

EDITED QRT REPORT

Major achievements of research (Project wise)

PROJECT CODE : MBD/RE/01
PROJECT TITLE : Understanding the threatened coral reef ecosystems of southern India and designing interventions aimed at their restoration

Principal Investigator: Dr. (Mrs.) Mary K. Manisseri,

2009 - 2010

- *Pocillopra damicornis* and *Pocillopora verrucosa* were recorded from Thankassery Harbour area. This survey revealed the presence of live, partially bleached and dead pocilloporids.

Porites lutea was dominant at Thirumullavaram, where it was observed that diseased corals were predominant and the live coral cover was less than 50 %.

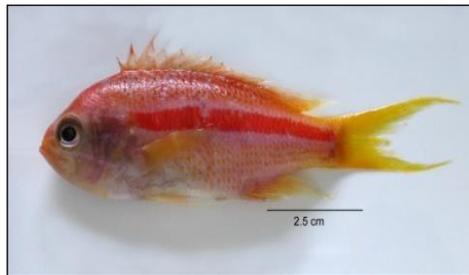
Rich assemblages of marine ornamental fishes were observed, especially at Thirumullavaram temple point, Thankassery harbour, Paravoor, Odayam, Varkala, Vizhinjam and Enayam waters.

Pink Line Syndrome was the most prevalent type of disease condition recorded at Thirumullavaram area in corals.



Pink Line Syndrome in *Porites lutea* from Thirumullavaram, Quilon

- Incidence of bleached *Pocillopra damicornis* among algal settlement and sedimentation was recorded at Thankassery Harbour area.
- At Vizhinjam Bay, Porites Ulcerative White Spot Syndrome along with infestation with boring organisms was recorded.
- The anthiimid fish *Pseudanthias fasciatus* (Kamohara, 1954) was reported from the Indian waters for the first time.

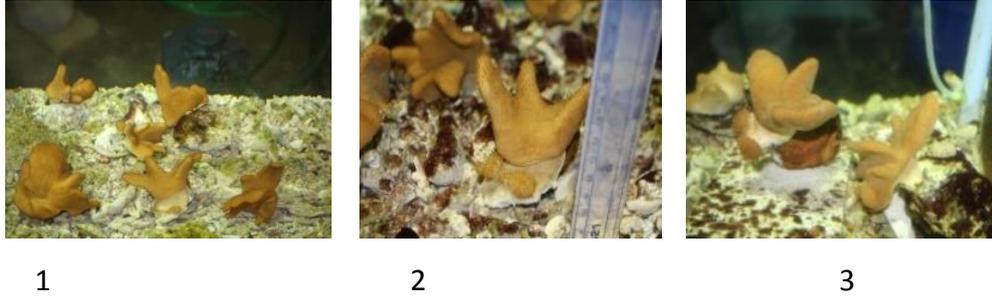


Female specimen of *Pseudanthias fasciatus* (Kamohara, 1954) landed at Neendakara



Rich sponge beds at Thonithurai

- At Thiruppalaikudi and Devipatnam areas damage to the sponge resources was mainly caused by mini trawl (*Thallumadi*) and bottom set gill net (*Nandu valai*) operations.
- At Shangumal near Rameswaram, although the area was observed to be polluted, a good population of sponges, predominated by *Spirastrella* sp. existed.
- At Goa the corals of *Turbinaria* species was dominated followed by *Porites* species.
- From Thankachimadam in the Palk Bay Sea, live colonies of *Lobophytum* and *Sinularia* were brought and maintained in the hatchery and conducted growth experiments.



L. crassum (1,2,3) showing growth of new lobes from the cut portion in 6 months

- A total of 163 species belonging to 49 families were recorded from Pamban, Mandapam and Keelakarai of Gulf of Mannar.
- 25 brachyuran crabs, one anomuran crab and 3 species of hermit crabs were recorded from Gulf of Mannar and Palk Bay.
- The numerical density of sea cucumber *Holothuria atra* at Pamban Island varied from 0.01 to 0.02 no/m² with a biomass ranging between 1.53 to 1.8 g/m⁻².
- *H. atra* showed variation in its habitat preference.
- In the trawler discards at Pamban, dominant species of echinoderm was *Salmacis virgulata* (38.7 %). Sea urchins landed were mostly broken. Colour and morphological variation were high in *Pentaceraster* spp.
- At Neendakara, sea stars and cake urchins were present in the trawler discards in minor quantities.
- Herbarium sheets of 85 macroalgae species have been prepared and deposited in the Designated National Repository Museum at CMFRI Headquarters.

2010 – 2011

Corals

The reefs around ThankasseryHarbour area in Quilon were found to be dominated by *Pocillopora damicornis* and *P.verrucosa* belonging to the family Pocilloporidae.

Occasional incidence of bleached *P. damicornis* among algal settlement and sedimentation was recorded in this area. However, at Thirumullavaram (Quilon), only massive corals were present, predominantly *Porites lutea*.

Most of the massive corals in this area were covered with algae/seaweeds and sediments and therefore weredead or affected by disease.

Pink line syndrome in *Porites lutea* from Thirumullavaram, Quilon

From samples of ulcerative white spot syndrome affected corals (*Porites* sp.) collected from Vizhinjam Bay, unique pink translucent bacterial colonies were isolated on Marine broth (MB) agar. These organisms were found to be slow growing gram negative rods, difficult to grow on general purpose media. The strains were sent to IMTECH, Chandigarh for phenotypic characterization and were identified as *Sphingomonas* sp. Another strain (C144) isolated from *Pocillopora* sp. from Vizhinjam Bay, growing as orange red colonies (Gram positive cocci) on Nutrient agar plates (with 2.5% added NaCl), was identified as *Microbacterium arborescens*. *Vibrio* spp. were the predominant colonies isolated from bleached *Pocillopora* sp. which are being identified to species level.

Taxonomic profile of a soft coral species, *Cladiella australis* (Mactadyen, 1936) (Colt coral small, blushing coral, blanching soft coral) which is a new distributional record for the Palk Bay reef ecosystem has been studied.



Cladiella australis

Lobophytum pauciflorum

Lobophytum pauciflorum was acclimatized to the hatchery conditions in the hatchery at Headquarters. An experiment on feeding trials was set up on 03.12.2010 using soft coral explants. *Nannochloropsis* sp. and an artificial feed were chosen as feeds, and each set along with control were run in triplicate.

Salinity was maintained at 34 ± 1 ppt., pH at 7.5 ± 0.5 and temperature varied between 24.5 and 29.5°C during the experiment. Light was provided for 10 hours per day using a timer.

The soft coral explants were found to attach firmly to the substratum after 20 days of cutting and on 28th December, the new polyps were

clearly visible on the cut portion of the coral explants.



Coral explant showing growth Coral explant (Initial)

Parent stock of some species of soft corals are cultured in the wet laboratory at Mandapam for further propagation experiments. Attachment studies on *Lobophytum* sp. indicated effective attachment on tiles in a span of 20 days. Propagation studies on *Sinularia* sp. using terminal fingers also resulted in successful establishment of explants (28.5%), with the parent showing 100% recovery.

Sponges

The present study revealed that Enayam-Vizhinjam waters have a good coral/sponge (14 species) cover with high fish density.



Sponges (*Spirastrella* sp.) growing along with seaweeds at Thonithurai

Reef fish

Fish assemblages and sponges associated with patchy coral reefs around Muttom and Enayam in Tamil Nadu and Adimalathura to Marathody in Kerala (South India) were investigated by using visual census method.

Coral reef fishes landed from the Gulf of Mannar at Pamban Therkuvady, Mandapam and Keelakarai were monitored and both qualitative and quantitative studies were made.

A total of 183 species belonging to 51 families were recorded. Out of this, two species namely, *Rhinopias eschmeyeri* and *Ablabys binotatus* are new distributional records to Indian waters.



Rhinopias eschmeyeri



Ablabys binotatus

2011 - 2012

Hard Corals

The study also revealed reduction in coral growth in the Vizhinjam Bay due to sedimentation and other anthropogenic activities in this area. But outside the Bay, live coral colonies on the rocks were found to be in healthy condition including several new recruits observed in this area.

At Jaleswar and Poshitra of Gulf of Kutch sporadic belaching of corals were noticed.

Soft Corals

Recent studies related to the shallower reef area of the Palk Bay Sea in the vicinity of Thankachimadam near Villundy revealed the presence of a new distributional range in the species of the genus *Lobophytum*. The colony growth morphology distinguished by sclerite characteristics and the microphotographs in different size compositions identified the species as *Lobophytum hirsutum* Tixier-Durivault, 1956. The zooxanthellate colony was collected by scuba diving from a depth zone of 3-5m. The species was conspicuous with finger like lobes and narrow stalk. Reported earlier from the waters off Vietnam, South and Middle Andamans.



