

QRT REPORT FOR APRIL 2009 – MARCH 2014

Demersal Fisheries Division

MAJOR FOCUS OF THE DIVISION

- Collection and analysis of data on fishing effort and catch (gear-wise catch-effort) and species composition of demersal fish from various fishery centres along the Indian coast.
- Conduct studies on the biology and resilience capacity of major commercial demersal finfish resources (elasmobranchs, perches, catfishes, sciaenids, pomfrets, flatfishes, silverbellies, lizardfishes, barracuda)
- Stock assessment of demersal fishery resources
- Suggestion of management options to maritime states for sustaining and enhancing the resources
- Faculty for training programs in finfish taxonomy and fish stock assessment
- Assessing the impact of climate change on marine fisheries

DIVISION'S STAFF STRENGTH (SCIENTIFIC)

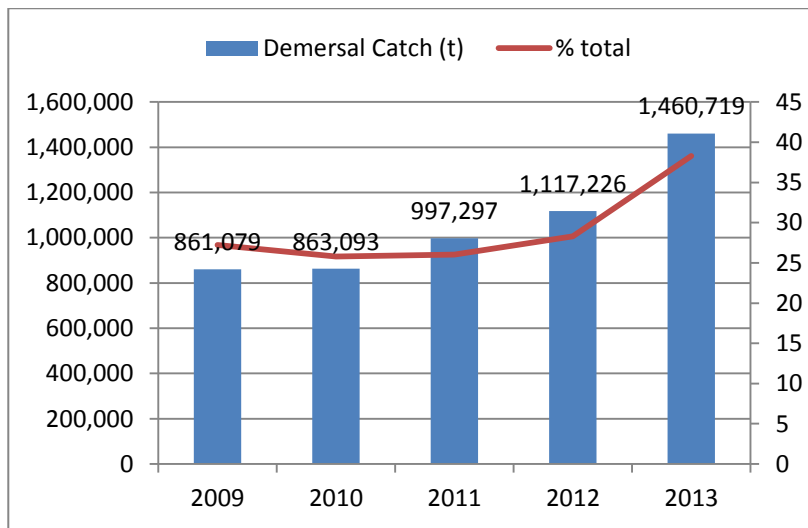
Name	Designation	Centre
Dr.P.U. Zacharia	Head	Kochi
Dr.P.P. Manojkumar	Principal Scientist	Calicut
Dr.K.S.Sobhana	Principal Scientist	Kochi
Dr.Sujitha Thomas	Senior Scientist	Mangalore
Dr.Sobha Joe K	Senior Scientist	Chennai
Dr. Rekha J. Nair	Senior Scientist	Kochi
Dr.T.M.Najmudeen	Senior Scientist	Kochi
Dr. G.B.Purushothama	Scientist	Mumbai
Ms. M.Muktha	Scientist	Visakhapatnam
Ms.Swathipriyanka Sen Dash	Scientist	Veraval

Technical: 2 at Head Quarters

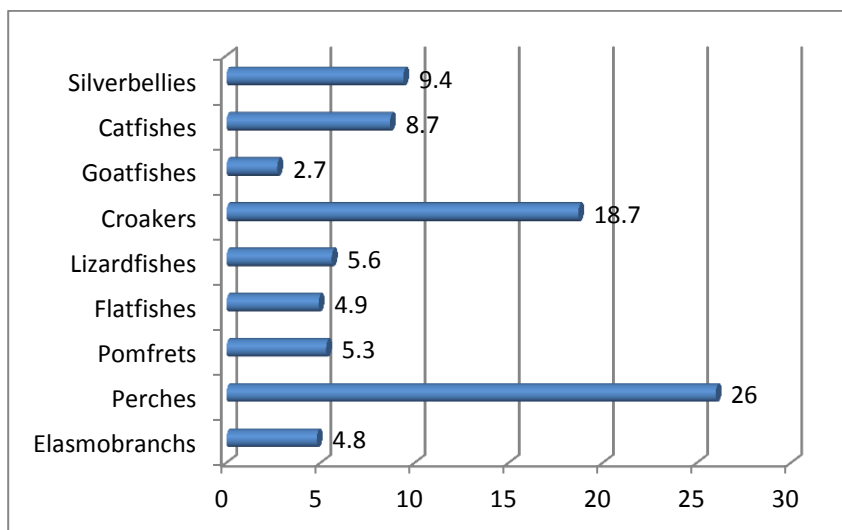
Skilled support staff: 1 at Head Quarters

General trend of Demersal fishery

The annual average landings of demersal fishery resources in India during 2009-2014 ranged from 0.86 million tonnes to 1.46 million tonnes with an average landing of 1.06 million tonnes during the period. This formed about 27% of the total landings of the country during the period. The contribution of demersal fish landings to all India marine landings reduced from 29 % in 2009 to 26% in 2013. The major gear accounting for bulk of demersal fish landing was trawlers contributing 85% of the landings followed by gillnetters (8%), dolnet (4%) and purse seines.



Among the major demersal resources, Perches contributed the bulk of the landings (26%), followed by croakers (18.7%), silverbellies (9.4%), catfishes (8.7%), lizardfishes (5.6%), and pomfrets (5.3%). Elasmobranchs contributed 4.8% of the total demersal landings of India. Among perches threadfin breams was the major component (60%), followed by other perches (20%) and rockcods (11.5%).



To monitor the demersal fishery resources and to suggest management measures for sustain the resources in various maritime states, **the following projects were taken up by the Division during the period 2009-14**

1. Management advisories for sustaining marine fisheries of Tamil Nadu and Puducherry (Completed in March 2012).
2. Management advisories for sustaining marine fisheries of Gujarat (Completed in March 2012).
3. Carbon sequestration potential of Indian seaweeds (Completed in March 2012).
4. Development of Fishery Management Plans for sustaining Marine Fisheries of Kerala and Lakshadweep (Ongoing - April 2012 onwards).
5. Development of Fishery Management Plans for sustainable Marine Fisheries of Gujarat (Ongoing - April 2012 onwards).
6. Assessment of the elasmobranch resources in the Indian seas (Ongoing - April 2012 onwards).

7. Derivation and characterisation of embryonic & induced pluripotent stem cell lines from selected marine fish species aimed at Mariculture/ conservation (Ongoing - April 2012 onwards).

The Division implemented the following sponsored and consultancy projects during 2009-14

1. ICAR network project “Impact, adaptation and vulnerability of Indian marine fisheries to climate change” (Completed in 2010)
2. MoES funded project “Studies on marine mammals in the Indian EEZ” (Completed in ...)
3. MoEF funded project “Bio-inventorisation of the coral fishes of South India with special emphasis on threats and conservation measures” (Completed in 2012)
4. DBT funded “Establishment and characterization of cell lines from selected marine food fish and ornamental fish. (Completed in 2012)
5. MOES Siber project “ Flow of Matter through tropic levels and biogeochemical cycles in Marine and Estuarine ecosystems” (Ongoing 2010 onwards)
6. Consultancy project on installation of Artificial Reefs in the inshore waters of Tamil Nadu (IFAD) (Ongoing 2012 onwards)
7. ICAR funded project “National Initiative in climate resilient agriculture of ICAR (NICRA)” (Ongoing – April 2011 onwards)
8. MOES funded project “Resources Assessment & Barcoding of Elasmobranchs”. (Ongoing – April 2013 onwards)

In addition, the scientists of DFD are associated as Co-PIs with several in-house and sponsored projects implemented by other Divisions.

MAJOR ACHIEVEMENTS OF RESEARCH UNDER PROJECTS

Project Title	Management advisories for sustaining marine fisheries of Tamil Nadu and Puducherry (Completed in March 2012)
PI	Dr. P.U. Zacharia, Dr. E. Vivekanandan

- During the period, Tamilnadu ranked third in marine fish production with an estimated average annual production was 5.09 lakh t.
- Monitoring and database management of fishery and biology of major pelagic, demersal, crustacean and molluscan resources occurring in trawl, gillnet and hook & line landings along Tuticorin, Mandapam, Chennai and Puducherry coast were carried out.
- A gradual change in the gear pattern was noticed in the state with a decrease in the number of non-mechanised units and a gradual increase in the number of Outboard gillnets. Landing show increasing trend, wide fluctuations after 1990, maximum landing seen in 1997 and afterwards show a decreasing trend; landings showed an increase from 2005. The increase in late 1980s coincides with the fitting of outboard engines in country crafts and introduction of more mechanised trawlers.
- Trawl landings formed 60% of the total landings. Finfishes formed more than 85% of the monthly landings, crustaceans 6% and molluscs 5%. Of the finfishes, pelagics formed 63 %.
- The exploitation rate of many dominant fishes remains below or near optimum, in the range of 0.26 – 0.55.
- Spawning stock biomass of many of the exploited stocks remains near to or more than 50-65 % of the standing stock biomass.
- An assessment of the composition of LVB at Chennai over the project implementation period shows an increase in the percentage of juveniles.

Issues in Marine Fisheries of Tamil Nadu

- Overcapitalisation
- Declining catches
- Bycatch , discards and juvenile catches in trawl fishery
- Increased removal of ovigerous crustaceans
- Exploitation of endangered species along TN coast
- Destructive fishing practices
- Conflict between artisanal and mechanized sector

Management advisories suggested

- Reduction of fishing effort and capacity
- Mesh size regulation and reduction in by catch and discards
- Diversification of vessels
- Discouraging harmful fishing practices
- Participatory management
- Strengthening of Ecosystem based fisheries management and need for integrated coastal management
- Fishing ban and closed seasons
- Capture based aquaculture practices and FADs for traditional fisherfolk communities

Project Title	Management advisories for sustaining marine fisheries of Gujarat (Completed in March 2012).
PI	Dr. R. Thangavelu, Dr. Subhadeep Ghosh, Dr. Mohamed Koya

- Gujarat with about 20% (1600 km) of the country's coastline, 33% of the continental shelf area (1,64,000 sq. km) and more than 2,00,000 sq. km of EEZ ranks second among the maritime states of India in marine fish production. There are 263 marine fishing villages and 217 marine fish landing centres in Gujarat with Junagadh district having the maximum of 72 villages.
- The annual marine fishery potential of the state is estimated at 0.57 million tonnes, which is about 17% of the all-India potential.
- Trawlers, gillnetters and dol-netters are the main fishing craft in the mechanized sector while plank-built boats and canoes figure more prominently in the artisanal sector. Trawlers target sciaenids, ribbonfish, lobsters, shrimps, etc., and contribute bulk of the total catch, while gillnetters target pomfret, seerfish, tuna and sharks; and dol-netters bombayduck and large sciaenids.
- There are some fishing practices which are typical to Gujarat and these include juvenile fishery for *Metapenaeus kutchensis* at Little Rann of Kutch and fattening of *Panulirus polyphagus* in pits at Mahuva.

