CRUSTACEAN FISHERIES DIVISION

QRT BACKGROUND INFORMATION

2009-2014

1. Introduction

The Technical mandate of the Crustacean Fisheries Division is:

- Assessment of fishery and resource characteristics of penaeid and non penaeid shrimps, lobsters and crabs landed along different maritime states of the Indian coast.
- Stock assessment of major exploited crustacean resources for each maritime state along the Indian coast.
- Development of fisheries management advisories for Maharashtra.
- Evaluation of bycatch and discards landed by trawlers and assess the impact on fishery resources.
- Development of management strategies for sustaining the crustacean fisheries and yield at optimum levels for different maritime states.
- During the period 2009-12, the Division has completed three inhouse projects, one divisional project on Recruitment dynamics of Penaeid shrimps along the Indian coast and two inter divisional projects entitled "Management Advisories for sustaining marine fisheries of Maharashtra" and "Resource damage assessment in marine fisheries: impact of selective fishing of juveniles and bycatch and discards in trawl fisheries".
- During 2009-12 the scientists of CFD also associated with 11 inter divisional projects operated by other divisions.
- During 2012-2014 the division has implemented two on-going inter divisional projects, one on Development of fishery management plans for sustaining marine fisheries of Maharashtra and the other on GIS based resources mapping of distribution and abundance of finfishes and shellfishes off Indian Coast for suggesting operational based strategies for fisheries management.
- During 2012-14 the scientists of this division also associated with nine inter divisional project operated by other divisions.
- During 2009-14 the division has implemented two funded projects and three consultancy projects. The scientists of this division also associated with six funded projects and six consultancy projects operated by other divisions.
- The division has published two books, four special publications and two posters.

2. STAFF STRENGTH:

LIST OF SCIENTISTS OF THE DIVISION AND THEIR PLACE OF POSTING (2009-14)

Sl.No	Name	Designation	Place of posting	Date of superannuation	Remarks
1.	Dr.G.Maheswarudu	Principal Scientist& Head, CFD	Visakhapatnam/ Cochin	31.7.2019	Scientist-in-Charge, VRC of CMFRI, Visakhapatnam up to 14-05-2013. Assumed charge as Head (ASRB selection), CFD from 16-05-2013 onwards.
2	Dr.E.V.Radhakrishnan	Principal Scientist & Head, CFD	Cochin	31.01.2012	Retired on 31-01-2012.
3	Dr.Josileen Jose	Principal Scientist	Cochin	31.05.2029	Transferred from Mariculture Division to CFD w.e.f. 14-06-2010.
4	Dr.S.Lakshmi Pillai	Senior Scientist	Cochin	30.09.2032	Transferred from Chennai to Kochi in 2010
5	Dr.Rekhadevi Chakaraborty	Senior Scientist	Cochin	30.04.2038	
6	Gyanaranjan Dash	Scientist	Mumbai/ Veraval	31.05.2046	Working in CFD from 14-06-2010 onwards.
7	Dr.V.D.Deshmukh	Principal Scientist & SIC	Mumbai	31.01.2014	Retired on 31-01-2014.
8.	Dr.K.K.Philippose	Principal Scientist & SIC	Karwar	30.09.2017	Transferred from CFD to Mariculture Division w.e.f. 15-05-2012.
9	Dr.A.P.Dineshbabu	Principal Scientist	Mangalore	31.07.2025	SIC, MRC of CMFRI, Mangalore up to 13.09.2013.
10	Mrs. P.T. Sarada	Senior Scientist	Calicut/ Tuticorin	31.05.2023	Transferred from Calicut to Tuticorin on 09-08-2010.
11	Mrs.K.N.Saleela	Scientist(SS)	Vizhinjam	30.04.2028	
12	Dr.E.Dhanwanthari	Scientist	Tuticorin	31.07.2030	On long leave and terminated from service w.e.f 10-04-2013.
13	Dr.M.Rajamani	Principal Scientist	Mandapam	31.05.2010	Retired on 31-05-2010.
14	Indira Divipala	Scientist	Chennai	28.02.2045	Working in CFD from 23-04-2012 onwards.
15	Rajendra Naik	Scientist	Visakhapatnam	30.04.2047	Working in CFD from 27-04-2012 onwards.