In-situ photograph of the colony of *Lobophytum hirsutum* from the hatchery

Lobophytum sarcophytoides Moser, 1919, recorded after 15 years from the shallow reef area of the Palk Bay. The colony is bowl shaped with marginal open raised folds exhibiting digitiform and crest-like lobes; the surface layer of stalk and lobes are quite different. Clubs with a central wart or irregularly placed warts; prominences on the handles are arranged in one or two girdles

Propagation studies on soft corals at Mandapam

Propagation of *Sinularia* sp. in the laboratory

A total of 20 fragments were taken utilizing 4 parent colonies. The substratum used for attachment was the concrete blocks. The time taken for attachment of fragments to the substratum is about 2 weeks. The mean increase in basal circumference after complete establishment of the colony to the new substratum was 16.71 mm in 30 days. The mean increment in the number of lobes after complete establishment on to the new substratum was 4.3 in 30 days.



Propagation of *Cladiella* sp. in the laboratory

A total of 10 fragments of *Sinularia* sp. were established on to tiles.

The tiles served as an excellent substratum for attachment of the fragments and it took about 2 to 3 weeks for complete attachment to the substratum. The survival was 100%.

Propagation studies were attempted on this species. The substratum like concrete blocks, tiles, coral rubbles and oyster shells were used and all these types of substratum were found to be successful in achieving quick attachment, survival and growth. A total of 25 colonies were developed with 100% survival. The average increase in the number of lobes was 20.8 in a culture period of 90 days in the laboratory.

Sponges

Survey and inventorying of sponge resources Sponges of the coral reef ecosystem of Gulf of Mannar and Palk Bay

Diverse sponge species were observed in the gill nets (*singhi valai*) having a meshsize of 110 mm, operated 9 km away from the shore off Vethalai at a depth of 10-11m. The studies revealed destruction of sponges and other invertebrates by gill net operations, particularly *singhi valai* which is operated for catching lobsters. Over twenty species of sponges come in these fishing nets. The non-target resources like some gastropods, crabs, star fish and sponges are landed in large quantities.

Sponges of the coral reef ecosystems along the south-west coast of India

Underwater surveys conducted in the shallow coastal waters extending from Enayam to Kollam, southern India revealed a total of 24 species of sponges which were identified during the study and belonged to 20 genera, 13 families and 6 orders. Maximum species diversity was recorded at Enayam (11 species), followed by an equal number of species at Vizhinjam and Adimalathura (10 species). A majority of sponge species at Enayam, Vizhinjam and Adimalathura were found to be associated with the mussel beds.

Reef fish

The Visual Census Method revealed a total of 47 species of reef fishes belonging to 30 genera, and 20 families along Enayam-Quilon waters in Southern India. Maximum species diversity was recorded at Thankassery (23 species), followed by Vizhinjam (20) and Varkala (20 species). In abundance, fishes of the family Pomacentridae (57%) dominated the sites followed by Chaetodontidae, Lutjanidae, Apogonidae, Ballistidae, Siganidae, Scaridae, Acanthuridae,

Labridae, Pomacanthidae, Carangidae, Mullidae, Holocentridae, Mugilidae, Muraenidae , Zanclidae, Serranidae, Ostraciidae, Scolopsidae, and Haemulidae.

A total of 202 species of coral reef fishes belong to 114 genera were studied from the Tuticorin area of Gulf of Mannar during the period 2008-2011. Biodiversity indices of 48 families in relation to the species present in different families and biodiversity indices were estimated. Maximum species diversity was observed in the families of Labridae (24) Chaetodontidae (17), Carangidae (12), Acanthuridae (12), Scaridae (10) and Serranidae (9).

Few new records in the family of Carapidae were observed in the Tuticorin area of Gulf of Mannar. Most common species of Labridae recorded from Tuticorin area were *Cheilio inermis*, *Chelinus trilobatus*, *Chelinus chlorourus*, *Chelinus oxycephalus*, *Coris gaimardi*, *Coris formosa*, *Halichoeres centriquandrus* and *Halichoeres hartzfeldi*. The fishing gears employed for exploitation included almost all the gears like trawl nets, shore seines, Thallumadi (minitrawl), different types and varieties of hook and lines and gill nets of different mesh sizes and materials.

Hence 9 species of starfishes were collected and identified from Mandapam and Mangalore waters. Three species of sea urchins collected and identified from Mandapam waters were identified as *Salmacis virgulata* L. Agassiz & Desor, 1846, *Lovenia elongata* (Gray, 1845) and *Echinolampas ovata* (Leske, 1778) Sea urchins collected from trawl discards and from the exploratory fishing operations along the Mangalore coast was dominated by a single species *Temnopleurus toreumaticus* (Leske, 1778) (plate 2). Two species of sand dollar *Clypeaster rarispinus* de Meijere, 1903 (Plate 3) were recorded in Mangalore coast along with the Malabar sole catches and *Peronella orbicularis* (Leske) was recorded in Mandapam trawl discards. Two species of Scyphomedusae, *Lychnorhiza malayanus* Stiasny 1920, and *Acromitus flagellates* was documented from Mulki Estuary and Netravati-Gurupura along Karnataka coast. The jellyfish survey revealed that the *Acromitus flagellates* swarm has been delayed by a month this year in Netravati-Gurupura Estuary.

PROJECT CODE: MBD/RE/04

PROJECT TITLE: Species variation and biodiversity of the fishes of the family Lutjanidae of India

Principal Investigator : Dr. K.K. Joshi

2009 - 2010



Lutjanus gibbus (Forsskal, 1775)



Lutjanus quinquelineatus (Bloch, 1790)

2010 - 2011

A total of 43 species of fishes of the family Lutjanidae were identified and taxonomic and biodiversity details were collected. Of the 43 species, 60% belonged to genus *Lutjanus*, 8% to *Pristipomoides*, 5% each to *Aphares* and *Etelis* and the rest to the genera *Aprion*, *Lipocheilus*, *Pinjalo*, *Pterocaesio*, *Macolor* etc (22%). *Paracaesio sordida* is a new distributional record to the north-west coast of India. About 80 % of the species are commercially important forming fishery along the coast. Maximum number of species was recorded from Cochin (22 species) followed by Mandapam (17), Vizhinjam (11), Veraval (10) and Visakhapatnam (6).

Detailed information on the morphometric and meristic characteristics, biodiversity, nomenclature, taxonomic description and biological characteristics of all the 43 species were collected. A four-day workshop was held on Taxonomy and Biodiversity of the fishes of the family Lutjanidae during 8-11 February, 2011 for consolidation of the data collected, species verification and data analysis.

PROJECT CODE : **MBD/RE/05**
PROJECT TITLE : **Assessment of Biodiversity and Ecological Changes in Open Sea Cage Farming**
Principal Investigator : **Dr. K. Vinod**

2009 – 2010

- At Mandapam, the cage farm sites were located at Villundi in Palk Bay and behind the Regional Centre of Mandapam in Gulf of Mannar. Three circular cages of 6m diameter were launched at 800 m from the shore. The outer and inner rings of the cage were fitted with HDPE nets of stretched mesh size of 60 and 30 mm respectively.
- The cage farm has one broodstock cage for Cobia (*Rachycentron canadum*) and another for Pompano (*Trachinotus blotchii*) as well as a rearing cage for Seabass (*Lates calcarifer*). A control site with similar depth characteristics was identified 1 km away from the cage farm site in the Gulf of Mannar which was used for in-depth studies on the ecology and biodiversity of open sea cage farm.
- Studies on water quality parameters, sediment, plankton and benthos were initiated in November 2009. Salinity varied from 28.5 to 33.2 ppt and 28.5 to 33.4 ppt; pH values from 7.92 to 8.1 and 7.94 to 8.5 and values of dissolved oxygen from 4.28 to 5.5 ml/l and 4.59 to 5.6 ml/l respectively in the cage farm and control site.
- Total suspended solids (TSS) ranged from 31.6 to 46.2 mg/l and 32.4 to 46.4 mg/l, and chlorophyll *a* values from 0.4724 to 2.58 mg/m³ and 0.2694 to 4.0414 mg/m³ in the cage farm and control site respectively. The textural analysis of sediment revealed a higher percentage of sand grains in all the tested samples.
- The fouling in Seabass cage net at Villundi (Palk Bay) was studied in May 2009. The barnacles were predominant forming a complete mat on the cage net. The average number of barnacles in one square metre area of the net was 8315 nos., while the same for oysters was 9.7. The average wet weight of the net infested with barnacles and oysters was 9.17 kg per sq.m. The vertical profile of fouler infestation was also observed and is as follows:



Barnacles and oysters attached Counting of the fouling to the cagenets at Villundi organismsin cage nets using quadrat

- In August 2009, the fouling organisms observed on Cobia cage nets included barnacles, pearl oysters, edible oysters, ascidians, sponges and crabs.
- In October 2009, the fouling organisms on Pompano cage nets were recorded. The organisms included the barnacles (915 nos./sq.m.), pearl oysters (82 nos./sq.m.), edible oysters (25 nos./sq.m.), ascidians (3 nos./sq.m.) and *Pinna* spp. (1 no./sq.m.). Besides, seaweeds, small crabs and shrimps were also found on the cage nets.