Fig. Juvenile ginger prawn fishery at Little Rann of Kutch



- The present annual catch is nearing the potential yield of 5.7 lakh tonnes estimated for Gujarat. There is a shift of trawling operations over the years from single day trawling to multiday trawling of 6 to 16 days.
- There is no ban on operation of outboard gillnets during the monsoon period which has resulted in exploitation of ripe and juvenile pomfrets in large quantities. During monsoon season, pomfrets undertake spawning migration to their breeding and nursery grounds which are shallow coastal waters having muddy-sandy substratum. With the mixing of shallow

coastal muddy waters by monsoon rain greatly hamper the visibility of monofilament gillnets to the silver pomfrets and hence they get entangled and gilled very easily. Juveniles of spade nose shark *Scoliodon laticaudus*, are also caught by gillnets in huge numbers during monsoon, dwindling the shark fishery.

Exploitation of juvenile pomfrets in gill nets



Brief description of marine fishing gears used and species exploited

Shrimp trawl net	Cod end mesh size	10 – 20 mm
	Top end mesh size	50 – 250 mm
	Targeted species	Penaeid Shrimps
	Bycatch	Non penaeid shrimps, sciaenids & ribbonfish
	Depth of operation	40 – 50 m
Ribbonfish trawl net	Cod end mesh size	20 – 35 mm
	Top end mesh size	200 – 1000 mm
	Targeted species	Ribbonfish
	Bycatch	Carangids, sciaenids & crabs
	Depth of operation	30 – 50 m
Cephalopod trawl net	Cod end mesh size	20 – 35 mm
	Top end mesh size	200 – 425 mm
	Targeted species	Cephalopods, threadfin breams & sciaenids
	Bycatch	Lizardfishes & bull's eye
	Depth of operation	50 – 75 m
Dol net	Cod end mesh size	10 – 30 mm
	Top end mesh size	110 – 240 mm
	Targeted species	Bombay duck
	Bycatch	Penaeid and nonpenaeid prawns, sciaenids, catfishes and anchovies
	Depth of operation	30 – 50 m
Monofilament gill net (Chokhla)	Mesh size	55 – 60 mm
	Targeted species	Mackerel, carangids, sciaenids, sharks & clupeids
	Depth of operation	25 – 35 m

	Net length	4 – 5 m
Monofilament gill net (Point)	Mesh size	100 – 120 mm
	Targeted species	Silver pomfret
	Depth of operation	20 – 35 m
	Net length	7 – 8 m
Monofilament gill net (Pankha)	Mesh size	140 – 160 mm
	Targeted species	Silver pomfret
	Depth of operation	20 – 35 m
	Net length	7 – 8 m
Multifilament gill net (Moul)	Mesh size	110 – 115 mm
	Targeted species	Tuna, seerfishes, catfishes, scomberoides & billfish
	Depth of operation	30 – 45 m
	Net length	7 – 8 m
Multifilament gill net (Kandari)	Mesh size	80 – 95 mm
	Targeted species	Spotted seer, wolf herring, horse mackerel, shads, sciaenid, sharks and catfishes
	Depth of operation	30 – 45 m
	Net length	4 – 7 m
Multifilament gill net (Jada)	Mesh size	145 – 160 mm
	Targeted species	Tuna, seerfishes, ghol, koth, threadfins, scomberoides & billfish
	Depth of operation	40 – 80 m
	Net length	4.5 – 10 m

- In 2008, the major contributors to the marine fishery of Gujarat were the pelagic finfishes with 39%, followed by demersal resources (31%), crustaceans with 22% and cephalopods with 8%.
- In 2011, the total marine fish production in Gujarat was 6.27 lakh t showing 19% increase over the previous year.
- Of the 66 different species/groups/categories landed, the five main contributors were Non-penaeid prawns (17%), ribbonfishes (13%), croakers (9.7%), molluscs (mainly the cephalopods) 8.2%) and Bombayduck (7.8%).
- There have been innovations in marine fish trade of Gujarat as well with processing and export of airbladders of ghol, koth, eel and catfish from Okha and of jellyfish from Jakhau earning huge foreign exchange.



Flourishing trade on airbladders at Okha



- Data on length frequency, food and feeding and other biological aspects (sex ratio, maturity stages, ova diameter etc) of important fish / shellfish species belonging to pelagic, demersal, crustacean and molluscan categories were estimated. Breeding season of dominant pelagic and demersal fishes, population parameters and stock status of these important fishes were estimated

Issues in the marine sector of Gujarat

- Increasing fleet number, size and fishing effort
- Non-implementation of mesh size regulation for cod end of trawl nets and dol nets
- Operation of outboard gillnetters and artisanal fishing during monsoon
- Irrational capture of mega spawners of long lived large marine fishes
- Large scale capture of juveniles and low value fish as bycatch in trawls
- Declining state of several stocks
- Impact of climate change on marine environment and the resources
- Inadequate on-board handling, quality control and marketing infrastructure
- Illiteracy and lack of awareness among the marine fisherfolk community
- Lack of proper extension services
- Impact of global pressures on trade

Management Options suggested

- Strict regulations on registration of new fishing vessels
- Reduction of fishing effort and capacity
- Implementation of mesh size regulations
- Strict adherence to international fishing rights
- Diversification of fishing vessels
- Conservation strategies
- Observation of closed season and establishment of Marine Protected Areas (MPAs)
- Sea safety
- Reinforcement of management information system
- Strengthening of extension services
- Strengthening fish marketing networks
- Certification, HACCP implementation and value addition technologies
- Impacts of climate change to be studied
- Marine Habitat Restoration
- Capture Based Aquaculture (CBA)

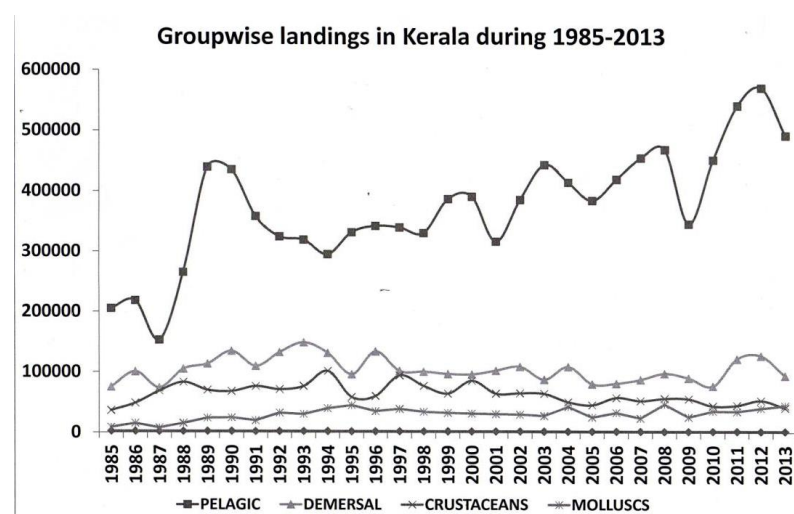
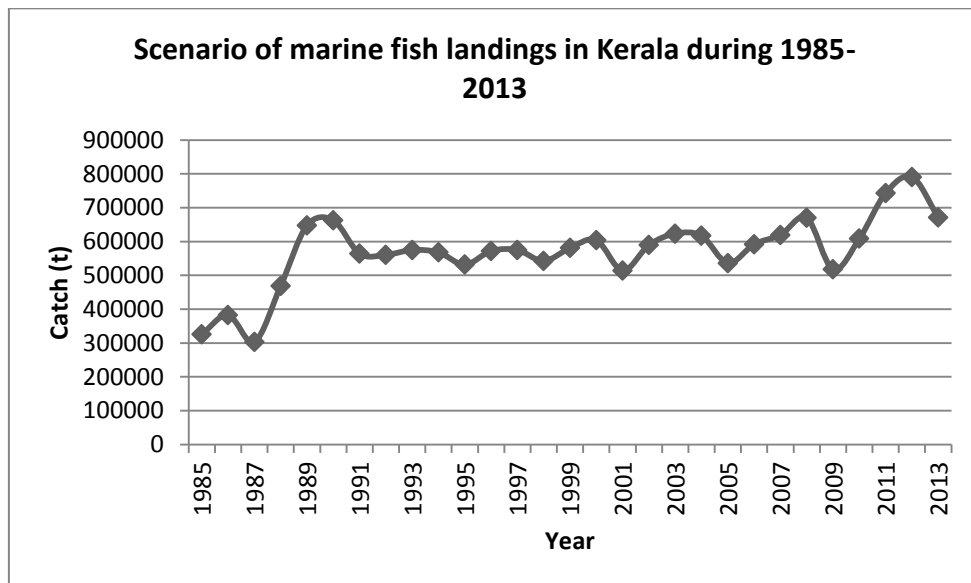
Project Title	Carbon sequestration potential of Indian seaweeds (Completed in March 2012).
PI	Dr. E. Vivekanandan

- The project was initiated during 2011 and experiment on CO₂ utilization of one species of sea weed attempted.
- Experiments indicate that seaweeds are an excellent source for fixing high levels of CO₂
- Among selected seaweeds, the green algae *Ulva lactuca* was found to have higher sequestration potential compared to the red algae *Gracilaria corticata* and the brown algae *Sargassum polystictum*.
- Among the two seaweeds studied, *Padina* sp. was found to fix higher levels of CO₂ (2 – 5 mg/l) when compared to *K. alvarezii* (1 – 2 mg/l).
- Seaweed farming on a large-scale, in suitable areas, would help to fix CO₂.
- The extensive cultivation of *Kappaphycus alvarezii* along the Palk Bay is one step ahead in the mitigation measures.
- More areas need to be brought under seaweed farming, particularly those seaweeds which have high CO₂ utilization capacity.

