire catch

Purse seiners loaded with oil sardine berthed at Baithkol Landing Centre, Karwar

was iced, loaded in trucks and transported to Mangaluru and other states also. The auction rate of the fish ranged from ₹ 360 to ₹ 420 per basket of 30 kg.

On an incidental catch of Spinner dolphin *Stenella longirostris*

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Spinner dolphin *Stenella longirostris* (Gray,1828) was incidentally entangled in an encircling gill net (55 mm mesh size) off Mangaluru on 18th September, 2013 and landed at the Mangalore Fisheries Harbour (Fig. 1). The mammal was found entangled in the net deployed at about 60 m depth around 04 00 am in the morning. Fishermen were of the opinion that Spinner dolphins mostly get caught in the net when the water is turbid and visibility is low. The morphometric measurements of the dolphin are given in Table 1.

Fig. 1. Spinner dolphin landed at Mangalore Fisheries Harbour

They are often found moving ahead of or along with the fishing vessels. They are reported to feed mainly at night on small fishes, squids and shrimps. In the present male Spinner dolphin, which was measuring 151 cm in length and weighing about 30 kilograms the gut was found to be empty.

Table 1. Morphometric measurement of Spinner dolphin

Morphometrics	Measurement (cm)
Tip of upper jaw to deepest part of fluke notch	151
Tip of upper jaw to centre of anus	109
Tip of upper jaw to centre of genital slit	99
Tip of upper jaw to centre of umbilicus	75
Tip of upper jaw to top of dorsal fin	88
Tip of upper jaw to anterior insertion of flipper	40
Tip of upper jaw to centre of blowholes	30
Tip of upper jaw to centre of eye	28
Tip of upper jaw to angle of gape	27
Tip of upper jaw to apex of melon	15
Notch of flukes to centre of anus	49
Rostrum- maximum width	7
Height of eye	0.6
Length of eye	1.6
Blowhole length	1.1
Blowhole width	1.7
Flipper width	13
Flipper length (tip to anterior insertion)	23
Flipper length (tip to axilla)	18
Dorsal fin height	15
Dorsal fin base	21
Fluke span	34
Fluke width	10
Fluke depth at notch	1.3
Girth at anus	40
Girth at axilla	67
Girth at eye	49
Total number of tooth on one side of upper jaw	43
Total number of tooth on one side of lower jaw	46
Genital slit length	6
Anal slit length	2.2

Brown-headed gull entangled in a gillnet

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Brown-headed Gull *Larus brunnicephalus* Jerdon, 1840, forming big flocks consisting of more than 200 numbers were observed at Bhimili, Visakhapatnam from the months of November 2013 till January 2014. These birds were also observed at Pokkalapeta, Srikakulam on 25th January 2014 forming a flock of around 100 birds. One such gull was recorded in a gillnet operated at a depth of 15 m by fisherman at Gowlamukkam landing centre, Andhra Pradesh on 10th February 2014 (Fig. 1) and brought ashore along with the catch comprising mainly of juvenile oil sardines. There are reports of sea turtles and marine mammals caught or stranded along the coasts of India, but there are no records of seabird by-catch and hence information on the number of coastal birds caught accidently and the impact of such capture on the coastal bird population is very important.

Fig. 1. Dead specimen of Brown-headed gull

BOOK REVIEW

TUNA - FISHERY, BIOLOGY AND MANAGEMENT

Pillai, N.G.K. and Satheesh Kumar, P., 2014
ICAR-Central Marine Fisheries Research Institute, Kochi
ISBN : 9789382263943, 222 p.

Tunas are highly valued food fishes, targeted by neritic water fisheries and distant water fishing nations. Global tuna production has been estimated to be around 4.3 million tonnes (t) in 2005. The contribution by the Indian Ocean tuna fisheries was 22% of the total tuna production of 1.2 million t. The rapid expansion of the tuna fisheries in the world oceans, especially the long line fisheries (both ordinary and deep long lining), purse seine fisheries (both log-associated and free school) drift gillnetting (oceanic and neritic), longlining employing converted trawlers, pole and line fishery and sport fishery (angling) urgently necessitated a compendium on the present status of tuna fisheries

in the global scenario. It is in this context that the book "Tuna-Fishery, Biology and Management" has been prepared by N.G.K. Pillai and P. Satheesh Kumar (222 pp) and published by CMFRI (2014).

The subject matter has been presented in eleven chapters and a bibliography. Chapter 1 presents the focus of the study and the source(s) of data such as those from FAO, IOTC, CMFRI, FSI, MPEDA etc and also collected from regular visits to fish landing centers in India. In Chapter 2, the taxonomy, distribution and also the IUCN Red list status of five oceanic species of tunas *Thunnus albacares, T.obesus, T.tonggol, Katsuwonus pelamis, Gymnosarda unicolor* and four coastal tunas such as *Euthynnus affinis, Auxis thazard, A.rochei* and *Sarda orientalis* are presented. Tuna fishing fleet in India has been categorized and tabulated as artisanal crafts and mechanized fishing fleets and fishing gears such as drift gillnets, longlines, hooks and lines, pole and line, troll lines and purse seines are described in the Chapter-3. Application of remote sensing in locating tuna shoals is presented as a compilation of published information. Brief mention of the Fish Aggregating Devices in India has also been made.