In December 2009, the fouling organisms observed on pompano cage nets were barnacles, edible oysters, seaweeds and sponges. The entrant fishes were the silver bellies (*Leiognathus daura*), lion fish and banner fish, besides lobsters, shrimps and crabs

2010 - 2011

It was also observed that the season of installation of the cage has significant impact on the ultimate dominance of the fouling species. The succession of inoculation of foulers in this area is in the order of oysters- barnacles- mussels- algae. A net exchange is essential mainly between fouling by barnacles and mussels. This means that if we go for a net exchange during July, the same net can be continued upto 6 months or more. The main foulers after this will be small patches of mussels and algae. Mussel patches mostly get cleaned by cultured lobster themselves and algae by algae-eating fishes available in the area. Sponges and ascidians which are the common foulers of Vizhinjam area were rather rare in the fouling community of the Kanyakumari area.



Wooden panel suspended Experimental panels Fouling on cage in August from cage(made of PVC Pipes)



Fouling on cage in September Fouling on nets in December Ascidian fouling on nets in Vizhinjambay

Karwar

The fouling communities comprised of edible oysters, pearl oysters, green mussels, barnacles and *Modiolus* sp. in all months. Safety measures were undertaken against fouling of cages and nets by cleaning the cages and changing the nets at regular intervals. Diversity of wild fish fauna as well as natural entrants to the cages at Karwar were studied and finfishes including *Therapon* sp., *Ambassis* sp., *Thryssa* sp, crabs like *Grapsus albolineatus*, spider crab, rock crab and sea urchin were recorded.

Water sample analysis from Karwar revealed the presence of *Staphylococcus* spp., *Vibrio* spp., and *Enterobacter* spp. The count ranged from 5.8×10^3 to 1.51×10^9 CFU/ml in cage waters and 1.4×10^3 to 3.5×10^9 CFU/ml in the reference site. Appearance of *Vibrio alginolyticus* during April-June 2010 was responsible for an outbreak of Vibriosis in Asian seabass cultured in open sea floating cages.

Mandapam

In open sea cages at Mandapam, the dominant fouling communities were the barnacles. In addition, pearl oysters, edible oysters and ascidians were also common. Other communities observed included sponges, seaweeds and bivalves including *Pinna* sp. and *Modiolus* sp. Attachment of pearl oyster spats on the nursery cage nets was observed during May 2010. The spats in large numbers (611 no./sqft) were found attached on the nursery cage nets stocked with cobia fingerlings.

The crabs observed in the cage nets included the depressed red rock crab *Plagusia tuberculata*, hairy crab *Pilumnus rouxi* spider crab *Hyastenus diacanthus*, Porcellanid crabs (3 species) and some visiting Portunids. Microbial studies indicated that the microbial load was below detectable limit in both seawater and sediment samples.

2011 - 2012

Mandapam

- A total of 38 genera of phytoplankton were identified from both the cage and control sties which included *Navicula*, *Rhizosolenia*, *Thalassiothrix*, *Pleurosigma*, *Coscinodiscus*, *Nitzschia*, *Melosira*, *Bacteriastrum*, *Thallasiosira*, *Chaetoceros*, *Surirella*, *Thalassionema*, *Leptocylindrus*, *Fragilaria*, *Biddulphia*, *Grammatophora*, *Diploneis*, *Dinophysis*, *Guinardi*, *Asterionella*, *Cocconcis*, *Ditylum*, *Planktoniella*, *Oscillatoria*, *Tintinnids*, *Eucampia*, *Synedra*, *Gyrosigma*, *Nostoc*, *Ulothrix*, *Licmophora*, *Amphora*, *Triceratium*, *Cyclotella*, *Campylodiscus*, *Peridinium*, *Prorocentrum* and *Ceratium*.
- The rate of fouling is found to be extremely high in the Gulf of Mannar waters and the dominant fouling community was the barnacles. The barnacles often form a very thick mat on the cage nets and smaller the size of mesh, the barnacle infestation is more, adding tremendous weight to the cage nets and minimizing water exchange to the cages.

The other major fouling organisms include the rock oysters, pearl oysters, sponges, seaweeds, Ascidians and *Modiolus* sp.
- The high rate of fouling compels for regular cleaning of cage nets and frequent net exchanges to keep the fishes healthy.
- The entrant animals include the lion fish, banner fish, lobsters, crabs and shrimps (*Hippolysmata* sp.). The lobsters enter the cage nets during juvenile stages and grow to large size due to availability of food.
- The common crabs found in the cage nets include *Plagusia squamosa*, *Hyastenus diacanthus*, *Nanopilumnus rouxi* and some Porcellanid crabs.
- The traditional fishing gear locally called *Patti valai* are operated very close to the cage farm and therefore regular observations were made on the fish catches of *Patti valai* to understand the richness of fish assemblages in the cage farm area.

Vizhinjam

- Thirty two genera of phytoplankters were recorded from the study sites, comprising both the cage and reference sites. They were *Asterionella*, *Chaetoceros*, *Rhizosolenia*, *Thalassiothrix*, *Biddulphia*, *Coscinodiscus*, *Thalassiosira*, *Thalassionema*, *Nitzschia*, *Pleurosigma*, *Fragilaria*, *Triceratium*, *Ceratium*, *Dinophysis*, *Eucampia*, *Peridinium*, *Stephaenophysis*, *Grammatophora*, *Bacteriostratum*, *Hemidiscus*, *Planktoniella*, *Ditylum*, *Protoperidinium*, *Asterionollopsis*, *Pseudonitzhia*, *Entomonesis*, *Actinotychus*, *Belanospis*, *Stephanodiscus*, *Ceratulina*, *Ceratium* and *Trichodesmium*.
- A total of 16 groups of zooplankters were recorded from the cage and reference sites. They were copepods, chaetognaths, cladocerans, decapod larvae, fish eggs, fish larvae, *Lucifer* sp., amphipods, gastropods, polychaete larvae, cumaceans, mysids, cirripede larvae, ostracod and salps.
- The copepods dominated the zooplankton biomass in both the sites, predominantly represented by the genera *Pseudodiaptomus*, *Acartia*, *Temora* and *Oithona* followed by chaetognaths, *Lucifer*, fish eggs and larvae and decapod larvae.
- Macrobenthos abundance was less in the reference site than in the cage site. The macrobenthos in the cage site comprised mainly of amphipods, bivalve shells, gastropods, polychaetes, copepods, nematodes, sipunculids and algae. In the control site, bivalves formed the dominant group, while copepods were recorded in meager numbers.
- A rich assemblage of fishes was observed around the cages which included carangids such as *Carangoides armatus*, *Caranx sexfasciatus*, *C. heberi*, *C. malabaricus*, *Alectis indica*, *Alepes djedaba*; mullet *Liza macrolepis*; parrot fish, *Chlorurus sordidus*; rabbit fishes, *Siganus canaliculatus*, *Siganus javus*; snapper, *Lutjanus fulviflamma*; spotted sickle fish, *Drepane punctata*; bat fish *Platax* sp., Pharaoh cuttlefish, *Sepia pharaonis*; squid *Sepioteuthis lessonian*.
- During the monsoon period, the dominant ornamental fishes were the butterfly and banner fishes (Chaetodontidae), Sergeant major and damsels (Pomacentridae - *Abudefduf sexatilis*, *A. sordidus*, *A. bengalensis*) and snappers (Lutjanidae) and in September siganids were the dominant ones.
- Experimental panels made of PVC pipes (15cm x 15cm) with 2cm mesh netting were suspended to study the fouling communities. A total of 62 panels were suspended. The panels were analysed from February onwards. The average weight of panels which was 180g in February increased to 390g in October.

PROJECT CODE : **MBD/RE/06**
PROJECT TITLE : **Biodiversity valuation of marine ecosystems of the southwest coast of India**
Principal Investigator : **Dr. K.K. Joshi**

2011 – 2012

- Species, genera, family and order list of the important marine organisms like fish, turtles, mammals, echinoderms, medusa, shrimps, lobsters, crabs, corals, sponges, ascidians, zooplankton, phytoplankton were prepared.
- A total of 57 species of shrimps belong to 22 genera and 9 families were prepared.
- 152 species of crabs of 86 genera and 20 families and 9 species of lobsters of 3 genera and 3 orders were reported.
- 112 species of echinoderms belonging to 70 genera and 35 families were recorded.
- A consolidated list of 91 species of sponges belonging to 45 families was prepared.
- Details of the 34 species of Gorgonids belonging to 10 families were prepared.
- A list of 508 species of phytoplankton belonging to 27 genera was prepared.
- A total 465 finfish species belonging to 212 genera were elucidated for the valuation purpose.
- The preliminary economic valuations of fishery resources were done collecting data on direct value, indirect value and other values.
- Total fish catch from the area was about 517592 t which included crustaceans, molluscs and miscellaneous groups which was taken for the estimation of direct value of resources.
- Total number of fishermen population was 602 234 of which 124103 were engaged full time, 10488 as part time also formed the basis for valuation.
- Total number of crafts were 29 177 of which 3982 trawlers, 54 purse seiners, 428 gillnetters and 443 ring seiners which form the basis for labour valuation involved.