Project Title	Development of Fishery Management Plans for sustaining Marine Fisheries of Kerala and Lakshadweep (Ongoing - April 2012 onwards).
PI	Dr. P. P. Manojkumar

- The total marine fish landings along the Kerala coast was 671364 t in 2013 against 839185 t during 2012 showing a decrease of 20.00% (167821 t) in the catch compared to previous year. Landings from the state have been showing an upward trend.
- In 2013, Pelagic finfishes constituted 73.27%, demersal 13.97 %, crustacean 6.1% and molluscs 6.66 % of the total landings.
- In 2012, Pelagic fin fishes constituted 73.4%, demersal 15.4%, crustacean 6.2% and molluscs 5.0% of the total landings.
- In 2013, Mechanised, motorised and artisanal sectors contributed 70.23 %, 28.6 0% and 1.17%% respectively. Ring seine was the most import gear with a catch rate of 1664.8 kg/u . In trawl net the catch rate was 52.87 kg/h, while in gill net and Hooks and line the catch rate was 66.8 kg/u and 91.97 kg/u respectively.
- In 2012, The contributions of mechanised, motorised and artisanal sectors were 68.2 %, 30.3 % and 15% respectively. Yield of 39 out of 60 important groups monitored has increased and 21 groups declined during 2012.
- In 2013, The major groups in the fishery were oil sardine (36.97 %), Indian mackerel (6.83 %) *Stolephorus* spp. (6.75 %), penaeid prawns (4.45 %), threadfin breems (6.3 %), carangids (10.04 %), cephalopods (6.66 %), flatfishes (1.92 %), tunas (1.94 %) and ribbon fishes (5.1 %).
- The highest landings were recorded during the last quarter (30.48 %) in October (14.89%) and least in June (4.56 %).
- The total fishing hours expended by trawlers during the year was 4.1 million fishing hours, which was 20.1% less compared to 2012. The effort expended by the other gears has also declined significantly during the year.
- Fishery of elasmobranchs has shown a slight improvement compared to the previous years.

- Twenty four species of sharks and 14 species of rays, 3 species of flatfishes contribute to the fishery along Kerala. **Landings of Indian Halibut *Psettodeserumei* have shown a slight improvement** during the year showing a possible indication of a stock revival.
- Major pelagic resources like *S. crumenophthalmus*, *M. cordyla*, *S. commerson* and *A. solandri* are being exploited at optimum levels, *E. affinis* and *A. rochei* are being over exploited.
- Demersal resources *C. limbatus*, *N. mesoprion*, *J. sina* and *O. ruber* are being over exploited in the fishery off Kerala. Landings of most of the other demersal resources have declined except whitefish which showed a marginal increase over the previous year.
- Analysis of historical data for the period 1985-2013 shows that the catch varied from 203266 t to 790762 t with an annual average of 570994 t, More than 800 commercial species are landed in Kerala and average contribution of pelagic, demersal, molluscan and crustacean are 65.41%, 18.19%, 11.10 % and 5.30%. Analysis of past data shows that the growth was mainly noticed in pelagic fisheries and other resources only annual fluctuations over the years were noticed.



- Yield of 23 out of 60 important groups monitored has increased and 37 groups declined.

Annual average landings 1985-2013 and potential yield estimates for pelagic resources in Kerala

Species /group	Potential yield (t)	Annual average landings (t)
<i>S. commerson</i>	9797	6176
<i>S. guttatus</i>	154	432
<i>S. leneolatus</i>	3	1.5
<i>Acanthocybium spp</i>	43	25
<i>E.affinis</i>	11143	9143
<i>Auxis spp</i>	6847	4980
<i>K.pelamis</i>	689	389
<i>T. tonggol</i>	842	397
Other tunnies	3139	2241
Bill fishes	1235	1039
Barracudas	5164	3776
Wolf herring	745	748
Oil sardine	236922	157257
Other sardine	12641	12764
<i>Stolephorus spp</i>	24559	31872
Ribbon fishes	21678	15757
Horse mackerel	4780	3395
Scads	25021	31805
Leather jackets	745	398
Indian mackerel	56209	56019

Annual average landings during 1985-2013 and potential yield estimates for demersal resources in Kerala

Species /group	Potential yield (t)	Annual average landings (t)
Shark	2301	2605
Skates	510	248
Rays	1522	1485
Eel	216	4339
Catfish	263	1505
Lizarfish	9575	9735
Rock cods	6119	3431
Snappers	1873	1013
Pigface breams	725	406
Threadfin breams	34555	36514
Other perches	10659	8633
Threadfins	126	95
Croakers	9389	9594
Silverbellies	5765	5023
Big jawed jumper	1762	1182
Black pomfret	1146	1010
Silver pomfret	1030	666
Chinese pomfret	54	61
Soles	19798	16564

- The highest landings were recorded during the last quarter (30.48 %) followed by first quarter (25.92%), third quarter (23.84 %) and second quarter (19.70 %). The highest catch was recorded in October (14.89%) and least in June (4.56 %).
- Ring seine was the most import gear with a catch rate of 1664.8 kg/u . In trawl net the catch rate was 52.87 kg/h, while in gill net and Hooks and line the catch rate was 66.8 kg/u and 91.97 kg/u respectively.

Status of important pelagic reoures in Kerala

Species	L_r	L_{max}	Mean	L_c	L_{mat}	Level of exploitation
<i>S. crumenophthalmus</i>	17.3	29.6	20.8	17.4	17.3	Optimally exploited
<i>M. cordyla</i>	19.6	39.7	27.4	24.7	25.4	Optimally exploited
<i>S. commerson</i>	13.6	162.0	82.3	75.6	70.1	Optimally exploited
<i>A. solandri</i>	74.0	138.0	97.6	92.2	-	Optimally exploited
<i>E. affinis</i>	18.4	68	41.2	37.6	39.4	Slightly over-exploited
<i>A. thazard</i>	16.7	47.8	33.7	29.4	29.7	Optimally exploited
<i>A. rochei</i>	17.8	36.4	24.2	23.8	20.7	Over-exploited
<i>D. russelli</i>	13.5	22.0	16.4	15.8	13.9	Near to optimum level

Status of dominant demersal reoures in Kerala

Species	L_r (mm)	L_{max} (mm)	Mean (mm)	L_c (mm)	L_{mat} (mm)	Level of exploitation
<i>C. limbatus</i>	498-2358	1241.9	1200-1800	0.78	768	Near to optimum level
<i>N. mesoprion</i>	22-258	143.9	120-210	0.71	9238	Near to optimum level
<i>N. japonicas</i>	42-308	151.4	120-240	0.67	7499	Near to optimum level
<i>C. macrostomus</i>	42-177	116.2	90-140	0.52	9506	Near to optimum level
<i>J. sina</i>	32-198	129.1	120-180	0.70	1792	Near to optimum level
<i>O. ruber</i>	72-298	175.3	160-240	0.73	249	Near to optimum level
<i>C. limbatus</i>	498-2358	1241.9	1200-1800	0.78	768	Near to optimum level
<i>N. mesoprion</i>	22-258	143.9	120-210	0.71	9238	Near to optimum level

Project Title	Development of Fishery Management Plans for sustainable Marine Fisheries of Gujarat (Ongoing - April 2012 onwards).
PI	Shri. Mohamed Koya

- The estimated marine fish production from Gujarat in 2012 was 6, 90, 396 t showing an increase of 9.14 % from that of previous year.
- Almost all the major resources recorded positive growth except the elasmobranch resources.
- The demersal landings were estimated as 2, 46, 257 t (18.78 %increase than previous year) which formed 35.66 % of total production.
- The pelagic resources contributed 2, 29, 950 t (33.30 %) followed by crustacean resources 1, 36, 849 t, (19.82 %) and molluscs 58,807 t (8.51 %).

- The maximum landings were that of Ribbon fish (91,729 t) followed by non-penaeid prawns (83,621 t), Bombay duck (65,496 t), sciaenids (62,284 t), thread fin breams (50,394 t) and catfishes (40,262 t).
- Bombay duck, Croakers, Ribbon fishes, Non-penaeid prawn and Penaeid prawn were consistently present in all the decades with varying dominances.
- Major Fishery in Gujarat during the last 3 decades over the 2010s was examined
 - = Bombay duck, croakers, Ribbon fishes, Non-penaeid prawn and Penaeid prawn were consistently present in all the decades with varying dominances
 - = Non-penaeid prawns gradually became the major contributor. Revival in contributions of Bombay duck and Penaeid prawn during 2012
 - = *Coilia dussumieri*, sharks, silver pomfret and big jawed jumper gradually moved out of top ten. Cephalopods and Threadfin breams entered the top 10 in 1990s and continued to raise in rank.
 - = Lizard fish is a new entry in top ten in 2011. Targeted fishing for Ribbon fishes and Cephalopods, threadfin bream and lizard fishes owing to demand from processing industry (frozen and Surumi products).
 - = Rock cod (mainly *E. diacanthus*) figured in top 10 during 2012

Project Title	Assessment of the elasmobranch resources in the Indian seas (Ongoing - April 2012 onwards).
PI	Dr. Shoba Joe Kizhakudan

- **Rapid stock analysis indicates that the elasmobranch population** along the Indian coast is either “less abundant” or “declining” in different parts of the coast. Sharks were either “less abundant” or declining along the Indian coast, except Tamil Nadu & Puducherry, where they could be classified as “depleted”.
- Skates maintained their status quo in Gujarat and showed an improvement in the last three years in Karnataka & Goa, “depleted” along Maharashtra and West Bengal, and “collapsed” along Orissa.
- Rays were found to have shown an improvement in Gujarat, Karnataka & Goa, Tamil Nadu and Andhra Pradesh. The status of rays remained more or less the steady in the last five, and they could be classified as “abundant” along the Indian coast.
- **Protected species** like *Rhincodon typus* Smith, 1828 (accidental entangling in drift gill net), *Rhynchobatus djiddensis* (Forsskal, 1775) (accidental catch in bottom set gill net), (from both trawl net & gill net) were encountered at Calicut and Tuticorin.
- **Many rare and new occurrences**/first records of elasmobranchs were reported all along the coastline- short fin mako, *Isurus oxyrinchus*, brown guitarfish *Rhinobatos schlegelii* etc.