3. RESEARCH PROGRAMMES:

IN-HOUSE DIVISIONAL RESEARCH PROJECTS

Sl. No	Projects	Principal Investigator	Location	Period
1.	Management Advisories for sustaining marine fisheries of Maharashtra (CF/IDP/01)	V.D.Deshmukh	Mumbai,	2007-2012
2.	Recruitment dynamics of Penaeid shrimps along the Indian coast. (CF/RE/03)	V.D.Deshmukh	Mumbai, Kochi, Vishakapatnam, Chennai, Tuticorin, Mangalore.	2009-2012
3..	Resource damage assessment in marine fisheries: impact of selective fishing of juveniles and bycatch and discards in trawl fisheries. (CF/IDP/02)	E.V.Radhakrishnan	Kochi, Veraval, Mumbai, Mangalore, Calicut, Mandapam, Vishakapatnam	2007-2012
4	Development of fishery management plans for sustaining marine fisheries of Maharashtra. (FISHCMFRISIL20121000010)	V.D.Deshmukh	Mumbai,	2012-2017
5.	GIS based resources mapping of distribution and abundance of finfishes and shellfishes off Indian Coast for suggesting operational based strategies for fisheries management. (FISHCMFRISIL201200900009)	A.P.Dineshbabu	Veraval, Mumbai, Karwar, Mangalore, Calicut, Kochi, Vizhinjam, Tuticorin, Chennai, Visakhapatnam	2012-2017

INHOUSE INTERDIVISIONAL PROJECTS IN WHICH CFD SCIENTISTS ASSOCIATED

Sl.No	Projects	Investigators	Location	Period
1.	Development of management advisories for sustaining marine fisheries of Gujarat ((DEM/ IDP/02)	G. Mohanraj, PI Subhadeep Ghosh, PI **Gyanranjan Dash, Co PI**	Veraval	2009-12
2.	Management advisories for sustaining marine fisheries of Karnataka and Goa(PEL/IDP/02)	**A.P.Dineshbabu, PI** Prathiba Rohit, PI A.P.Dineshbabu, Co- PI	Mangalore, Karwar	2009-12
3.	Management advisories for sustaining marine fisheries of Kerala and Lakshadweep (PEL/IDP/01)	N.Gopalakrishna Pillai, PI **E.V.Radhakrishnan, Co - PI** **P.T.Sarada, Co-PI** **K.K.Philipose, Co-PI** **Josileen Jose, Co-PI** **Rekha Devi Chakraborty, Co-PI** **S. Lakshmi Pillai, Co-PI** **K. N. Saleela, Co-PI**	Kochi, Calicut, Vizhinjam	2009-12
4.	Management advisories for sustaining marine fisheries of Tamil Nadu and Puducherry (DEM/IDP/ 01)	P.U. Zacharia, PI **M.Rajamani, Co-PI** **P.T.Sarada, Co-PI** **K.N.Saleela, Co-PI**	Mandapam, Tuticorin, Chennai	2009-12
5.	Management advisories for sustaining marine fisheries of Andhra Pradesh (AP/MF/CAP/01)	G.Syda Rao, PI Prathiba Rohit, PI **G.Maheswarudu, PI& Co-PI**	Vishakapatnam	2009-12
6.	Biotechnological applications in mariculture and conservation. (PNP/BIOT/02)	P.C.Thomas, PI **Rekha Devi Chakraborty, Co-PI**	Kochi	2009-2012
7.	Technology development for the seed production of shellfish (MD/IDP/01)	Manmadhan Nair, PI **E.V.Radhakrishnan, Co.PI** **Josileen Jose, Co-PI**	Calicut, Kochi, Mandapam, Chennai	2009-2012