PROJECT CODE : FISHCMFRISIL201600016
PROJECT TITLE : Investigations on vulnerable coral reef ecosystems of Indian waters with special emphasis on formulation of management measures for conservation
Principal Investigator : Dr. Rani Mary George

2012 – 2013

Hard corals

Gulf of Kutch

Survey was carried out at two stations in the Gulf of Kutch region viz., Mithapur and Poshitra. At Mithapur, the supratidal region was devoid of hard coral growth, the intertidal region is with 2% coral cover and 35% coral coverage was recorded in the rock pools and the subtidal region. Macro vegetation viz., *Sargassum* sp. coverage in the subtidal and intertidal pools was 40% which may have impact on the growth of hard corals. Genus *Favia* showed higher coverage followed by *Porites* and *Favites*. Patchy distribution of *Acanthastrea* sp. and *Montipora* sp. was also recorded from the region. Patchy colonies of hard corals were observed along the southern margin at Laku Point of Poshitra which is demarkated and protected from sedimentation by Marine National Park Authority. The turbidity was very high in this region and was characterized with strong currents also. Minor Supratidal coral patches were found at Laku Point. Coral coverage of 40% was recorded in the intertidal region and 35% were rerecorded in subtidal region upto 1.5 metres depth. Beyond that sedimentation has prevented coral growth. The genera, *Porites* and *Favia* showed maximum coverage followed by the genera *Symphyllia*, *Platygyra*, *Turbinaria*, *Siderastrea*, and *Pseudosider astrea* . No bleaching was recorded from both the areas in the winter season.

Malvan

Preliminary study carried out at Malvan revealed the presence of patchy coral growth dominated by *Porites lutea* and *P.lichen* followed by *Goniastrea* sp. *Siderastrea* sp., *Cyphastrea* sp. and *Turbinaria* sp. In areas where depth is more than 1m, few colonies of *Favites* spp. was observed. The annual average rainfall is about 3000 mm with maximum precipitation during the summer monsoon extending from June to September. The atmospheric temperature ranges from

Goa

In the first site, the coral cover was dominated mainly by *Turbinaria* spp., *Psammocora profundacella*, *Goniastrea retiformis*, *Plesiastrea versipora*, *Favites pentagona*, *P. lobata*, *Cyphastrea serailia*, *Porites lutea*, *Favia pallid*, *Favites complanata*, *Favia speciosa*, *Alveopora fenestrata* and *Dendrophyllia* sp. In this transect, the estimated total coral cover area was 54.2% of the surveyed transect area followed by sponges (8.55%) and dead corals having encrusting algae (1.8%). The rest of the area (34.45) was dominated by rocks and sea weeds, especially *Padina* sp. and *Chaetomorpha* sp.

In the second site the estimated coral cover was 43.77% followed by sponges contributing 10.84% and the green algae forming 1.23% of the total transect area. *Turbinaria* spp. dominated the coral fauna followed by *Goniastrea retiformis*, *Porites lobata*, *Psammocora profundacella*, *Favia speciosa*, *Favites pentagona*, *Favia pallida*, *Porites lutea*, *Cyphastrea serailia*, *Pocillopora verrucosa* and *Pavona minuta*. The third site, little far from the first two adjoining sites, is having comparatively less coral cover (29.98%) and 3% of sponge cover. In this site *Favites pentagona* was the dominating coral followed by *Goniastrea retiformis*, *Favia speciosa*, *Turbinaria mesenterina*, *Porites lutea* and *Porites lobata*.

GOMBR (Tuticorin)

The live corals cover is mainly by corals belonging to the family Faviidae (RA- 95.19% of total live corals) and Dendrophyllidae (RA- 4.81% of total live corals). Faviids dominated by *Favia* sp., *Favites* sp. *Goniastrea* sp.. *Turbinaria* sp. dominated among the dendrophyllids. Dead corals were mostly dominated by acroporids and dead corals with encrusting algae were dominated by faviids. CMI is estimated as 0.75 and as it is > 0.33, the patch reef is classified as sick.

Soft corals

Fragmentation culture of the soft coral, (*Lobophytum sarcophytoides*) was initiated and the experiment in triplicate was set up using feed and light as variables

Studies on the propagation of soft coral *Dampia pocilloporaeformis*

Experiments were initiated to study the substrate preference, attachment and growth of a soft coral *Dampia pocilloporaeformis*. Three types of substratum were used for the study viz., coral rubble, black stone and tiles. There was no difference between the substrates with regard to

the time taken for attachment. The cut fragments were found to attach on to the substratum in about 20 days and the cut area of the fragment was found to start healing in about 2 weeks time.

Reef fishes

In Grande, Pomacentridae dominated the fishes followed by *Chaetodon lunula*, *C. collare*, *Bodianus* sp., *Heniochus* spp., *Sargocentron* sp., *Gymnothorax* sp., *Epinephelus* sp., *Acanthurus* spp., *Plectorhynchus lineatus*, *Thalassoma lunare*, *Bodianus* sp., *Labroides dimidatus*, *Aballistes stellatus* etc. The *Lutjanus* spp. dominated the reef fishes observed in the second site followed by *Heniochus* spp. *Chaetodon collare*. *Sargocentron* sp. *Chlorurus sordidus* *Siganus canaliculatus*. Fishes belonging to the family Sparidae dominated the fishes recorded from the third site. *Acanthurus* spp. was abundant in this site followed by *Chaetodon* spp., Ballistids, Wrasses, *Sargocentron* sp., *Lutjanus* sp., *Scorpaenopsis* sp., etc. Hlothurians and beautifully coloured nudibranchs, were also observed in this site.

Mandapam

A total of 202 species belonging to 53 families were recorded of which, the maximum numbers were contributed by trawl, followed by traps, gillnets and the least number of species was contributed by hooks & lines from this region. Quantitatively, the maximum was contributed by trawl net and the least by traps in Gulf of Mannar. As per the IUCN Red List, one species namely, *Cheilinus undulatus* is an Endangered species.



Cheilinus undulatus from Gulf of Mannar

Vishakhpatnam

Fourty five species belonging to 23 families are recorded during the study period. Lutjanidae dominated the collection with six species followed by Mullidae, Holocentridae and Apogonidae. Other families recorded were Acanthuridae, Ambassidae, Antennaridae, Balistidae, Chaetodontidae Haemulidae, Nemipteridae, Pempheridae, Platacidae, Plotosidae,

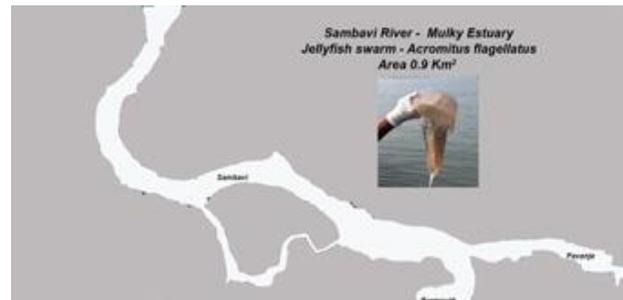
Pomacanthidae, Scaridae, Scatophagidae, Scorpaenidae, Serranidae, Siganidae, Sparidae, Terapontidae and Uranoscopidae.



Spiny sea urchin, *Stomopneustes variolaris* (Lamarck, 1816)

Sand star species *Astropecten indicus* Doderlein, 1888, were found in good numbers in the single day trawl catches in Mangalore waters. The gut content analysis of 180 sand stars revealed a diverse benthic organisms viz., *Umbonium sp.*, *Cerithedia sp.*, *Oliva sp.*, *Turritella sp.*, Bivalves, Elephant tusk shell etc., in their gut content. *Umbonium sp.* and *Cerithedia sp.* were the dominant food item.

The jellyfish survey was conducted during the peak swarming this year in January in two places viz., Netravati-Gurupur Estuary (9.8 Km²) and Sambavi-mulki estuary (0.9 Km²) revealed that the species *Acromitus flagellates* was dominant. At Kamini river bar mouth the successive breeding of *Acromitus flagellates* was observed in 2011 and 2012. The Scyphomedusae diversity along the southwest coast stands at 8 species, in which two species have been collected from Karnataka coast this year.



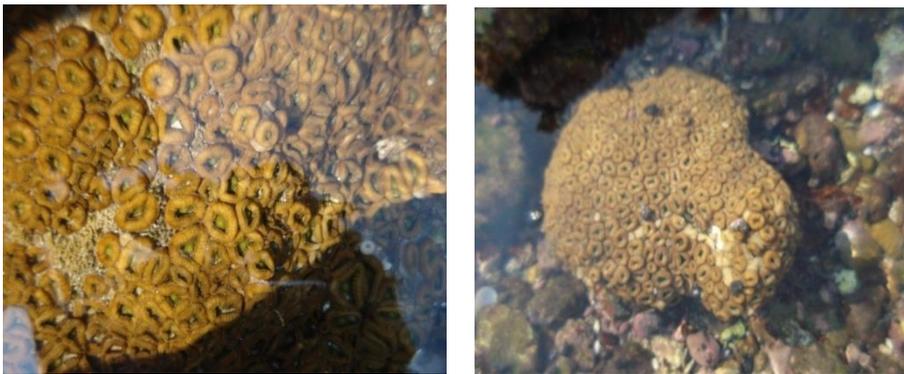
Survey area in Netravati - Gurupura Estuary Survey area in Sambavi river-Mulky estuary

In July 2012, four species of scyphozoan jellyfishes have been recorded from Palk bay and Gulf of Mannar viz., *Cassiopea cf. andromeda* (Forsskål, 1775), *Chrysaora caliparea* (Reynaud, 1830) [*species inquirenda*], *Mastigias cf. papua* (Lesson) and *Rhopilema cf. hispidum*. The

species *Cassiopea cf. andromeda* has been recorded from Tuticorin coast and the remaining three species have been recorded from Mandapam and Thiruppalaikudi coast of Palk bay.