Elasmobranch fishery

The production of elasmobranchs in India in 2012 was to the tune of about 52261 t, with trawl nets accounting for 55.6%, gill nets 29.4% and hook & line and longline units 10.5%. The catch showed a slight reduction of 2.3% from the catch in the previous year. Sharks formed 44.6% of the total elasmobranch landings, skates, 3.9% and rays, 51.5%. The quantum of sharks landed has seen a fall of 13% from the landings in the previous year, while skates have fallen by 25%. Rays however registered an increase in the quantity landed, being about 12% more than the landings in 2011. The production of elasmobranchs in India in 2013 was to the tune of about 49000 t, with trawl nets accounting for 48.8%, gill nets

35.6% and hook & line units, 6%. Sharks formed 42.5% of the total elasmobranch landings, skates, 4.8% and rays, 52.7%. The mechanized sector contributed to 75.4% of the total elasmobranch landings in the country, while the motorized sector contributed to 24.3%. The role of the non-mechanized sector was very minimal. Tamil Nadu & Puducherry accounted for 32.3% of the elasmobranch landings, Gujarat, Daman & Diu, 23.9%, Kerala, 11.7%, Maharashtra, 11.1%, Andhra Pradesh, 9.8%, West Bengal, 5.9%, Karnataka & Goa, 2.9% and Orissa, 2.5%.

Sharks were the dominant group in Gujarat, Maharashtra, Goa, Karnataka, Kerala, West Bengal and Orissa, while Rays were dominant in Andhra Pradesh, Tamil Nadu and Puducherry. Skates contributed to the fishery considerably only in Karnataka, Kerala and Maharashtra, and to some extent in Andhra Pradesh, Tamil Nadu and Puducherry. Except in West Bengal and Goa, the mechanized sector contributed to the major share of the elasmobranch landings. Trawl net was the major contributor to elasmobranch landings in all the states except Daman & Diu, Maharashtra, Goa and West Bengal.

Species diversity: The species profile of elasmobranch landings from different landing centres along the Indian coast revealed high species richness in Indian waters. Sharks were mainly represented by members of the families Carcharhinidae, Triakidae, Sphyrnidae, Echinorhinidae, Hemiscylliidae, Alopiidae, Lamnidae, Centrophoridae, Squalidae and Stegostomatidae. The ray fishery was dominated by Dasyatidae, Mobulidae, Myliobatidae, Gymnuridae and Rhinopteridae. Skates landed along the coast mostly belonged to families Rhinidae and Rhinobatidae.

Unusual occurrences: The shortfin mako shark *Isurus oxyrinchus* and the longfin mako shark, *Isurus paucus* have been recorded for the first time from the waters off north Tamil Nadu. *Isurus oxyrinchus* was also reported from Dwarka in Gujarat and Tuticorin in Tamil Nadu. The occurrence of *I. paucus* has not hitherto been documented from the Bay of Bengal along the Indian coast. The silky shark, *Carcharhinus falciformis* was also recorded for the first time in the commercial landings at Madras Fisheries Harbour. The porcupine ray *Urogymnus asperrimus*, the sharpnose sevengill shark *Heptanchias perlo* and the slit-eye shark *Loxodon macrorhinus* were reported in the landings at Cochin Fisheries Harbour. The occurrence of pelagic thresher shark, *Alopias pelagicus* was reported from Porbandar. The largest recorded size of *Iago omanensis* was also reported from Mangrol. Rare landing of small eye sting ray by trawl has been observed at Veraval. Pregnant females of *Rhinobatos annandalei* observed in September at New Ferry Wharf in the trawl net, which was operated at 40-45 m depth towards South Gujarat. The occurrence of the brown guitarfish *Rhinobatos schlegelii* has been recorded in the waters off south Chennai, confirming the distribution of this species in the Bay of Bengal along south-east peninsular India. Pups of *A. pelagicus* were observed at Chennai. Rare species like *Echinorhinus brucus*, *E. cookei*, *Pseudocarcharias kamoharai*, *Pteroplatytrygon violacea*, *Rhina ancylostoma* and pups of *M. japonica*, *Aetobatus narinari*, *A. superciliosus*, *R. granulatus* & egg case of *C. griseum* were reported from Tuticorin.



Iago sp.



Functional female with claspers & embryos



Alopias pelagicus pups



Rhinobatos schlegelli collected at Chennai

Protected species: A single individual of the large tooth sawfish *Pristis microdon*, declared protected under Schedule I of the Wildlife (Protection) Act, India, was accidentally caught in a trawl net and brought ashore to Malpe in Udupi district, Karnataka in February 2013. The fish weighed about 800 kg. Protected species like *Rhincodon typus* and *Rhynchobatus djiddensis* were encountered at Tuticorin as accidental catch. To counter recurrence of such accidental catches, pamphlets in all local languages are being prepared to spread awareness on the protected elasmobranch species, their biology and vulnerability, so as to encourage fishermen to remain watchful and release any such individual back into the sea.

Stakeholder Participation: A major initiative under the project has been the involvement of the shark fishermen from Thuthoor, a fishing village in Tamil Nadu known for targeted shark fishing along the Indian coast. Representatives of the Association of Deep-Sea Going Artisanal Fishermen (ADSGAF), Thuthoor, participated in the Inception Workshop of the

project held at Chennai during 11-13 December 2012, and their constant inputs on shark fishing activities along the coast are of help in understanding seasonal availability of different species, location of shark fishing grounds and market trends.

Trade in devil ray gill rakers: In 2011-'12, trade in devil ray gill rakers saw an upward trend at Chennai. Processed gill rakers are sold at prices ranging between Rs 2500 and 10000/kg, depending on the size of the ray and the species. The gill rakers of *Mobula tarapacana*, commonly called "white" was sold by traders from Kochi to buyers in Chennai, at high prices of Rs 9000/kg dry weight, and the meat at Rs 200/kg wet weight. The gill rakers of *M. japonica*, locally called "black" fetch only Rs 4000/kg dry weight. The gill rakers were exported from Chennai to foreign countries for soup and medicine preparation.

Population studies: Growth and stock parameters were assessed for *Scoliodon laticaudus* exploited from the north-west coast. With a size range of 190-590 mm TL and mean size of 367 mm represented in fishery, L_{∞} was estimated to be 610 mm, annual K , $0.52y^{-1}$ and exploitation ratio E , 0.46. About 59% and 67% of the landings of *S. laticaudus* in the states of Maharashtra and Gujarat was comprised of juveniles. Growth and stock parameters estimated for the scaly whipray *Himantura imbricata* were L_{∞} = 260.6 mm DW, K = $0.64 y^{-1}$, E = 0.35.

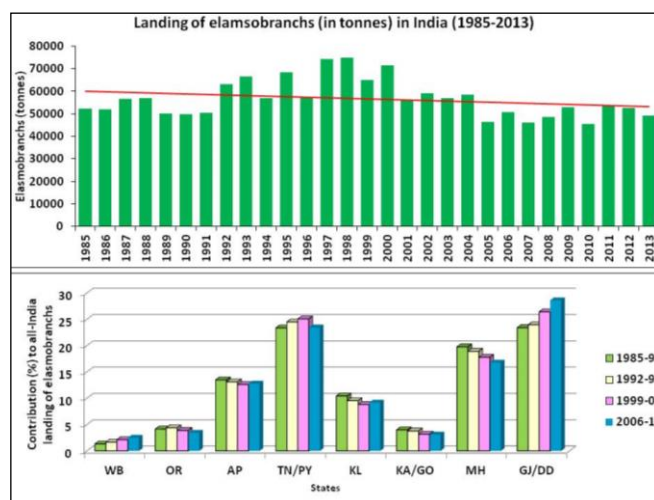


Mobula sp.



Removal of gill rakers

Classification of Stock: Rapid stock analysis indicates that the elasmobranch population along the Indian coast is either "less abundant" or "declining" in different parts of the coast.



RAPID STOCK ASSESSMENT OF ELASMOBRANCHS ALONG INDIAN COAST

RESOURCE	COAST	HMC (t)	3YA (T)	% of HMC	Status
SHARKS	Gujarat	27985	11069	39.6	DC
	Maharashtra	12929	4034	31.2	DC
	Karnataka & Goa	2829	749	26.5	DC
	Kerala	5151	2328	45.2	DC
	Tamil Nadu & Puducherry	10934	827	7.6	DP
	Andhra Pradesh	6871	1572	22.9	DC
	Orissa	3077	1128	36.6	DC
	West Bengal	5482	3196	58.3	LA
	Gujarat	1412	1132	80.2	A
	Maharashtra	1927	131	6.8	DP
SKATES	Karnataka & Goa	307	229	74.6	A
	Kerala	875	257	29.4	DC
	Tamil Nadu & Puducherry	1613	426	26.4	DC
	Andhra Pradesh	685	119	17.4	DC
	Orissa	351	6	1.6	C
	West Bengal	601	57	9.4	DP
	RAYS	Gujarat	7012	2446	34.9
Maharashtra		2660	498	18.7	DC
Karnataka & Goa		2398	345	14.4	DC
Kerala		4070	1082	26.6	DC
Tamil Nadu & Puducherry		16429	10487	63.8	LA
Andhra Pradesh		9971	6746	67.7	LA
Orissa		1971	906	45.9	DC
West Bengal		2059	831	40.4	DC

A- Abundant; LA-Less abundant; DC-Declining; DP-Depleted; C-Collapsed

Project Title	Derivation and characterisation of embryonic & induced pluripotent stem cell lines from selected marine fish species aimed at Mariculture/ conservation (Ongoing - April 2012 onwards).
PI	Dr. K.S. Shobana

- Formulated tissue culture media with various additives and growth factors for initiation of primary culture of embryonic stem cells from embryos of the ornamental clown fish.
- Twenty one trials were attempted to initiate primary embryonic stem cell cultures from the orange clown fish *Amphiprion ocellaris* embryos. Enzymatic treatment and mechanical separation were attempted for isolating blastomeres from the embryos and the latter method gave better results with minimum interference of yolk globules. In order to standardise the optimum stage of the embryos for initiating primary stem cell culture, blastomeres were isolated at different stages viz., 16, 32, 64, 128 and 256 cell stage embryos and it was found that the mid blastula stage with 256 cell stage gave better blastomere attachment and formation of colonies.
- Four attempts were made to initiate primary embryonic stem cell cultures from the maroon clown fish *Premnas biaculeatus* embryos and in this case, both 128 and 256 cell stage embryos were found to be fine for blastomere attachment.