8.	Innovations in sea cage farming and development of sustainable capture based aquaculture (CBA) systems (MD/IDP/04)	G. Syda Rao, PI **V.D. Deshmukh, Co PI** **A.P.Dineshbabu, Co PI** **K.K. Philippose, Co PI** **G. Maheswarudu, Co-PI**	Kochi, Vizhinjam, Mandapam, Karwar, Visakhapatnam, Mangalore, Chennai and Mumbai	2009-2010
9.	Assessment of biodiversity and ecological impact in open sea cage farming (MBD/RE/05)	K. Vinod, PI **K.K. Philippose, Co PI** **A.P. Dineshbabu, Co PI**	Mandapam, Vizhinjam, Kochi, Mangalore and Karwar	2009-2012
10	Sustainability profiling of major fisheries off Kerala – a multi-dimensional scaling approach (FRAD/IDP/01)	J. Jayasankar, PI **P.T. Sarada, Co-PI**	Kochi, Calicut	2009 -2010
11.	Pathogen profiling, diagnostics and health management in maricultured fin fish and shell fish **(MBTD/PATH/01**)	K.K. Vijayan, PI **K.N. Saleela, Co-PI** **Rekha Devi Chakraborty, Co-PI**	Kochi, Chennai, Mandapam, Vizhinjam and Veraval	2009-2010
12.	Development of Fishery Management Plans for Sustaining Marine Fisheries of Gujarat. **(FISHCMFRISIL 201200400004)**	K. Mohammed Koya, PI **Gyanranjan Dash, Co PI**	Veraval	2012-2014 ongoing
13.	Development of fishery management plans for sustaining marine fisheries of Karnataka and Goa. (**FISHCMFRISIL 201200600006)**	Prathibha Rohit, PI **A.P.Dineshbabu, Co-PI**	Mangalore Karwar	20012-2014 ongoing
14.	Development of Fishery Management	P.P Manojkumar **Josileen Jose, Co-PI** **Rekha Devi Chakraborty,**	Kochi, Calicut, Vizhinjam	20012-2014 ongoing

	Plans for Sustaining Marine Fisheries of Kerala and Lakshadweep. **(FISHCMFRISIL 201200300003)**	**Co-PI** **S. Lakshmi Pillai, Co-PI** **K. N. Saleela, Co-PI**		
15.	Development of Fishery Management Plans for sustaining Marine Fisheries of Tamil Nadu and Puducherry. **(FISHCMFRISIL 201200800008)**	M.Sivadas, PI **P.T. Sarada, Co-PI** **Indira Divipala, Co-PI** **K. N. Saleela, Co-PI**	Mandapam, Tuticorin, Chennai	20012-2014 ongoing
16.	Development of Fisheries Management Plans (FMPs) for Sustaining marine fisheries of Andhra Pradesh. (**FISHCMFRISIL 201201100011)**	P.Laxmilatha, PI M. Muktha, PI **G. Maheswarudu, Co-PI** **Rajendra Naik, Co-PI**	Visakhapatnam	20012-2014 ongoing
17.	Remote sensing assisted oceanologic biodynamic forecasting paradigm for Indian marine resources. **(FISHCMFRISIL 201200200002)**	J. Jayasankar, PI **Gyanranjan Dash, Co PI** **Indira Divipala, Co-PI** **Rajendra Naik, Co-PI**	Veraval Mumbai Mangalore Cochin Tuticorin Mandapam Chennai Visakhapatnam	2012 – 2014 ongoing
18.	Trawl fishery of the North east coast of India: An appraisal. **(FISHCMFRISIL 201203200032)**	Shubhadeep Ghosh, PI **G. Maheswarudu, Co-PI** **Rajendra Naik, Co-PI**	Visakhapatnam Paradeep Digha	2012-2014 ongoing
19.	Development of tissue culture technology for *in vitro* production of pearls from the blacklip pearl oyster *Pinctada margaritifera* and	K.K. Vijayan, PI **Indira Divipala, Co-PI**	Kochi Tuticoprin Chennai	2012-2014 ongoing

	refinement of in vitro pearl formation in *Pinctada fucata.* **(FISHCMFRISIL 201202900029)**			
20	Innovations in sea cage farming and coastal mariculture **(FISHCMFRISIL 201202500025)**	**K.K.Philipose, PI** **A.P.Dineshbabu, Co.PI**	Veraval Karwar Mangalore Calicut Kochi Mandapam Visakhapatnam	2012-2014 ongoing