Review of the development of tuna fisheries in the World Oceans from pre-1950 to1990 to present has been presented in Chapter 4. Global tuna production and species composition as of 2008 was presented and discussed. Status of tuna fisheries in the Pacific and Atlantic oceans, biology of tunas such as reproductive biology including gonad development and maturation, spawning, fecundity and Biological Reference Points are presented with passing mention of the migration of tunas in these areas. Tuna fisheries in the Indian Ocean form the content of Chapter 5. Catch and species composition were presented, and major tuna stocks in the Indian Ocean such as Skipjack tuna, Yellow fin tuna, Big eye tuna, Bullet tuna, Frigate tuna and Little tunny are discussed. Biological parameters discussed were food and feeding, length-weight relationship, growth parameters and reproductive biology. Tuna fisheries in the Exclusive Economic Zone (EEZ) of India has been presented in Chapter 6. The current production of tunas from the neritic and oceanic waters has been estimated to be 81,375 tonnes. Survey details and assessment of tunas and related resources in the EEZ of India have been analyzed and the summary presented. Development of tuna fishery in India as a timeline has been included separately. Tuna production in the EEZ of India have been presented region-wise and species-wise, and the trends were discussed. Island tuna fisheries such as those from Andaman & Nicobar Islands and Lakshadweep Islands was discussed along with production trend and constraints for tuna fisheries development in these island realms.

Climate variability and its impacts on tuna production in the Indian Ocean are the subject matter of the Chapter 7. Satellite data has been utilized, but it was not clear which software was used and which band was selected for the studies. ENSO (El Nino Southern Oscillation) index was presented, and tuna fisheries data from different gears collected from IOTC has been utilized in this study. Environmental data such as Sea Surface Temperature (SST), Sea Level Pressure (SLP), Zonal wind (U), Merdional wind (V) and Scalar wind (W) data were collected from ICOADS. The list of *El nino* and *La nina* years during 1951-2010 has been utilized in the study and Principal Component Analyses (PCA) and Multidimensional Scaling (MDS) has been carried out. Details of oceanographic parameters variability during extreme climatic events in the Indian Ocean such as wind actions, SST, SLP are included. The correlation of *El Nino* and *La Nina* to tuna catch were very informative. It was observed that during strong *El Nino* years the tuna landings decreased in the Indian Ocean due to warm climatic variability, and during weak *El Nino* years, the tuna catch show signs of increase due to optimum SST and SLP values.

Processing technology of exploited tuna resources in India under frozen tuna, canned tuna, *Masmin*, Tuna pickles; tuna paste etc. categories has been presented Processing of value added tuna products such as *Sashimi*, tuna loins, *Sushi*, *Saku* blocks, steaks, battered and breaded products besides the by-products possible from tuna

processing waste has been included in Chapter 8. Global markets for tunas, especially *Sashimi*, frozen and canned tuna are discussed in Chapter 9. From India, chilled Yellowfin tuna, gutted and beheaded tuna and tuna loins are exported. During 2009-2010, tuna export from India was 21,846 t valued at US $ 34.49 million.

In chapter 10 broad aspects of tuna migration, tuna culture, application of remote sensing in locating tuna shoals, tagging behaviour of tuna species, DNA based stock identification and population genetics of tunas are presented. In Chapter 11, Management of tuna fisheries are discussed. According to FAO (2005), the rate of stock collapse had accelerated throughout the period 1950-2004 and all major species are affected. Excessive deployment of purse seines, management concerns regarding Big eye and Southern Blue fin tuna, Illegal, Unreported and Unregulated (IUU) fishing and the steps taken by IOTC for implementing Quota Allocation System (QAS) are included in this chapter. Major management issues on tuna fisheries in the Indian Ocean are excess fishing capacity, IUU fishing, insufficient financial resources and by catches. Issues like species-specific data collection and analyses, target reference points, efficient management of the harvest, low habitat damage/ catch ratio, ecolabelling and certification of tunas and IOTC's efforts to establish strong policy on fishing, curb excess fishing capacity and by-catch management are mentioned. Major issues in the management of tuna fisheries in the Indian EEZ have been presented separately. The last Chapter 12 gives recommendations for the development of Indian Ocean tuna fisheries and tuna fisheries in the EEZ of India. In the former section, steps taken by IOTC for the implementation of Quota Allocation System (QAS) were discussed. Several points under Tuna Conservation and Fishery Management(TCFM) were presented such as reduction of fishing capacity ;area - time closure of fishery; reduction of fishing pressure on the major tuna species and their MSY level; Letter of Permit (LOP) vessels need to report their catch to the native country; necessity of tuna tagging programme and Quality Assurance System (QAS) for tuna and related fishes. Recommendations for the development of Indian tuna fisheries are included in this chapter. These include development of transportation facilities including flight connectivity; development of a modern long line fleet to produce *Sashimi* grade tunas; HRD for island fishermen in tuna longlining and handling for *Sashimi* grade tunas; annual species-wise stock assessment; tagging of oceanic tuna species; regular supply of raw materials for maximal utilization of Indian processing plants; introduction of modified fishing gears ; abolishing LOP system in the Indian waters ; a sound and effective deep sea fishing policy to be developed; future research should focus utilization of time series data on tuna and environmental variables such as SST, SLP, Chlorophyll and forage distribution; reduction of cost of production to be achieved through small scale fisheries; reduction of import of fishing fleets, and effective utilization of by-catch and discards by processing value added products from them.

In conclusion, it has been stated that the major market species of tunas are a part of international fisheries requiring multilateral co-operation for management, and at all ocean basins fisheries management organizations have been established. Depleted/affected species of tunas were identified, and swift actions are needed for ensuring that tuna populations are maintained at levels of abundance that can support MSYs on sound basis. The publication also presents an exhaustive bibliography on Tunas, Tuna fisheries and their management. This book will function as reference manual for scholars, tuna fishing industry and policy planners involved in tuna fishery management

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