Mastigias cf. papua

Field surveys carried out along Visakhapatnam coast recorded spiny sea urchins, gastropods and zooanthids on the rocky shores during low tide from VUDA Park to Lawson bay of Visakhapatnam.



Exposed zooanthids at Lawsons bay, Visakhapatnam

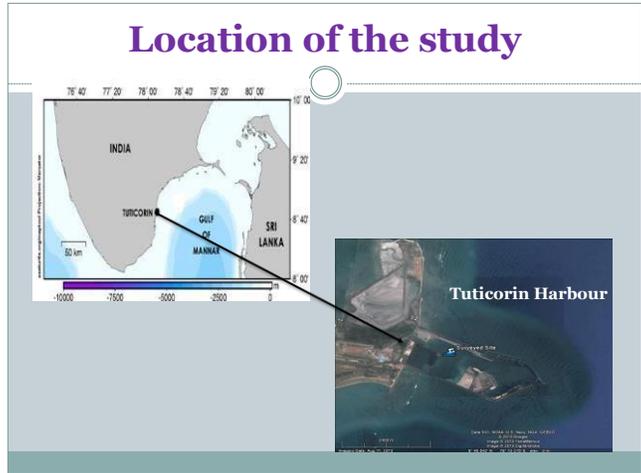
2013 - 2014

Survey and inventorying of bio-resources

Coral diversity and growth, fish assemblage, sponges and other bio-resources associated with coral reefs around Tuticorin Harbour and selected islands (viz., Agatti, Bangaram, Kadamat and Amini) of Lakshadweep and Goa were investigated following the Line Intercept Transect and Underwater Visual Census methods.

Hard Corals

GOMBR (Tuticorin)



- The study revealed that the entire reef recorded 30 species of hard corals belonging to 9 genera and 5 families. The total coral cover in the entire transect area recorded 25.91% live corals, 30.56% dead corals, 17.97% dead corals with algae and the rest 25.56% was contributed by sand, stones and concrete blocks.
- The results also revealed that the massive corals were dominant in most of the areas followed by foliose and branching forms. The live corals were represented by Faviidae (18.4%), Dendrophyllidae (6.1%), Acroporidae (1.0%), and Poritidae (0.4%). Faviids were dominated by *Favia* spp. and *Favites* spp.; *Turbinaria* sp. dominated the dendrophyllids and acroporids were represented by *Acropora* spp.

Goa

- In the first site - Lobster Avenue, the entire transect area recorded 75.56% live coral, 5.0% bleached coral, 12.5% dead corals with algae and rest 6.94% comprised of sand, stones and seaweeds (*Padina* spp.). The live coral cover was represented by hard coral species belonging to six families namely Poritidae (9.11%), Merulinidae (19.13%), Faviidae (4.53%), Agariciidae (1.13%), Psammocoridae (2.64%) and Dendrophyllidae (39.76%).
- The second site - Chow Point, registered 62.35% live coral, 21.5% dead corals with algae and rest 16.15% by sand, stones and boulders. Hard coral species belonging to four families namely Dendrophyllidae (28.44%), Poritidae (22.79%), Merulinidae (7.74%), and Faviidae (3.37%) were dominant among the live coral cover.

- The third site - Jetty, recorded 21.5% live corals, 35.62% dead corals with algae and rest 16.15% was contributed by sand, seaweeds (*Caulerpa* spp., *Sargassum* sp., *Padina* sp.) and boulders. The live coral cover recorded hard coral species which belonged to four families namely Dendrophyllidae (14.02%), Poritidae (2.26%), Merulinidae (1.15%), and Faviidae (0.78%) and soft coral – Gorgonids (3.27%).

Lakshadweep islands



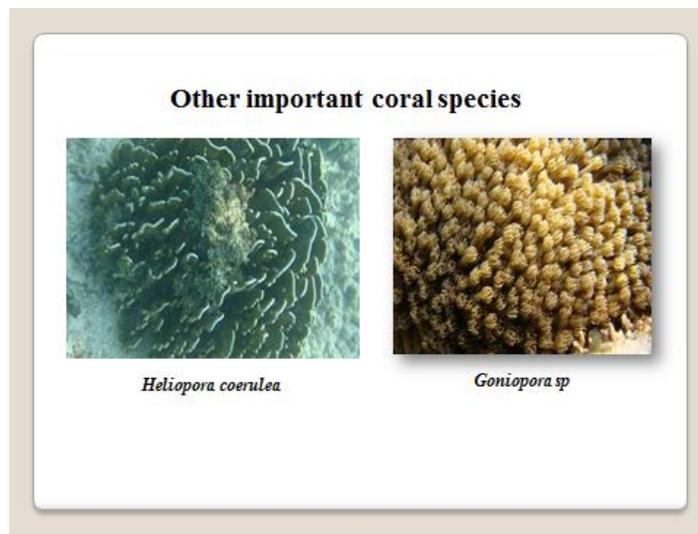
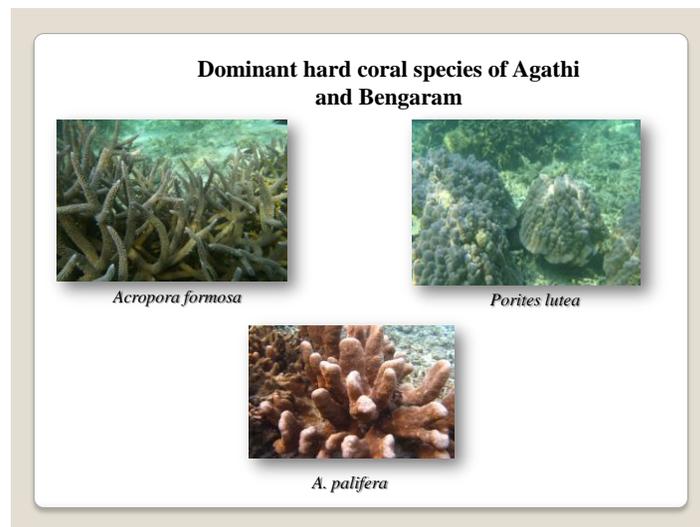
Map depicting Sampling sites of Bengaram-Tinnakkara Lagoon

- **In Agathi islands total of 70 scleractinian species belonging to 25 genera were recorded during the survey. Genera *Acropora* (37%) and *Porites* (35%) showed maximum abundance in the transected areas followed by *Pocillopora* and *Platygyra* (4% each).**
- The other genera recorded were *Psammacora*, *Gardineroseris*, *Pavona*, *Turbinaria*, *Cyphastrea*, *Leptoria*, *Leptastrea*, *Galaxea*, *Echinopora*, *Astreopora*, *Pocillopora*, *Goniastrea* and *Agaricia*. Bleaching was not noticed in any site in the surveyed areas, although sites with dead corals were noticed.
- **The non-scleractinian corals were represented by *Millepora exesa* and *Heliopora coerulea*.**

- Results of ‘Relative Abundance Analysis’ categorised 3 species as ‘Abundant’ namely, *Acropora formosa*, *Porites lobata* and *Porites lutea*; 20 as ‘common’ species, 34 ‘Uncommon’ species and 13 as ‘Rare’ species. Coral Mortality indices showed lesser rate of mortality in the south eastern part of the atoll. In the lagoon which lies on the western side of island, the southern most station(S3) showed maximum mortality. As most of the sites had a MI value >0.33, they can be classified as near to ‘ sick’. The species *Porites lobata* and *Porites lutea* inside lagoon (Station S6) supported a variety of *Acropora spp.*. Occurrence of algal growth on dead corals and less incidence of freshly bleached corals showed that the incidence which caused the mortality has not occurred in the recent past.

Bengaram

- A total of 40 species of corals were recorded from Bengaram atoll. Acroporids of selected areas were found dead and were covered with algae.



Amini and Kadamat islands

- The hard corals (55 and 72 species and from Amini and Kadamat islands), 26 species of molluscs (24 gastropods, 1 giant clam and 1 octopus), 20 species of sea weeds, 8 species of holothurians, 3 species of sea hares, 1 feather star, 5 species of brittle stars, 1 pin cushion star were recorded. Quantification of the coral fishes and hydrological analysis were also carried out.