- Primary cultures were initiated from different tissues of the Malabar grouper *Epinephelus malabaricus*, for developing induced pluripotent stem cells. The cultures were grown and the initial passages were stored in liquid nitrogen for use in iPS development.

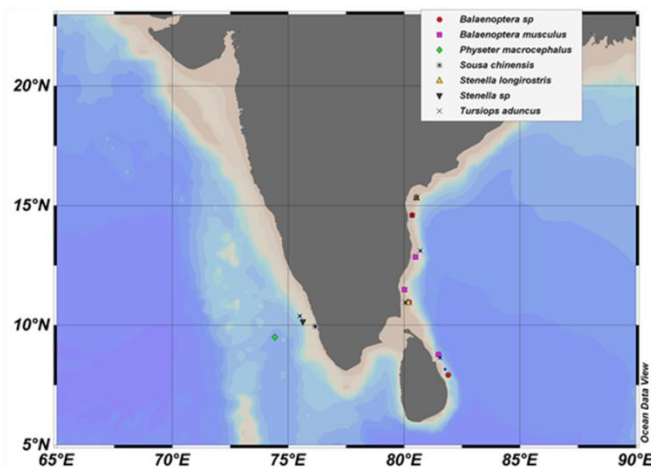
Externally funded projects

Project Title	Impact, adaptation and vulnerability of Indian marine fisheries to climate change (ICAR network project, Completed in 2012)
PI	Dr. E. Vivekanandan

- Increase in oil sardine landings along the northwest coast attributed to increase in seawater temperature and other oceanographic parameters.
- Temporal changes in the oceanographic parameters and fish catch along Kerala coast studied showed significant changes in the trend and increase in anomalies.
- Indigenous Technical Knowledge (ITK) of fishermen on climate change studied.

Project Title	Studies on marine mammals in the Indian EEZ" (MoES funded, Completed in 2012)
PI	Dr. E. Vivekanandan

- Surveys undertaken locally as well as along the Indian Ocean with FORV Sagar Sampada indicated that *Stenella longirostris* was the most frequently sighted species showing wide distribution.
- Blue whale (*Balaenoptera musculus*) and *B. edeni* were recorded on very few occasions.
- Baleen whale was frequently sighted in the southern Sri-Lankan waters.
- Cetacean distribution is related to SST. During the survey period, the SST ranged from 24.2 to 32.0 °C and a relationship between SST and distribution of species was evident. *S. chinensis* and *S. longirostris* are restricted to 24.0 – 30.9 °C, but *D. capensis* is distributed at 26.2 to 32.0 °C.



Map showing locations of cetacean sightings during the cruises 288 and 290

Project Title	Flow of Matter through tropic levels and biogeochemical cycles in Marine and Estuarine ecosystems. (MOES Siber project, Completed in)
PI	Dr. Sujitha Thomas

- The project is a part of the National project on Sustained Indian Ocean Biogeochemical Cycle Research (SIBER) in which different institutions doing research in Indian Ocean across the country are involved. The project is undertaken in Mandovi and Zuari estuaries and coastal waters of Goa. The project was initiated in May 2011 with recruitment of JRFs.

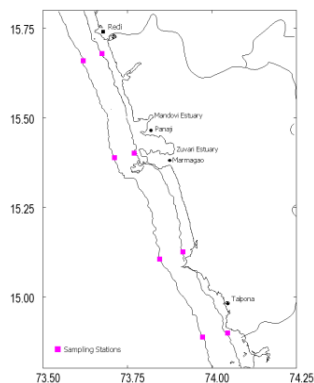


Fig 1

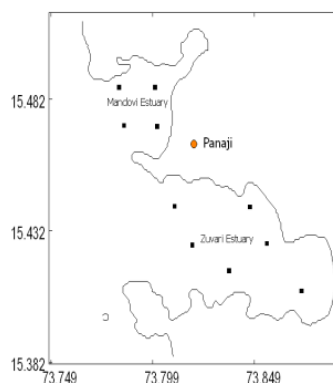


Fig 2

- Sites for sampling was selected from Mandovi, Zuari estuary and coastal waters of Goa. The coast was divided into 8 equal sampling grids of 0.25° starting from south to north. Eight sampling stations were fixed along the coast (Fig. 1). In Mandovi estuary 4 stations were fixed and in Zuari estuary 6 stations were fixed (Fig. 2). Sample collection centres for fish/shell fishes from the estuaries and coastal waters were also fixed.
- Monthly sampling was done from Mandovi, Zuari and coastal waters of Goa. The coast was divided into 8 equal sampling grids of 0.25° starting from south to north.
- Samples were collected from eight sampling stations fixed along the coast. In Mandovi estuary samples were collected from 4 stations and in Zuari estuary from 6 stations.
- Data collection on primary production, zooplankton estimation, benthos and fishes of different ecological groups were completed from Mandovi and Zuari estuary and coastal waters of Goa.
- Data on L/F and other population parameters for biomass estimation for 85 species completed during the period.
- The diet data was analysed using index of preponderance, volume method and percentage of occurrence. Diet matrix of 120 species of finfishes studied during the period.
- Preliminary non validated estimates of the biomass of six major groups completed for mandovi estuary.
- Population parameters of major groups in Mandovi estuary done during the period. Further work is in progress.

Project Title	Establishment and characterisation of cell lines from selected marine food fish and ornamental fish (DBT funded, Completed in 2012)
PI	Dr. K.S. Shobana

- A total of 29 continuous cell lines have been established and characterised from 5 species of marine food fish (*Rachycentron canadum*; *Epinephelus merra*; *Siganus canaliculatus* ; *Epinephelus malabaricus* ; *Trachinotus blochii*); and 3 species of marine ornamental fish.
- The cell lines were characterised by chromosome analysis, immunotyping, ultrastructural studies (TEM analysis) and by molecular characterisation to confirm the species of origin.
- All the cell lines have been successfully stored by cryopreservation in liquid nitrogen with good survival rate on revival.
- The cell lines will be deposited in the National Fish Cell Line Repository which is being developed at NBFGR, Lucknow (with funding support from DBT), for distribution to end users.

Project Title	Bio-inventorisation of the coral fishes of South India with special emphasis on threats and conservation measures (MoEF funded, Completed in 2012)
PI	Dr. Rekha J. Nair

- Landings from hooks and line, trawl, gill net were observed at major Fishing Harbours and Fish landing centers of Kerala (eight centres), Karnataka (three centres) on the west coast and Tamil Nadu (eight centres), Andhra Pradesh (two centres) on the east coast. Landings from hooks and line, trawl, gill net were observed at major fishing Harbours of Kerala, Tamil Nadu and Karnataka.
- Centre wise documentation of resources was done compiling the total work.
- Out of 450 fishes collected from the different landing centers on both east and west coast of India, 1 Endangered, 4 Vulnerable, 12 Near Threatened, 75 Least Concern and 12 Data Deficient fishes listed by IUCN Red list has been reported. Other than these 104 fishes, 346 fishes collected have Not Evaluated Status by IUCN. Many commercially important fishes like Snappers, Pig face breams, Nemipterids etc have been listed as Near Threatened by IUCN.
- A rapid survey was also conducted to assess the species diversity, composition and abundance of reef fishes in Andaman Islands for a period of two months. About 14 sites were investigated which included North, Middle & South Andaman and also Little & Great Andaman Islands.
- A total of 101 species of fish belonging to 65 genera under 37 families were recorded in Andaman Islands. Hooks & lines and *tharni jal* (flowing gill net) are the two fishing nets used here by local fishermen. Other nets like ring seine, shore seine and *bada jal* (mesh size 30 - 32 mm) were used in some areas like Jungligat, Hut Bay and Chatham Islands. In Haddo, hand nets were used by some fishermen; hand picking was also done from the shallow rocky pools.
- During the survey the most speciose families were Serranidae and Lutjanidae due to the use of Hooks & lines and Gill nets in these areas. The other species belonging to Nemipteridae, Pomacentridae, Labridae, Mullidae, Acanthuridae were also abundant. Species richness, was found to be highest at Wandoor and Jungligat.
- Two surveys were conducted at Lakshadweep islands. The monsoon fishery was observed during the second year of work, followed by an underwater survey with divers in the third year.
- Landings of *Chelinus undulatus*, a fish in the Protected list of IUCN was recorded as landings among the reef fishes at Cochin Fisheries Harbour. The biological characters of the species were studied.
- Data documentation was initiated on MS Word and on an Access platform.
- A comparative study on the occurrence of fishes on the three coasts showed that west coast showed abundance in the major families like Carangidae wherein 42 species were recorded. However some families were represented only in the East coast.
- Database on coral fishes of South India being prepared as part of the funded project.

- During the period, it was noticed that *Epinephelus areolatus*, *Aphaereus rutilans* landings have declined during the study period whereas landings of *Epinephelus epistictus* has increased.
- New records off Indian waters: Thirteen fishes which are range extensions of fishes reported earlier, but not from Indian waters.
- Tissue samples were collected for all species - 105 species in 35 families; collected from the second year onwards and preserved in alcohol as per the instructions given in the first Review workshop.
- Two Charts on Reef fishes of India and Reef Associated Perches of India was published.
- A database on is being completed with information on all fishes recorded in the project.