DIVISIONAL FUNDED AND CONSULTANCY PROJECTS

Sl. No	Projects	Principal Investigator	Location	Period	Remarks
	Funded projects				
1.	NAIP project on 'A value chain on oceanic tuna fisheries in Lakshadweep sea'	**Dr. E.V.Radhakrishnan - CPI**	Cochin	2008-2012	Project has been transferred to PFD after retirement of CPI.
2.	DST project on "Integrative Taxonomy of Deep sea shrimp resources along the southern coast of India"	**Dr. Rekhadevi Chakraborty, PI**	Cochin	2012-2016.	On going
	Consultancy projects				
1	**PROJECT:** "Rapid assessment of fishery resource of Vasishti river estuarine system and possible impact of intake and discharge of water from thermal power plant on it" **CLIENT:** M/s National Institute of Oceanography, Dona Paula, Goa-403004. **PROJECT COST: Rs. 14, 64, 630/-**	**V.D. Deshmukh, PI**	Mumbai		Completed
2	Development of fresh water, brackish water and marine aquarium at	**K.K.Philipose, PI**	Surat, Gujarat	2009-2014	PI transferred from CFD

	Surat. **CLIENT:** Surat Municipal Corporation, Surat, Gujarat.				to Mariculture Division w.e.f. 15-05-2012.
3	Monitoring chemical parameters of the effluent and hydro-biological conditions in the Arabian Sea off Chithrapur near the marine outfall of M/s. Mangalore Refinery & Petrochemicals Ltd., Mangalore. **Client:** of M/s. Mangalore Refinery & Petrochemicals Ltd., Mangalore. **Project cost:** Rs. 9 lakh	**A.P. Dineshbabu, PI**	Mangalore	2009-2010	Completed

INTERDIVISIONAL FUNDED AND CONSULTANCY PROJECTS

Sl. No	Projects	Principal Investigator	Location	Period	Remarks
	Funded projects				
1.	MoA project on ' Open sea floating cage demonstration farm for R&D in marine fish and shell fish production	G. Syda Rao, PI **G. Maheswarudu, Co-PI** **K.K. Philipose, Co-PI**	Visakhapatnam Mandapam, Vizhinjam Karwar	2005-2011	Completed
2.	NFDB project on " Open sea cage culture demonstration farms in India	G. Syda Rao, PI **V.D.Deshmukh, Co-PI,** **G.Maheswarudu, Co-PI** **K.K. Philipose, Co-PI** **A.P. Dinesh Babu, Co-PI**	Cochin Mangalore Karwar Chennai Kakinada Balasore Veraval Mumbai	2008-2010	Completed
3.	DAHD, Ministry of Agriculture funded programme " Marine Fisheries Census-2010"	M. Srinath, PI **V.D. Deshmukh, Co-PI** **K.K. Philipose, Co-PI** **A.P. Dineshbabu,Co-PI** **G. Maheswarudu,Co-PI**	Veraval, Mumbai Karwar Mangalore Visakhapatnam	2010.	Completed
4.	National Initiative on Climate Resilience in Agriculture, NICRA	E. Vivekanandan, PI **P.U. Zacharia, PI** **Gyanranjan Dash, CoPI**	Veraval, Mumbai Karwar	2011-2014	On-going