GOMBR (Mandapam)

Soft corals

Studies on the propagation of soft coral

i) Removal of explants by tying noose in soft coral *Sinularia kavarattiensis*

- Removal of explants by slicing with razor blades leads to injury to both the parent as well as the explant. When the explants are removed by tying noose to the parent colonies using cotton thread, it is possible to get injury-free explants. A total of 13 explants were removed successfully from 4 parent colonies of *Sinularia kavarattiensis*. The noose is tightened on every alternate days and it was found that the explants get detached in a span of 15 to 20 days. The explants thus detached were planted on red tile (burnt pressed clay tile). The explants were found to attach to the substratum in a span of 2 weeks. The increase in biomass of individual colonies ranged from 48.9 to 53.4 g and the increase in number of lobes was 4 on an average.



Newly developed colonies of *Sinularia kavarattiensis*

ii) Growth performance of explants of the soft coral *Dampia pocilloporaeformis*

The explants were removed from the parent colonies using a sharp razor blade. Concrete blocks, red tile, floor tile and granite stones were used as substratum. All the substrates used facilitated attachment of explants and the time taken for attachment ranged from 14 to 21 days. The growth increment of individual colonies ranged from 10 to 37 mm during a culture period of 120 days.



Newly developed colonies of *Dampia pocilloporaeformis*

iii) Growth performance of a single colony of *Cladiella laciniosa* in captive condition

A colony of *Cladiella laciniosa* was developed on a concrete block and cultured for a period of 120 days. The maximum spread which was 95.0 mm increased to 125.0 mm during the culture period.

Mollusc Resource

- **The major mollusc resources recorded were the gastropods, giant clams and octopus. These have an important bearing on sustainability of the coral reefs.**
- The mollusk resources recorded in the lagoon around the coral reefs of Amini and Kadamat Islands of Lakshadweep and from the intertidal flats are listed in the tables. **Molluscs representing 14 families of gastropods, 3 families of bivalves and 1 family of octopus were recorded from the Amini and Kadamat Islands of Lakshadweep Islands.**
- **Amini Island:** Molluscs in the lagoon/reef of Amini Island was represented by 2 families of gastropods, 1 bivalve and 1 octopus **The gastropods *Lambis chiragra*, *Plueroplaca (Fasciolaria) trapezium* and the giant clam *Tridacna maxima* are protected species listed under Schedule IV of the Wildlife Protection Act, 1972.**
- Molluscs in the intertidal flats of Amini Island were represented by 4 families of gastropods. Six species of *Cypraea*, 3 species of *Strombus*, 2 species of *Nerita* and 1 *Littorina* species were recorded
- **Kadamat Island:** 11 families of gastropods, 2 families of bivalves and 1 octopus were recorded from the lagoon waters of Kadamat Island. 3 species of *Cypraea*, 1 *Cerithium sp*, 3 species of muricids, 4 species of *Strombus*, 1 *Tonna sp*, *Trochus sp*, *Turbo sp*, *Plueroplaca trapezium*, 3 species of *Vasum* and 1 *Oliva sp* were recorded. The giant clam *Tridacna maxima* and *Octopus cyanae* were also recorded from Kadamat Island. Among these, the gastropods *Lambis chiragra*, *Plueroplaca (Fasciolaria) trapezium* and the giant clam *Tridacna maxima* are and *Octopus cyanae* were also recorded from Kadamat Island. Among these, the gastropods *Lambis chiragra*, *Plueroplaca (Fasciolaria) trapezium* and the giant clam *Tridacna maxima* are protected species listed under Schedule IV of the Wildlife Protection Act, 1972.
- **The intertidal flats of Kadamat Island had high species diversity. Gastropods representing 9 families were recorded among which 4 *Conus sp*, 6 *cypraea sp*, 5 muricids, 3 neretids, 1 *Terebra sp*, 2 *Cymatium sp*, 2 trochid sp and 1 *Vasum sp* were recorded.**
- Other resources recorded from the coral reefs of Amini and Kadamat islands are holothurians (5 species), brittle stars (4 species), feather star (1 species), cushion star (1 Species), sea hares (3 species), isopod (1 species),

Other resources

Sponges -

- A total of 24 species of sponges which were identified during the study and belonged to 20 genera, 13 families and 6 orders. The specimens have been deposited to the Designated Repository, Cochin and an account on sponges, corals and other bioresources is being finalized for publication.

Sea weeds observed in Amini and Kadamat

A total of 20 species were observed. *Padina* sp. was found to dominate in Amini. Species diversity was found to be more in Amini than in Kadmath Island.



Acanthophora specifera
Borgesenia forbessi

PROJECT CODE: FISHCMFRISIL201201700017

PROJECT TITLE: Assessment of fishing impacts on biodiversity loss, with Special reference to the Threatened species, to formulate management options for their protection.

Principal Investigator : Dr. K.Vinod

2012 – 2013

- At Mumbai, the trawl net was found to have a cod end mesh size of 25mm (for shrimp) and 35mm (for fish); fish at an average of four trawls per day at depth range between 25m and 55m. The average total catch per haul was found to be 333 kg with maximum of 500 kg/haul and minimum of 150 kg/haul and the **average total discard was found to be 188 kg** with maximum of 250 kg/haul and minimum of 100 kg/haul i.e. 56% of the total trawl catch per trawl was found to be discarded.
- In Cochin, two types of trawl are operated viz., Single day trawler and Multiday trawlers. The trawl catches include juveniles and sub adults of a variety of fishes like sharks, rays, skates, catfishes, sciaenids, flatfishes, silverbellies, perches, groupers, snappers, breams, saurids, whitefish, threadfin breams and pomfrets. The landings of cat fish and white fish (*Lactarius lactarius*) showed a decline over the years. Recent studies indicated that the fishes like *Nemipterus* (Threadfin breams), *Sphyraena*(Barracuda), *Trichiurus* (Ribbon fish), *Euthynnus affinis* (Little Tuna), *Stolephorus* (Anchovies), *Chirocentrus dorab* (Wolf herring), *Hemiramphus* (Halfbeaks), *Leiognathus* (Silver bellies), *Carcharhinus* (Grey sharks), *Arius* (Catfishes) and *Pampus argenteus* (Pomfrets) were also showing a declining trend.
- The list of threatened species of Elasmobranchs landed at Cochin from the present study and previous reports as given below.
- At Neendakara and Sakthikulangara, trawl nets and ring seines are mainly operated and juveniles of nemipterids, flat fishes and *Saurida* spp. are landed along with the main catch.



Juveniles of *Nemipterus* spp.

- Colachel is mainly a trawl net operating centre which is cephalopod oriented. The species of cuttlefish landed were *Sepia aculeata*, *S. pharaonis* and *Sepiella inermis* and those of squid were *Doryteuthis sibogae*, *D. singhalensis* and *Loligo duvauceli* and octopus. Fin fishes such as *Saurida tumbil*, *S. undosquamis*, and *Synodus indicus*, Nemipterids, *N.japonicus*, and *N.bleekeri*, the puffer, *Lagocephalus enermis* are common. Heavy landing of sharks and rays, especially *Rhyncobatus djiddensis* and **honeycomb stingray**, *Himantura uarnak* were also observed in the trawl landings.

Elasmobranch landing in Colachel

At Vishakapatnam, *Charybdis natator* was the most dominant in the trawl (single day trawl) discards (22.7% by number and 18.69% by weight), followed by *Varuna littorata* (16.3% by number and 6.03% by weight).

- On 27th November 2012, two Olive ridley turtles were caught as by-catch on trawl net at a depth of 40m while undergoing experimental trawling along Visakhapatnam coast (Fig.-3). The curve carapace length and weight of the turtle were 68 cm and 40 - 45 kg respectively. After taking morphometric measurements, the turtles were released back into the sea.



Olive Ridley turtle (*Lepidochelys olivacea*) as by-catch in trawl net

- Two numbers of tiger shark, *Galeocerdo cuvier* (Peron & Le Sueur, 1822) were landed by mechanized trawler at Visakhapatnam Harbour.

In trawl nets (fish and shrimp) operated in Vembar and Tuticorin Fishing Harbour, diverse fin fish species, crustaceans, molluscs, sponges, soft corals and echinoderms were observed.

- At Muttom, chain of rocks found on the shore as well as on the sea bottom harbour a very rich sponge fauna along with gorgonids and good concentration of rock dwelling fishes mainly perches and lobsters. The most important damaging gear observed was *Thathu valai*, a bottom set gill net mainly used for catching *Sillago* spp. Another damaging gear is the bottom set gill net *Kelaichu valai* (fishing time restricted to 4-6 hrs). The different types of bottom set gill nets along with the fish catch, remove the sponges, gorgonids, antipatharians, star fishes and other echinoderms, sea weeds etc. in large quantities. But a positive thing observed in this centre is, most of the local fishermen are aware of the destruction they cause while fishing. To minimize the loss, immediately after the removal of the desired catch they clean the net in the sea itself, thus giving a chance for the other organisms like sea weeds and echinoderms to replenish. They throw the sponges and gorgonids removed from the net also back to the sea, but their survival is doubtful due to their sedentary nature of living. Moreover due to the seasonal nature of this type of fishing which extends for hardly 3-4 months, the destruction caused is less compared to other places.