Scientific Name	Previously recorded	Present location
<i>Xanthichthys lineopunctatus</i>	East Africa south to Port Alfred, South Africa, east to northwest Australia and Ryukyu Islands.	CFH, Kerala.
<i>Polyipnus indicus</i>	Only from the east African coast- Tanzania	Kollam, Kerala.
<i>Parascolopsis baranesi</i>	Gulf of Aqaba - Israel	Kollam, Kerala.
<i>Myripristis greenfieldi</i>	Endemic to Japan.	CFH, Kerala.
<i>Myripristis formosa</i>	Taiwan.	CFH, Kerala.
<i>Myripristis seychellensis</i>	Seychelles, Reunion, St. Brandon's Shoals and Madagascar.	CFH, Kerala.
<i>Pontinus macrocephalus</i>	Japan to Micronesia, Hawaiian Islands, Malaysia, Bali Strait to Timor Sea in Indonesia.	CFH, Kerala.



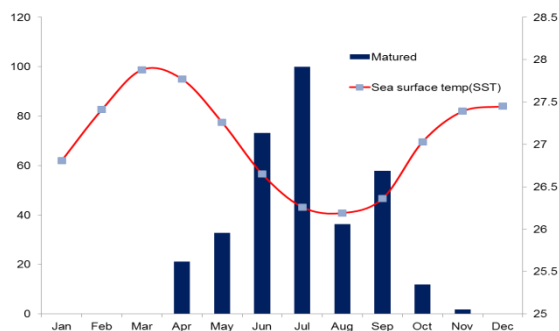
Project Title	National Initiative in climate resilient agriculture of ICAR (NICRA) (ICAR funded project, Ongoing – April 2013 onwards)
PI	Dr. P.U. Zacharia

Objectives:

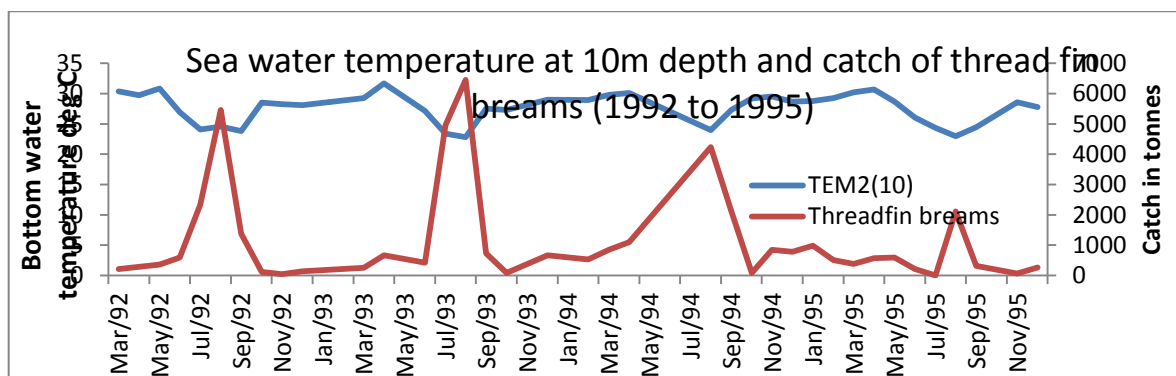
- To enhance the resilience of Indian fisheries to climatic variability and climate change through development and application of improved production and risk management technologies
- To demonstrate site-specific technology packages on farmers fields for adapting to current climate risks
- To enhance the capacity of scientists and other stakeholders in climate resilient agricultural research and its application.

Salient Achievements:

- **Catch effort standardization was done** for all fishery resources in all states which will be a major input for modelling.
- Length at first maturity (Lm) of Mackerel decreased from 22.4cm in 1960 on the West coast of India to 18.38cm in 2012. The SST in 1960 was 28.21 which increased by 28.691 in 2012 Lm shows a strong negative correlation (-0.61) with temperature which indicates the spawning is taking place early in the life cycle.
- **Oil sardine:** Real time data showed that spawning season of Sardine showed significant negative correlation with SST. These databases collected along the coast could be used for developing scenarios 2030 and 2050 for studying the effect of temperature on spawning of fishes.



- Gut content of oil sardine tabulated from published literature. Changes in the predominant plankton in the gut of oil sardine were noticed over the years 1948-2013. *Fragilaria* was noticed in the gut of sardines during Nov 2012–Feb 2013 after a long gap.
- Threadfin breems showed very strong relation to bottom water temperature; the preferred temperature was seen to be 23.8⁰C; highest catch of the decade was 6453 tonnes when the bottom water temp was 22.8⁰ C.



- Catches of oil sardine show increasing trend over past 20 years and showed a positive correlation with SST along South west coast. Mean size of oil sardine in the fishery has decreased from 155 mm in 2002 to 145 mm in 2012.

Impact of extreme climatic events on coastal population and capture fisheries

- The impact was assessed for 2000-2013. 21 Cyclones hit regularly during the period and the most affected states are the states in the east coast of India

- **Table.** Loss of life and value owing to Extreme Climatic Events estimated during 2000-2013

No of Cyclones	Life Lost	Fishing days loss	Catch loss (tonnes)	Value lost (Rs)
21	9,805	167	171,347.24	19,854 crores

- When compared to the initial period, the loss of life and property has considerably reduced during recent years by early forecast and warning and better disaster management system in place. However, there is still scope for improving the warning and disaster warning systems. It is hoped that ITK and awareness building and effective networking will further reduce the losses.

IDLAM

- As part of the integrated District level adaptation and mitigations (IDLAM) plan to assess perception of fishermen on causal factors of climate change and to analyze perception of fishers on different effects of climate change to develop a bottom up approach in climate change mitigation and adaptations, vulnerability of coastal districts and its fishermen population to climate change was assessed from selected districts of Kerala, Karnataka, Tamil Nadu, Gujarat in the west coast and Tamilnadu, AP in the east coast.

Table : Major factors which increase the vulnerability of fishers to climate change in the villages which were surveyed in the four states		
	Factors which increase vulnerability of fishers	How vulnerability is increased
1	Low level of awareness about climate change	Makes fishers more vulnerable to CC impact
2	Low literacy rate (except Kerala)	Unable to accept /adopt protective measure
3	Lack / inadequate level of sanitation and health care facilities	Fishers more vulnerable to spread of epidemics consequent to flood or inundations / cyclones
4	Lack of protection shelters, wireless weather communication tools, poor/ bad roads	Exposes fishers to more vulnerable situations
5	Distance between residential area and the coastline very low (Gujarat varied from 330 m to 925 m; within 100m in Cuddalore (TN);	High vulnerability to sea erosion; SL rise
6	Unplanned developmental activities (construction and destruction of habitats)	Has led to sea water intrusion during high tides since most villages are low lying areas (especially Udupi)

- The level of awareness of fisherfolk to climate change is low which indicate that the fishers couldn't correlate environmental changes consequent to climate change to their livelihood. The fishers were prone to loss in fishing days and erratic monsoon.
- There is need to improve on the awareness of the fishers knowledge to climate change by involving them in the disaster preparedness and planning process. The alternative avocations available across the different fishing villages need to be strengthened in order to negate the different risks and uncertainties of climate change and in ensuring a climate change informed fishers in the future.
- Mangrove planting in shallow extensive and semi-intensive shrimp ponds was demonstrated to increase C sequestration. Vetiver slips was planted at sandy soil of the sea shore of

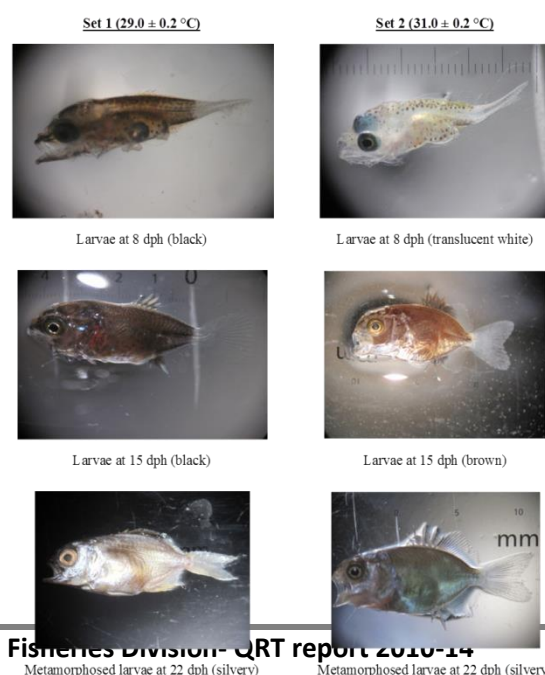
Alleppy district to prevent erosion due to sea level rise since mangroves could not be planted there.

Carbon Life Cycle Assessment in fisheries

- Carbon emission from fishing activities pre-harvesting, harvesting, post harvesting was estimated from Mangalore, Mumbai, Veraval, Tuticorin, Chennai and Vishakhapatnam. At Visakhapatnam emission from harvest accounts for ...% of Carbon emission.
- LCA analysis of mechanized and motorized vessels from Vishakhapatnam showed that C emitted per kg of fish was least for motorized boats (0.186) compared to mechanized (0.466).