		V.D. Deshmukh, Co-PI **K.K. Philipose, Co-PI** **A.P. Dineshbabu, Co-PI** **G.Maheswarudu, Co-PI** **S. Lakshmi Pillai, Co-PI** **Indira Divipala, Co-PI** **Rajendranaik, Co-PI**	Mangalore Kochi Tuticorin Mandapam Chennai Visakhapatnam		
5	Flow of Matter through tropic levels and biogeochemical cycles in Marine and Estuarine ecosystems **(MoES/OOIS/ SIBER)**	Sujitha Thomas, PI **A.P.Dineshbabu, Co-PI**	Mangalore	2011-2012	
6	Establishment of sea cage farms for the 'Sidi' adivasi tribe of Saurashtra coast of Gujarat and transfer of technology of sea cage farming to the tribe as a livelihood support under the tribal sub plan (TSP)-2012-13 **(TSP: 2012-13)**	G. Syda Rao, PI **Gyanranjan Dash, CoPI**	Veraval	2012-14	On-going
	<u>Consultancy projects</u>				
1.	**PROJECT**: Marine Outfall Studies for Mumbai Sewage Disposal Project (MSDP) Phase II **CLIENT:** Mat Mc Donald Pvt. Ltd., Mumbai. **PROJECT COST**: **Rs.23,08,64000/-**	V.V. Singh, PI **V.D. Deshmukh, Co-PI**	Mumbai		
2.	**PROJECT**: Baseline Marine Ecology Study required as a part of an EIA Study for proposed expansion project at TPL, Trombay, Village Mahul, Mumbai. **CLIENT:** M/s Tata Consulting Engineers Ltd., Mumbai. **PROJECT COST**: RS. **46,19,569/-**	V.V. Singh, PI **V.D. Deshmukh, Co-PI**	Mumbai		
3.	**PROJECT**: Study on the use of Fly ash for manufacture of	P.Laxmilatha, PI **G. Maheswarudu,** Co-PI	Visakhapatnam		

	Artificial Reefs. **CLIENT:** Deputy Manager (AUD), NTPC, Simhadri Thermal Power Plant, Visakhapatnam **PROJECT COST**: **Rs. 9,19,471.**				
4.	**Project:** Impact assessment of multi-purpose reef at Howa beach at, Kovalam, Thiruvananthapuram on fishery resources of the area.**Client:** DOT, Govt.of Kerala. **PROJECT COST**: **7 lakh**	M.K. Anil, PI **K.N. Saleela, Co-PI**	Vizhinjam		Completed
5.	**Project:** Base line data collection and monitoring for environmental and social impact for the Vizhinjam International Sea port. **Client:**Asian Consultant Engineers, New Delhi. **Project cost:** **Rs.30 lakhs**	M.K. Anil, PI **K.N. Saleela, Co-PI**	Vizhinjam		Completed
6.	**Project:** Installation of artificial reefs at a selected site off Visakhapatnam coast, Andhra Pradesh. **Client:** Dept. of Fisheries, Govt. of AP **Project cost:** Rs. 30.3 lakhs	Love son Edward, PI **Rajendra Naik, Co-PI**		2013-2014	Ongoing

4. Achievements project wise:

1. *Management advisories for sustaining marine fisheries of Maharashtra* **(CF/IDP/01; 2007-2012)**

- The estimated marine fish landings in Maharashtra averaged for 2007-2012 were 3.06 lakh t that contributed 9.3% to 3.29 million t of total marine fish landings of the country. During the period the landings declined from 3.49 lakh t in 2008 to 2.4 lakh t in 2010. When compared to previous five year period (2002-06) the landings declined from 3.62 lakh t to 3.06 lakh t by 15.5% and correspondingly the percentage contribution of the state to the total landings of the country declined from 12.3% to 9.3%.

- The annual value of the marine fish landings in Maharashtra increased from Rs 1,259 crores in 2007 to 2,122 crores in 2011 despite of fluctuations in the annual landings. The average price of fish per kg increased from Rs 39.3 in 2007 to Rs 66.8 in 2011 with the annual rate (inflation) of 13.6%.

- The gear wise catch showed that almost the entire landings in Maharashtra were landed by mechanized boats (99%) and merely 1% by the non-mechanized crafts. The mechanized trawlers landed 47% of the total catch followed by *dol* netters (29%), purse seiners (11.9%), gill netters (11.3%), hooks and lines (0.3%) and non-mechanized boats landed 0.5%.

- Comparison of gear wise landings showed that share of trawlers slipped from 2.39 lakh t (65.1%) to 1.44 lakh t (47%) by 38.7% while *dol* net fishery showed improvement from 76,668 t to 88,824 t by 15.5%. The catch by purse seines and gill nets also showed 95.1% and 31.7% improvement respectively while non-mechanized traditional bag nets showed 40.2% decline. The non-mechanized shore seines (rampani) however, showed 5 fold increases due to high abundance of mackerel and oil sardine. The hooks and lines fishery has almost completely declined with very few operations showing 40.2% decline.