***Thathu vala* Antipatharians removed from the net**



Kelaichu valai



Sea weeds and gorgonids in Kelaichu valai



***Thathuvala* before cleaning Sponges collected from the *Thathuvala* landings**

The mini trawls locally called *thallu valai* are operated in the sea grass beds off Devipattinam and Thiruppalaikudi in the Palk Bay. These gears target the juveniles of *Penaeus semisulcatus* which are found to inhabit in the sea grass beds. About 10 to 15 kg of sea grass are removed during a single operation while the targeted *P. semisulcatus* constituted about 3 kg. Star fish (*Pentacaster* spp.), gastropods, large number of juvenile crabs (*Portunus pelagicus*) are also very common. Highly endangered animals like sea cucumber and pipe fish are also caught in this gear.



Sea grass removed by mini trawl *Holothuria spinifera* observed in mini trawl

- On 3rd August 2012, a dead green turtle was found washed ashore on R.K beach of Visakhapatnam. On 19th November 2012, a dead Olive Ridley turtle was found washed

ashore near Bheemunipatnam, about 20 – 25 km south of Visakhapatnam city. An injury mark was present on the head of the specimen and it is suspected that death was caused by incidental capture and drowning. Intensive near-shore fishing takes place between Visakhapatnam and Bheemunipatnam, a distance of nearly 25 km (Tripathy & Choudhury, 2001). The curve carapace length and weight of the Olive Ridley turtle was 70 cm and 35-40 kg respectively. From the morphometric measurements it appeared that the turtle was an adult male.

Some of the protected species encountered in different fishing gears

Place	Gear	Vulnerable / Threatened species encountered	Indian Wildlife (Protection) Act, 1972
Colachel	Trawl	<i>Rhyncobatus djiddensis</i>	Schedule I, part II-A
Vishakapatnam	Expt. trawl	Olive Ridley turtle, <i>Lepidochelys olivacea</i>	Schedule I, part II
Vembar	Trawl	Sponges	Schedule III
Tuticorin	Trawl	Sponges	Schedule III
	Bottom set gill net	corals	Schedule I, part IV-A
		Sponges	Schedule III
Thiruppalaikudi, Devipattinam (Palk Bay)	Mini trawl, <i>Thallu valai</i>	Sea cucumber	Schedule I, part IV-C
		Pipe fish	Schedule I, part II-A
	Bottom set gill net, <i>Nandu valai</i>	Sponges	Schedule III
		Sea cucumber	Schedule I, part IV-C
Muttom	Bottom set gill net, <i>Thathu valai</i>	Gorgonids	Schedule I, part IV-A
		Sponges	Schedule III
	Bottom set		Schedule I, part

	gill net, <i>Kelaichu valai</i>	Gorgonids	IV-A
		Sponges	Schedule III
Vethalai, GOM	Bottom set gill net, <i>Singhi valai</i>	Gorgonids	Schedule I, part IV-A
		Sponges	Schedule III
	Bottom set gill net, <i>Nandu valai</i>	Sponges	Schedule III

2013 - 2014

Vizhinjam

- In Muttom, a large mesh-sized bottom set gill net, *Ottakunduvala* entangled huge quantities of live rocks along with large sized rare bivalves and gastropods like *Malleus malleus*, *Pinnabicolor*, *P.muricata*, *Lambiscrocata*, star fishes such as *Protoreaster lincki* and cushion star, *Culcita novaeguineae*. Along with targeted species of rays *Plutosus* spp., *Lutjanus* spp., lethinids etc. fairly good number of big sized ornamental fishes such as *Chlorurus sordidus*, *Plectorhincus* spp., *Scarus* spp. also were entangled in the net.**



A view of Ottakunduvala (Bottom set gill net)



Malleus malleus ***Lambiscrocata***

- In Neendakara trawl landings, large quantities of juvenile *Decapterus russelli* was recorded in September 2013.

Cochin

- In gears other than trawl (gill nets, hooks & lines, purse seines, ring seines and drift nets), as per the IUCN Red List, 1 species was endangered (*Sphyrna lewini*), 4 species were Vulnerable (*Stegostoma fasciatum*, *Taeniura meyeni*, *Rhina ancylostoma*, *Rhinobatus djiddensis*).

Mumbai

- The most vulnerable groups in the trawlnet are the juveniles of commercially important species that are being caught as bycatch. It was found that teleosts with 15 species has 69% of their catch consisting of juveniles; 45% of the elasmobranch catch consisted of juveniles and 25% of cephalopod catch consisted of juveniles.
- Rare species landed in trawl net are *Colletteichthys dussumieri*, *Antennarius striatus*, *Torpedo marmorata*, *Galeocerdo cuvier*, *Rhynchobatus djiddensis*, *Oratosquillinaperpensa* and *Oratosquillakempi*.



Sample of crustacean trawlnet bycatch



Bycatch sample from Dolnet



Juveniles of *Sphyraena putnamae*



Juveniles of *Parastromateus niger*

Visakhapatnam

- Analysis of bycatch sample from single day as well as multiday trawlers revealed an altogether 11 different groups of biota, of which finfishes were the most dominant group in terms of biomass.
- A total of 130 species were identified from the discard samples during June 2013 to December 2013, which comprised of 95 species of finfishes, 4 species of gastropods, 1 species of bivalve, 6 species of cephalopods, 13 species of shrimps, 2 species of stomatopods, 8 species of crabs, 1 species of lobster and juveniles of unidentified sharks and rays.

- Landings of protected species such as juveniles of tiger shark and skates and turtles were observed along Visakhapatnam coast.



Bow-mouth guitarfish Juvenile of tiger shark Olive Ridley turtle

Tuticorin

- The major vulnerable groups encountered in gill net & trawl nets were: elasmobranchs [*Rhincodon typus* Smith, 1828 & *Rhynchobatus djiddensis* (Forsskal, 1775)]; gastropods (*Lambis crocata* (Link, 1807) & *Fasciolaria trapezium* (Linnaeus, 1758) accepted as *Pleuroploca trapezium* (Linnaeus, 1758)], hard corals [*Acropora* sp., *Pocillopora* sp., *Turbinaria* sp., *Montipora* sp. & *Cycloseris* sp.], gorgonids, sponges & sea cucumbers were

encountered in the gill nets and trawl nets. Other groups like sea grasses, sea urchins, and starfish's occurrence were high in gill nets and juvenile fishes dominate in trawl nets.

- Rare species like *Neoharriotta pinnata* Schnakenbeck, 1931, *Galeocerdo cuvier* (Peron & Le Sueur, 1822), *Echinorhinus brucus* (Bonnaterre, 1788), *E. cookei* Pietschmann, 1928, *Pseudocarcharias kamoharai* (Matsubara, 1936) & *Rhina ancylostoma* Bloch & Schneider, 1801 was reported.



Bycatch of bottom set gill net *Lambis* spp. from bottom set gill net



Bycatch of bottom set gill net showing heaps of sea grasses



Whale shark, *Rhincodon typus*



Sygnathid



Hard coral

Mandapam

- The mini trawls locally called *thallu valai* operated in the sea grass beds off Devipattinam and Thiruppalaikudi in the Gulf of Mannar remove 10 to 15 kg of sea grass during a single operation; while the targeted juveniles of *Penaeus semisulcatus* constituted about 3 kg. Star fish (*Pentaceraster* spp.), gastropods, large number of juvenile crabs (*Portunus pelagicus*) are also caught. Highly endangered animals like sea cucumber and pipe fish are also caught in this gear.
- **The bottom set lobster gill net locally called *Singhi valai* operated in the Gulf of Mannar is found to be destructive to the many non-target resources.** The targeted lobsters are caught in very few numbers. The non-targeted resources that are caught include the live rocks (about 10 kg), gorgonids, gastropods (*Bursa spinosa*, *Hemifusus* sp., *Xancus pyrum*, *Murex* spp., *Chicoreus* spp., *Pteria* sp.) and many species of non-edible crabs.
- A large number of bottom set crab gill net locally called *Nandu valai* is operated in the Gulf of Mannar. The targeted crabs (*Portunus pelagicus*) constitute about 5 to 15 kg and a small income is obtained from the catch of the gastropod *Xancus pyrum*. The other

molluscs include *Murex virgineus*, *Hemifusus* sp., *Conus* spp. and *Chicoreus* sp. Sponges, starfish and different species of non-edible crabs are also caught in this gear.

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PROJECT TITLE: Bioinventorying and biodiversity valuation of marine organisms in selected marine ecosystems along the Indian coast.

Principal Investigator : Dr. K.K. Joshi

2012 – 2013

Bioinventorisation

Seven species of fishes collected from Tuticorin area and were deposited into the Marine Biodiversity Referral Museum and got accession numbers. These include the spot fin cardinal fish, *Apogon queketti* Gilchrist, 1903 which was recorded for the first time from the Tuticorin coast, southeast coast of India. Three specimens of this species of 72.6, 106.2 and 110.6 mm total length were caught by a commercial trawler at depths of 90-100 m. Two specimens of Two stripe goby, *Valenciennesa helsdingenii* (Bleeker, 1958) were collected off Tuticorin, southeast coast of India in November 2012. The large toothed cardinal fish, *Cheilodipterus macrodon* (Lacepede, 1802) was recorded for the first time from the east coast of India. Three specimens of iridescent cardinal fish, *Pristiapogon kallopterus* (Bleeker, 1856) with lengths of 72.6, 106.2 and 111.6 mm was recorded from the Tuticorin coast. One specimen of Blackspot band fish, *Acanthacepola limbata* (Valenciennes, 1835) with length of 192.3 mm was recorded from Tuticorin coast. One specimen of Brown-banded cusk eel, *Sirembo jerdoni* (Day, 1888) of

Family Ophidiidae of total length 161.9 mm was recorded from Tuticorin coast. One specimen of *Acropoma hanedai*, Matsubara, 1953 of family Acropomatidae with a total length of 129.2, 109.5 mm was recorded from Tuticorin coast.