Mariculture

- The effect of temperature on incubation of Cobia eggs, hatching rate, development of larvae, survival and growth of cobia larvae was investigated.
- Temperature plays a vital role in the yolk-sac utilization as well as growth of the larvae of cobia. At the end of 52 hours post hatch, the lowest yolk-sac volume and maximum length was recorded at a temperature range of 31 to 33°C.
- Studies on Silver Pompano were undertaken to study the increase in temperature on larvae; increase in temperature reduced the hatching rate, time taken for mouth and anal opening and metamorphosis. Survival rate proportionately declined with increase in temperature. A temperature range of 29-31°C may be advantageous in the larviculture of *T. blochii* for better survival as well as growth rate.
- The increase in temperature reduced the hatching rate, time taken for mouth and anal opening and metamorphosis. Survival rate proportionately declined with increase in temperature. A temperature range of 29-31°C may be advantageous in the larviculture of *T. blochii* for better survival as well as growth rate.
- The average increase of 2°C in water temperature resulted in reduced growth of about 10 to 33 per cent from 7 dph to 12 dph. The reduced growth rate coupled with change in pigmentation of larvae can be taken as the resilience response of the silver pompano larvae to combat the temperature stress



Technology demonstration

- In Kerala, field demonstrations are being carried out in three new *Pokkali* farms Nedungad, Kumbalangi and Kadamakkudy for Pearl spot, Mullet, Pompano species. Fish seeds have been introduced in the cages during November. A new candidate fish **Pompano (*Trachinotus blochii*)** introduced for culture in low saline waters for first time in Kerala. The fish is performing well in Pokkali fields.
- The demonstrated technology of cage culture of fin fish in Pokkali fields resulted additional net income of 0.80 lakhs/ha resulting a total net income of 1.3 lakhs/ha. The net income in case of paddy cultivation alone would be INR 0.15 lakhs/ha, whereas paddy and shrimp together give income of only 0.50 lakhs/ha.



- Formulated pellet feed for Pearl spot, *Etroplus suratensis* larvae and juveniles developed under CADALMIN™ brand in the trade name - **Pearl Plus** for feeding pearl spot during Pokkali integrated farming.

Technical Programme for 2014-15:

- Database creation and IPCC modelling for Indian oil sardine and mackerel.
- Continuing studies on spawning behaviour and abundance of major fishes in relation to climatic factors and chlorophyll
- Continuing collection of real time oceanographic, environmental, biological data using F.V Silver Pompano
- Consolidation and publication of studies done under LCA and IDLAM.
- Assessing the impact of temperature on egg development, hatching, larval cycle of food fish for identifying climate resilient species for mariculture.
- Technology demonstration activities in selected centres.

Project Title	Resources Assessment & Barcoding of Elasmobranchs) (MoES funded project, Ongoing – April 2013 onwards)
PI	Dr. P.U. Zacharia

- 37 different species were collected which includes 20 sharks, 14 rays and 3 skates from east and west coast of India for DNA barcoding.
- Among them the sequenced samples were submitted to National Center for Biotechnology Information.
- The details & accession numbers of 4 species of rays (*Mobula japonica*, *Mobula tarapacana*, *Himantura gerrardi* and *Himantura fai*) and 5 species of sharks (*Galeocerdo cuvier*, *Mustelus mosis*, *Triaenodon obesus*, *Alopias pelagicus*, *Sphyrna lewini*) have been received.

Project Title	Installation of Artificial Reefs in the inshore waters of Tamil Nadu (IFAD) (Consultancy project, Ongoing)
PI	Dr. Shoba Joe Kizhakudan

- Site survey and site selection for deployment of artificial reefs in the inshore waters of Thiruvallur, Kancheepuram, Kanyakumari, Nagapattinam, Cuddalore and Villupuram districts were conducted.
- Ten fishermen meets at the respective villages were also conducted to spread awareness on artificial reefs.
- Organized fishermen-scientist interface meeting on artificial reefs at Kancheepuram, Tiruvallur, Cuddalore Districts of T. Nadu

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Peer reviewed journals

2014

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2. Thomas Sujitha, A.P. Dineshbabu and Geetha Sasikumar 2014. Gastropod resource distribution and seasonal variation in trawling grounds off Konkan Malabar Region, eastern Arabian Sea. *Indian Journal of Marine Geo sciences*, 43 (3): 384-392.
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Symposium presentations

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2013

1. Sujitha Thomas* and Dineshababu A.P 2013. GIS based resource mapping of fishery resources to reduce CO2 emission by multiday trawlers. In International symposium on Greening Fisheries held at Kochi from 21-23 May 2013. (Received best paper award)
2. A.P. Dineshababu, Sujitha Thomas and A.C.Dinesh 2013. Use of GIS in formulating "operation based bycatch reduction" interventions in Indian trawl fisheries. In International symposium on Greening Fisheries held at Kochi from 21-23 May 2013
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Gateway Hotel, Cochin organised by MoEF, New Delhi, MFF NCB, and Mangrove for Future (MFF) pp.139-142.

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2. Mukta. M. Chapter on “Species selection for cage culture” and chapter on “ Economics of open sea floating cage culture of finfishes” in the Training Manual of “Cage Culture of Finfishes” held at VRC of CMFRI, Visakhapatnam during 27.1.2014-1.2.2014

2012

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2009

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Book Chapters

2014

1. T.M. Najmudeen and P.U. Zacharia.2014. Collection of biological data on demersal resources. pp. 17-30 In:Training Manual on Biology and Identification of Demersal Fishes, 175 pp
2. Najmudeen, T.M. 2014. Taxonomy and Identification of lizardfishes. In: “Training on Biology and Identification of Demersal Fishes, Training Manual published by Central Marine Fisheries Research Institute, Kochi pp. 59-68.
3. Najmudeen, T.M. 2014. Taxonomy and identification of pigface breems. . In: “Training on Biology and Identification of Demersal Fishes, Training Manual published by Central Marine Fisheries Research Institute, Kochi pp. 69-84.
4. T.G Kishor, C.A Shiyas, P.U Zacharia, K.S Shobana, Rekha J. Nair. 2014. Identification of commercially important sharks. pp 85-96 In:Training Manual onBiology and Identification of Demersal Fishes, 175 pp
5. T.G Kishor, C.A Shiyas, P.U Zacharia, K.S Shobana, Rekha J. Nair. 2014. Shark identification by using fins.pp 97-102. In:Training Manual on Biology and Identification of Demersal Fishes, 175 pp
6. S. Dinesh Kumar and Rekha J. Nair.2014.Collection and preservation of fishes, pp. 31-37, In:Training Manual onBiology and Identification of Demersal Fishes, 175 pp.
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9. Rekha J. Nair. 2014.Introduction to classification of fishes, pp 38-45. In:Training Manual on Biology and Identification of Demersal Fishes, 175 pp

10. Rekha J. Nair and S. Dinesh Kumar. 2014. Field identification of common groupers, pp 118-125 In: Training Manual on Biology and Identification of Demersal Fishes, 175 pp
11. Rekha J. Nair and P.U Zacharia. 2014. Field identification of rays. pp 103-117. In: Training Manual on Biology and Identification of Demersal Fishes, 175 pp
12. P.U. Zacharia. 2014. Trophodynamics and review of methods for stomach content analysis of fishes. In: Training Manual on Biology and Identification of Demersal Fishes, 175 pp
13. Ghosh, S., Rao, M. V. H., Ranjan R., Xavier, B., Edward, L. L., Menon, M., Behera P. R. and Naik N. R. 2014. Bioremediation, A novel tool for environmental friendly shrimp aquaculture. In: Gupta S. K and Bharti P. K. (Eds) Aquaculture and Fisheries environment. Discovery publication house, New Delhi p. 140-163.

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2. Purushottama, G. B., Ramkumar, S, Thakurdas, Katkar, B. N. And Chavan, B. B. 2013. Management of elasmobranch fisheries in Maharashtra. In: S. K. Chakraborty and W.S. Lakra (Eds.), Fisheries Resources of Konkan Region - Utilization and Management, Central Institute of Fisheries Education, Mumbai, pp.73-88.

2011

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2. Najmudeen, T.M. and Zacharia P.U. 2011. Collection of biological data on demersal resources- practical. In: 'Training Manual for the international training entitled Regional Training Course on Strengthening of Data Collection and stock assessment (RTC-SDL)' in collaboration with FSI under the funding for the BOBP- inter governmental Organization (BOBP-IGO) for the member countries of BOBP-IGO to be held during 25-04-2011m to 07-05-11 at CMFRI, Kochi,

Training Manual

2014

1. Rekha J. Nair. 2014. Training Manual on Biology and Identification of Demersal Fishes, 175 pp.

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1. Thomas, Sujitha and Dineshbabu, A P and Rohit, Prathibha and Sasikumar, Geetha and Rajesh, K M and Sulochanan, Bindu 2013. Training Manual on Capture Based Aquaculture Practices. Manual. Central Marine Fisheries Research Institute, Mangalore.
2. Thomas Sujitha and Rohit, Prathibha 2013. Training Manual on Impact of aggregating devices on cuttlefish fishery.
3. Thomas Sujitha 2013. Capture based aquaculture of red snapper *Lutjanus argentimaculatus* in cages. In Course Manual for Customized Training in Mariculture for Maldivian Officials. p147.
4. Sasikumar Geetha, Dineshbabu, A P, Rajesh K M, Sulochanan Bindu, Swathi Lekshmi, P S, Rohit, Prathibha Thomas Sujitha , Rajesh K M, Sasikumar Geetha, Dineshbabu, A P (2013). Training Manual on Taxonomy of exploited marine fishery resources
5. Kizhakudan, Shoba Joe. 2013. Data processing and its applications in fisheries management. BOBP-IGO Fifth Regional Training Course on Code of Conduct for Responsible Fisheries, 19 January-02 February 2013 Chennai, India, Training Manual Working Paper.

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1. Zacharia, P. U. and Najmudeen, T. M. 2012. *Marine Finfish Resources of India: Distribution, Commercial Exploitation, Utilization Pattern and Trade*. In: World Trade Agreement and Indian Fisheries Paradigms: A Policy Outlook, 17-26 September 2012, Kochi.
2. Kizhakudan, Shoba Joe. 2012. Basics of fish stock assessment & estimation of effort. BOBP-IGO Fourth Regional Training Course on Code of Conduct for Responsible Fisheries, 11 July, 2011 Chennai, India, Training Manual Working Paper.
3. A.P.Dineshbabu, Prathibha Rohit and Sujitha Thomas, 2012 (Eds.). Manual for the workshop "GIS based resource mapping and abundance of finfish and shellfishes off Indian coast". 17-18 August, 2012. Central Marine fisheries Research Institute, p 36.