- The month wise total landings in the state showed two peaks, the major peak during November-December and minor during April-May. The CPUE also showed similar trend with two peaks in the same period.

- ***Resources*:** The major fishery resources were pelagic (34.7%), demersal (30.2%), crustacean (29.8%) and molluscan (5.4%). A comparison with 2002-2006 shows that excepting for pelagic resources which improved by 9.6%, the rest declined; demersals declined by 29.5%, mollusks by 30.4% and crustaceans by 17.6% as against previous quinquennium.

- The annual average catch of important resources showed that ribbonfish catch declined by 55%, perches by 42.3%, eels by 36%, threadfin breams by 35.5%, penaeid prawns by 34.8%, anchovies by 30.6%, cephalopods by 28.7%, lobsters by 26.1%, pomfrets by 24.7% and bombayduck by 24.3%. But, the catch of oil sardine and mackerel increased by almost 1.5 folds. Owing to increase in catch of pelagic fishes, the purse seine fishery flourished as a result number of purse seiners increased in Maharashtra from 156 in 2005 to more than 580 in 2011.

- Decadal compounded growth rate (CGR) of marine fish landings from 1961 to 1990 increased at the rate of 3.2% annually, but slowed down to 0.41% during 1991-2000 and showed negative growth rate (-4.7%) during the past decade (2001-2010). The contribution of the State to total marine fish landings of India also declined from 19.6% in 1971-80 to 12.6% during 2001-10.

- Among the 25 resources investigated by CGR only 5 recorded positive growth rates (increasing trends) while the rest showed negative growth rates when compared to the previous decade. Half-beaks and full beaks (1.5%), tuna (1.2%), mullets (0.9%), mackerel (0.2%) and whitefish (0.3%) showed increasing growth rates (CGR) while ribbonfish (-16.4%), goatfish (-12%), eels (-9.5%), elasmobranchs (-8.7%), seer fishes (-8.3%), pomfrets (-7.7%), unicorn cod (-6.4%), perches (-5.9%), flatfishes (-2.8%), lizardfish (-2.8%), threadfins (-2.4%), cephalopods (-1.9%), catfish (-1.2%) and carangids (-0.1%) showed negative growth rates.

Rapid stock assessment: Rapid assessment (Mohamed *et al*., 2010) of 25 stocks in Maharashtra during 2007-2011 showed that 8% were abundant, 28% less abundant, 56% declining, 4% depleted and 4% in collapsed state and their contribution to the maximum landings in the state were 9.6%, 56.5%, 30.5%, 0.16% and 0.08% respectively.

- MSY and Fmsy for shrimps targeted by trawlers were estimated by using 22 years of time series data with standardized trawling effort (in hours) and catch rate. Based on MSY (44,647 t) and Fmsy (7.75 million trawling hours) the optimum

number of trawlers in the state was computed at 2,778 as against present fleet of 5,613 (CMFRI, 2010). This indicated that the state has overcapacity in the trawling fleet.

- For the penaeid shrimp stock, the MSY estimated by Schaefer-Fox model was 44,647 t and the trawling effort (Fmsy) to harvest it was 7.75 million trawling hours while the prevailing trawling effort was very close to Fmsy (7.21 million hrs). Yet, the annual average yield during the same period was 30,053 t. This discrepancy is attributed to economic compulsions that regulated trawling operations for shrimps in the state. It was noticed that shrimp prices remained stable due to flooding of international markets by the cultured shrimps from aquaculture industry, but at the same time fuel prices increased every year as a result the operational cost increased and the profit margin plummeted for the capture fishery as a result fishers laid up the shrimp trawlers whenever the catch rates of shrimps declined below the breakeven point. A few trawlers continued with fish trawl operations to catch threadfin breams and sciaenids which had better prospects owing to demand for the export oriented 'Surumi' products and frozen fish.

- Analysis of Indian mackerel landings in Maharashtra also showed 7-9 year cycles of abundance. Considering the lowest biomass during the lean years of the cycles, the MSY and Fmsy were estimated at 29,547 t and 5,46,875 fishing hours by purse seiners. The estimated optimum fleet size for regulation of purse seine fishery in the state is 182 against the present fleet of over 500 in 2011.