Seven species of fishes collected from Cochin area and were deposited into the Marine Biodiversity Referral Museum and got accession numbers. The species deposited are *Pogonoperca punctata* (Valenciennes, 1830); *Priacanthus blochii* Bleeker, 1853; *Scarus rubroviolaceus* Bleeker, 1847; *Chelidoperca investigatoris* (Alcock, 1890); *Naucrates doctor* (Linnaeus, 1758) *Caesio xanthonotus* Bleeker, 1853 and *Stegostoma fasciatum* (Hermann, 1783).

Phytoplankton: A total of 493 species belonging to 174 genera, 105 families and 65 orders under 13 classes were recorded. Of this, class Bacillariophyceae or diatoms dominated with 326 species followed by Dinophyceae with 128 species and other classes formed only minor components. About 66% of the total number of species of phytoplankters was contributed by Bacillariophyceae in the area.

The most dominant class, the Bacillariophyceae was composed of 326 species, 103 genera, 56 families and 35 orders. The next dominant class, the Dinophyceae was comprised of 128 species, 38 genera, and 24 families under 10 orders. These two classes are followed by Cyanophyceae (15 species) and Chlorophyceae (7 species) in the order of abundance in terms of number of species. Under the class Bacillariophyceae, the family Chaetocerotaceae (Order: Chaetocerotales) was the most diverse one with 51 species followed by the family Coscinodiscaceae (Order: Coscinodiscales) with 22 species. Under the class Dinophyceae, a maximum of 33 species were recorded under the family Ceratiaceae (Order: Gonyaulacales) followed by 22 species under the family Protoperidiniaceae (Order: Peridinales). Under other classes, only a few species were recorded from the southwest coast of India.

There is a steady increase in the occurrence of harmful blooms in Indian seas which can affect our fishery resources adversely and hence, suitable measures have to be adopted to avoid the potential blooming conditions in our coastal waters in order to control toxic algal blooms.

Zooplankton: Zooplankton group contains 251 species of organisms belonging to 170 genera, 84 families and 36 orders of different phylum were recorded from this coast. The species diversity and species richness of the south west coast is one of the mega diversity and values more than any other group of organisms.

Sea weeds and sea grasses: Seaweed flora of Lakshadweep and Southwest coast, revealed a total of 118 species under 40 families. Among the six species of Seagrasses recorded, four species belong to the family Cymodaceaceae and three species represented the family Hydrocharitaceae.

Coelentrates: The coral fauna includes the subclass Hexacorallia (15 families) and among this, the family Acroporidae (55 spp.) dominated followed by Faviidae (34), Fungiidae (19), Poriitidae (18.), Agaricidae (13) Pocilloporidae (10) and Mussidae (10). Large scale exploitation

of coral reefs for industrial purpose and their fauna and flora for multipurpose uses, the effect of dredging and the consequent mass mortality of corals.

Annelida: Nematode diversity along the Southwest coast was high and unique. A total of 154 species of nematods have been reported from West coast of India. Also the seasonal rains during the monsoon and post-monsoon periods influence the water quality and resulted species variation.

Echinodermata: The present study revealed the presence of 112 species of echinoderms belonging to 70 genera, 35 families and 16 orders along the coast.

Sponges: Sponge fauna of Lakshadweep and Southwest coast, revealed a total of 91 species recorded from this area.

Gorgonids: Among the 34 species of gorgonids reported, majority belongs to the family Plexauridae (10), followed by Ellisellidae (7), Melithacidae (2) Acanthogorgiidae (2) and Subergorgiidae (2). The families Clavariidae, Nephtheidae, Isididae, Anthothelidae and Gorgoniidae were represented by single species only.

Mollusca: A total of 730 molluscan species were enlisted from southwest coast which include 515 species of gastropods (75 families, 196 genera) 171 species of bivalves (35 families, 91 genera) 28 species of cephalopods (12 genera) and 14 species of scaphopods (5 genera).

Fishes: Fish species occurring along the coast were about 950 species (175 families, 42 orders) of which 200 species were landed in the commercial fishery. Commercial fishery scenario of Southwest coast contains variety of gears includes trawl nets, drift gillnetters, bottom set gillnets, ring seines, hooks and lines boat seines were the major operated in fisheries sector.

Mangroves: The present study revealed the presence of 33 species of mangroves belonging to 26 genera and 18 families were compiled. Of the 17 sq. Km mangrove area, 36% is either completely degraded or is degrading. The destruction of mangroves is usually proportional to human population density.

Reptiles: Five species of sea turtles, *Dermochelys coriacea*, *Eretmochelys imbricata*, *Chelonia mydas*, *Lepidochelys olivacea* and *Caretta caretta* are endangered and vulnerable species of reptiles. Sea snake diversity of Southwest coast of India was about 25 species.

Birds: Bird diversity along the southwest coast very well documented from different estuaries, backwaters and Kole wetlands. About 76 species of birds are known to occur in Southwest coast in association with mangroves.

Marine Mammals: Marine mammals come under the class Mammalia included in three orders namely Cetacea (whales, dolphins, and porpoises), Sirenia (manatees and dugong), Carnivora (sea otters, polar bears and pinnipeds like seals and walrus). In India, 31 species of marine mammals (30 species of Cetacean and one species of Sirenia) are documented accounting to one fourths of the world's marine mammalian fauna and almost 8% of the total Indian mammalian fauna.

Dolphins: Include the genera *Feresa* (1 sp.); *Globicephala* (1 sp.); *Orcinus* (1 sp.); *Peponocephala* (1 sp.); *Pseudorca* (1 sp.); *Delphinus* (1 sp.); *Grampus* (1 sp.); *Lagenodelphis* (1 sp.); *Orcaella* (1 sp.); *Sousa* (1 sp.); *Stenella* (3 sp.); *Steno* (1 sp.) and *Tursiops* (1 sp.)

Beaked Whales: Genera *Hyperoodon* (1 sp.); *Mesoplodon* (1 sp.); *Indopacetus* (1 sp.); *Ziphius* (1 sp.).

Sea snakes: There are about 80 species sea snakes belonging to 3 families inhabiting the world oceans and estuaries. Along the Indian coast about 22 species of marine snakes belonging to 3 families have been documented. Twenty species are represented in the family Elapidae, of which 18 belong to sub-family Hydrophiinae (true sea snakes) and 2 belong to sub-family Laticaudinae (sea kraits); 1 species belong to the sub-family Homalopsinae under family Colubridae, and a single species is represented in the family Acrochordidae.

Biodiversity Indicators

The important components of biodiversity along the southwest coast are coastal fisheries, mud bank ecosystems, productive rocky bottoms, Malabar upwelling area, Island and Coral ecosystems, mussel beds, and traditional coastal mariculture area.

Mud banks: The mud banks (Chakara) are 1 to 3 m thick in calm, turbid near shore waters of 2-5 Km along the coast with a width of 1.5 to 4 Km appear along with southwest monsoon. Several past studies indicated the importance of mud banks to commercial fishermen of Kerala during the monsoon period.

Pokkali fields and prawn farming: A traditional system of more than 3000 years old prawn farming in paddy fields using highly salt resistant ‘Pokkali rice’ is another important uniqueness of Kerala coast.

Biodiversity valuation

Total fish landings from the area were about 1.187 million tones (31% of all India landings). Marine fish landings from Kerala was 7.43 lakh t of which more than 50% was contributed by oil sardine, mackerel, threadfin breams, carangids and penaeid prawns. Total number of fishermen population was 6, 10,165 of which 1, 30,922 were engaged full time and 10582 as part time. Number of fishing crafts along Kerala coast were 21871 of which 3768 trawlers, 60 purse seiners, 460 gillnetters and 495 ring seiners form the capital investment. The preliminary economic valuation of fishery resources was done collecting data on direct value, indirect value and other values. The value estimated for the ecosystem services and natural capital of Kerala coast is of US \$ 1660-1930 billion per year from an area of 260101 Km² which includes brackish water, estuaries and open Ocean. The Ecosystem Based Fisheries Management (EBFM) approach develops models of fisheries dynamics, trophic relations and ecosystem interactions.

2013 – 2014

Fig. 1. Some of the New records to East coast/Vishakatanam



Balistoides viridescens (Bloch& Schneider, 1801)



Stegastes fasciolatus (Ogilby, 1889)



Plectorhinchus gibbosus (Lacepède, 1802) *Abudefduf sordidus* (Forsskal, 1775)



Acanthurus bariene Lesson, 1831



Scarus ghobban Forsskal, 1775