Books

2013

1. Swathi Lekshmi, P. S., Dineshbabu, A. P., Purushottama, G. B., Sujitha Thomas, Geetha Sasikumar, Prathibha Rohit, Vivekanandan, E. and Zacharia, P. U. 2013 *Indigenous Technical Knowledge (ITKs) of Indian Marine Fishermen with reference to Climate Change*. Central Marine Fisheries Research Institute, Kochi. 124 p.

2012

2. Manisseri, Mary K and Antony, Geetha and George, Rani Mary and Nair, Rekha J and Joshi, K K and Geetha, P M (2012) *Marine Biodiversity Museum (A Designated National Repository) Catalogue*. CMFRI Special Publication, 107 . Central Marine Fisheries Research Institute, Kochi, pp. 1-222.

2011

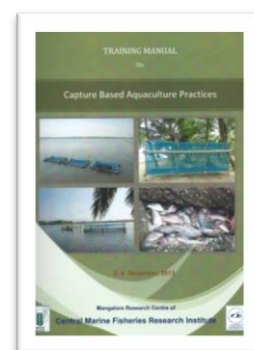
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2010

2. Vivekanandan, E., Narayanakumar, R., Najmudeen, T.M., Jayasankar, J. and Ramachandran, C. 2010. Marine Fisheries Policy Brief 2- Seasonal Fishing Ban. *CMFRI Special Publication No.103*. 44p.

PRODUCTION PROCESS, TECHNOLOGIES DEVELOPED AND BENEFICIARIES

1. **Book on Marine Finfishes of Karnataka** – an illustrated compendium : CMFRI /special publication No 113. Authored by Sujitha Thomas, Prathibha Rohit, Geetha Sasikumar, K. M. Rajesh, A.P. Dineshbabu and P.U. Zacharia. The book deals with an illustration of 441 species of finfishes landed along the coast of Karnataka. The book is a reference for fishers, fish merchants, fisheries officials and exporters and students as it illustrates the fishes along with the local names.
2. **Training Manual on Capture based Aquaculture practices:** authored by Thomas, Sujitha and Dineshbabu, A P and Rohit, Prathibha and Sasikumar, Geetha and Rajesh, K M and Sulochanan, Bindu. The manual gives details of small scale cage farming in estuaries, The book is useful for prospective fish farmers, entrepreneurs, fishers, fisheries officials and students.
3. **Prepared a Poster on Reef fishes of India - Groupers** and is on sale through ATIC. 37 groupers collected from different parts of India are presented with both scientific and common names.. Beneficiaries include researchers, students, export units, research institutes etc.



4. **Prepared a Poster on Reef Associated Perches of India** - prepared for sales through ATIC. 44 reef fishes collected from different parts of India are presented with both scientific and common names. Beneficiaries include researchers, students, export units, research institutes etc.

AWARDS/HONOURS

2014

1. Best Poster Award (3rd) in the National Conference "Strategies for bridging yield gap in Fisheries and Aquaculture" organized by Professional Fisheries Graduates Forum (PFGF), India, NFDB, Hyderabad, COFAA, Mangalore and AFSIB during 24-25 March, 2014 at the College of Fisheries, Mangalore, Karnataka

2013

1. Zacharia P.U., Rekha J. Nair, Somy Kuriakose, Jayasankar J., Dinesh Kumar, S., Dinesh Babu, A.P., Sujitha Thomas, Shoba Joe Kizhakudan, Najmudeen, T.M., Anulekshmi Chellapan and Mohammed Koya, K. 2013. Distributional shift of pelagic Indian oil sardine and Indian mackerel towards northern Indian Ocean: a climate change induced scenario? *BEST PAPER awarded at ECOCASD 2013 – Second International Conference on "Ecosystem Conservation and Sustainable Development", 3-5 October 2013, Thiruvananthapuram, Kerala, India*
2. G.B. Purushottama, Thakurdas, C. Anulekshmi, Shoba Joe Kizhakudan, P.U. Zacharia and V.D. Deshmukh. 2013. Fishery and biology of *Rhizoprionodon oligolinx*, Springer, 1964, (Family: Carcharhinidae) exploited along north-west coast of India. *BEST POSTER (Third) awarded at the National conference on "Strategies for bridging the yield gap in fisheries and aquaculture", 24-25 March 2014, College of Fisheries, Mangalore, Karnataka, India.*
3. Sujitha Thomas* and Dineshbabu A.P 2013. GIS based resource mapping of fishery resources to reduce CO2 emission by multiday trawlers. In International symposium on Greening Fisheries held at Kochi from 21-23 May 2013. (Received best paper award)

2011

1. Purushottama, G. B., Best Poster Award (2nd) in the category of Genetics, Breeding and Biotechnology at 9th Indian Fisheries Forum, Chennai during 19-23 December, 2011.
2. Zacharia P.U. 1st prize for best poster award for at 9th IFF Chennai during Chennai 2011 for the poster "Low value bycatch and discard associated with bottom trawling at Tuticorin Fishing harbor, Gulf of Mannar coast". Poster No. FRP.52 presented at 9th IFF, 18-23 December, 2011.

INFRASTRUCTURE AND PHYSICAL FACILITIES DEVELOPED


1. Central Fishery Biology Laboratory (Under NICRA Project)

The Central Fishery Biology Laboratory of the institute was established with a view to centralize all the fishery biology as well as phonological studies for NICRA project with the fresh specimens collected from various landing centres and onboard fishing vessel. The facility now being used by all the scientists and technical staff and research fellows of Pelagic, Crustacean, Demersal, Fishery Environment, Marine Biodiversity Divisions and Research fellows of NICRA Project. Division scientists have actively engaged in designing and establishing different facilities necessary for the laboratory, such as storage spaces and high quality stainless steel fish dissection tables so as to enable the use of the laboratory by the concerned persons at high standards.

2. CMFRI Research Vessel F. V. Silver Pompano (Under NICRA Project)

As part of the project, CMFRI has procured a 19.75 m OAL fisheries research vessel *F.V. Silver Pompano* for carrying out fisheries related research in the territorial waters. The vessel shall

be used for trawl fishing - both bottom and midwater trawling using Issac-Kid Mid-water Trawl system and collection of oceanographic parameters and marine biotic and abiotic samples from the sea towards climate change related studies. The vessel is equipped with underwater CTD sampler, Doppler current meter, instruments for chlorophyll measurements, zooplankton, TSS and sediment sampling. The vessel has a laboratory for preliminary analysis and to fix the samples for further analysis. The laboratory will be further equipped with modern instruments and highly sensitive microscopes for fishery and oceanographic research. An automatic weather station is available to collect the atmospheric parameters like rainfall, humidity etc.

Specifications of F.V. Silver Pompano	
Length Over All	19.75 m
Breadth (mxm)	5.50-6.0 m
Depth	2.80 m
Draft (mxm)	2.00 m
Free running speed	10 knots
Endurance	10 days/100 nautical miles
Scientists	Two
Crew	8
Classification	IRS SUL "Fishing vessel" IY
Type of fishing	Trawling
	

FREQUENCY OF STAFF MEETING

Meetings with Staff meetings of the division were held every month in which various issues related to both scientific and non-scientific matters were discussed and proceedings were maintained in the Division.

Participation of scientific staff in national and international conferences

Zacharia P.U.

1. Attended the BOBLME Regional Fisheries Management Advisory Committee meeting at Bangkok, Thailand during 25-26 June 2012.
2. Attended the BOBLME Marine Protected Area Working group meeting at Penang, Malaysia during 11-12 February 2014.

Dr. K.S Sobhana

1. Three months International training in Frontier areas of Agricultural Sciences on “Stem Cell Research” during 1st April to 30th June 2011 under the HRD programme of NAIP (Component-1) at the Stem Cell Research Centre, W. M. Keck Centre for Collaborative Neuroscience, Rutgers, the State University of New Jersey, USA.
2. Indo-UK joint panel meeting to conduct peer review on the DBT-BBSRC (Biotechnology and Biological Sciences Research Council, UK) joint call for collaborative research proposals held during 5th to 6th September, 2013 in London, UK

Najmudeen, T.M.

1. Netherlands Fellowship Programme (NFP) fellowship offered by NUFFIC, Netherlands to attend a shortcourse on “Climate change governance: adaptation and mitigation as institutional change processes” at Wageningen University UR, Netherlands during 02- 13, September 2013.

LINKAGES

a. Collaboration with local institutions in the area (educational, research and infrastructural facilities)

- Fishery Survey of India
- CUSAT
- KUFOS
- CIFNET
- University of Calicut

b. National Institutes and agricultural Universities

- Central Institute of Dryland Agriculture (CRIDA)
- Central Institute of Brackishwater Aquaculture (CIBA)
- Central institute of fishery Technology (CIFT)

c. International Institutions

- Bay of Bengal Large Marine Ecosystems (BOBLME)
- Wageningen University
- Australia India strategic Research Fund

d. Extension and development agencies

- ADAC
- National Institute for Rural Development
- Krishi Vigyan Kendra

e. Research/ extension linkages

TRAINING PROGRAMMES ORGANISED

Date	Subject	Beneficiaries	Source of fund	Duration
18 -21 February 2014	Training Course on Biology and Identification of Demersal Finfishes conducted by Demersal Fisheries Division	University students State fisheries officials CMFRI staff	HRD, CMFRI	4 days
28-29 November, 2013	Methodology Workshop" under the project "Development of Fishery Management Plans for Sustaining Marine Fisheries of Kerala and	Associates of FMP projects	Institute	2 days

	Lakshadweep"			
23-25 February 2012.	Introduction to fish biology and taxonomy of demersal finfishes"	University students State fisheries officials CMFRI staff	Institute fund	3 days
11-13 December 2012.	Inception Workshop for the Project "Assessment of Elasmobranch Resources in the Indian Seas" at Madras RC of CMFRI	Associates of elasmobranch project	Institute fund	3 days

CONSULTANCIES

Installation of Artificial Reefs in the inshore waters of Tamil Nadu (IFAD) for Tamil Nadu State Fisheries Department at a cost of 52 lakhs. Deployment of reef structures completed under first 3 projects in six coastal districts of Tamil Nadu.