- With Schaefer-Fox model MSY for the shrimps, the optimum fleet size for trawlers is estimated at 2,770 whereas the present fleet is 5600 trawlers which clearly indicated that there is overcapacity in the trawling sector in the State.

Length based stock Assessment of fish resources: Stock assessment by analytical length based model for 36 species of commercially important finfishes, elasmobranchs, crustaceans and cephalopods during 2007-11 showed that 25 (70%) were over-exploited ($E>E_{max}$).

Population parameters and Stock Assessment of exploited marine fishery resources of Maharashtra.

Species Name	L_∞ mm	K (annual)	Z	M	F	E	E_{max}	Remarks
Bombay duck	400	0.75	4.01	1.37	2.64	0.66	0.60	over-exploited
Coilia dussumieri	214	1.45	4.38	2.5	1.88	0.43	0.55	under-exploited
S. longiceps	197	1.0	5.6	2.02	3.58	0.64	0.68	under-exploited
R. kanagurta	280	1.3	7.93	2.16	5.77	0.73	0.69	over-exploited
Arius dussumieri	658	0.58	3.48	1	2.48	0.71	0.55	over-exploited
Arius tenuispinis	597	0.4	1.41	0.81	0.6	0.43	0.58	under-exploited
Arius caelatus	564	0.58	2.07	1.05	1.02	0.49	0.59	under-exploited
O. militaris	598	0.65	2.17	1.11	1.06	0.49	0.52	under-exploited
N. japonicus	350	0.91	4.89	1.61	3.28	0.67	0.46	over-exploited
N. mesoprion	284	0.84	3.78	1.62	2.16	0.57	0.53	over-exploited
J.macrorhynus	346	0.65	3.82	1.29	2.53	0.66	0.62	over-exploited
J.vogleri	392	0.5	3.21	1.05	2.16	0.67	0.60	over-exploited
J. sina	276	1.19	4.86	2.05	2.81	0.58	0.58	Opt. exploited
O. cuvieri	414	0.88	4.44	1.5	2.94	0.66	0.56	over-exploited
P. diacanthus	1420	0.52	1.65	0.74	0.91	0.55	0.43	over-exploited
O. biauritus	1820	0.51	3.78	0.7	3.08	0.81	0.42	over-exploited
E. diacanthus	560	0.62	7.9	1.13	6.77	0.86	0.49	over-exploited
S.laticuadus (♂)	610	0.52	1.77	0.96	0.81	0.46	0.60	under-exploited
S.laticuadus (♀)	638	0.54	1.69	0.97	0.72	0.43	0.73	under-exploited
P. argeneus	355	0.76	2.93	1.22	1.71	0.58	0.53	over-exploited
S. tumbil	494	0.73	2.64	1.26	1.38	0.52	0.52	Opt. exploited
P. heptadactylus	300	0.63	4.23	1.32	2.91	0.69	0.58	over-exploited
P. stylifera (♂)	115	1.8	8.3	3.45	4.85	0.58	0.68	under-exploited
P. stylifera (♀)	147	1.8	12.47	3.2	9.27	0.74	0.64	over-exploited
M. affinis (♂)	163	1.9	7.47	3.22	4.25	0.57	0.66	under-exploited
M. affinis (♀)	210	1.7	11.48	2.79	8.69	0.76	0.65	over-exploited
S. crassicornis(♂)	108	1.9	7.31	2.82	4.49	0.61	0.70	under-exploited
S.crassicornis (♀)	129	1.9	6.4	3.44	2.96	0.46	0.64	under-exploited
M. monoceros (♂)	200	1.8	7.2	2.94	4.26	0.59	0.64	under-exploited
M. monoceros (♀)	233	1.7	5.27	2.71	2.56	0.49	0.61	under-exploited
P. merguensis (♂)	205	2.0	12.36	3.13	9.23	0.75	0.665	Over-exploited
P. merguiensis	252	1.9	8.1	2.85	5.24	0.65	0.643	Over-exploited
N. tenuipes (♂)	73	1.42	7.4	3.33	4.07	0.55	0.53	Over-exploited
N. tenuipes (♀)	79	1.50	6.8	3.38	3.42	0.51	0.50	Over-exploited
L. duvaucelli	370	0.95	4.15	1.86	2.29	0.55	0.55	Opt. exploited
S. aculeata	206	1.05	6.52	2.01	4.51	0.69	0.60	over-exploited
S. inermis	106	0.52	2.72	1.2	1.52	0.56	0.56	Opt. exploited
S. pharonis	430	0.77	5.66	1.59	4.07	0.72	0.55	over-exploited
C. indicus	250	0.91	2.73	1.22	1.51	0.55	0.65	under-exploited

2. *Resource damage assessment in marine fisheries: impact of selective fishing of juveniles and bycatch and discards in trawl fisheries* (CF/IDP/02).

OBJECTIVE 1 : To estimate the quality and quantity of landed low-value bycatch and discards by commercial trawlers at major landing centres and to evaluate potential bycatch problems.

It was observed that even though trawl is a non-selective gear there is a targeted fishery in each season. Major targets are shrimps, cephalopods and high valued demersal fishes. High opening bottom trawls, midwater trawls and semi-pelagic trawls are operated which target semi-pelagic and pelagic fishes. In the early years of trawling the depth of operation was limited to 30 to 50 m with the voyage time of 5 to 8 hours. The entire catches were brought to the shore and similar scenario is continuing in single day operating vessels in many landing centres. In the case of multi-day operating vessels it was observed that the comparative economic viability of bringing the fish in preserved form or in non-preserved form depends on the demand for the species in the landing centre.

The estimated all India trawl landing show an increasing trend during the period of study. Average all India trawl landing for the period 2008-2011 is 17,21,000 t with a maximum of 20,27,000 t in 2011 which formed 51 % of the total marine fish landing in the country. In this about 51 % of the catch was contributed by west coast and remaining by east coast of India. The trawl contribution in the total fish landing of the country in 2008, 2009, 2010 and 2011 were 45, 51, 52 and 53 percent, respectively. Gujarat accounted for 20% of trawl landing of the country of which 42% is landed at Veraval fisheries harbor. Likewise, Karnataka account for 11% of the country's trawl landing and of which 54% landed in Mangalore fisheries harbor. In the east coast of India, Andhra Pradesh accounted for 9% of Indian trawl landing of which Visakhapatnam fisheries harbor accounted for 51%. It was observed that even though the total landing by trawlers showed steady increase during 2009-2011, similar increase was not reflected in the edible portion of the landing, which was fluctuating around 3 lakh t. The non-edible portion of the landing steadily increased from 50,000 t. in 2008 to 1 lakh t in 2011. Overall analysis of the trawl centres of Indian coast showed that the LVB percentage in the total landed fish was 16% in 2008 which has increased to 27% in 2011.

Discarded bycatch in the trawl fishery

With participatory data collection method by participating in the cruise and training the crews in data collection at Veraval, Mangalore, Calicut and Visakhapatnam fisheries harbours, an estimate of the percentage of discard was made. In 2008, the estimated discard percentage constituted 18% of the total trawl catch (which formed 22% of the trawl landing) at Mangalore, which came down to 6% in 2011, whereas in Calicut, In Calicut discarded bycatch was 15% of the total trawl catch (17% of the trawl landing) which came down to 4% in 2011. At Veraval, since there was no restriction of the landing of trash in any form of deterioration, it was assumed that there is no discards from the trawlers. But by the participatory data collection program, it was observed that from August to December, the fishes caught are discarded and the discard percentage in 2011 was estimated at 10% of the total trawl catch. In Visakhapatnam the discarded bycatch was 22% and the percentage of discard remained same during the period of study. In Mumbai 15% of the bycatch was presumed to be discarded since there was restriction on trash fish landing in deteriorated form and the average trash landing was only 7%. In Chennai, reported discard was very nominal (1%).

Low value bycatch (LVB) landing

At Veraval, Gujarat it is a regular trend to land most of the fishes caught by trawlers and the LVB landing during the study showed a steady increase from 24% to 33%. At Veraval fisheries harbour a very efficient market chain exists for the LVB which encourages trawl operators to bring as much trash as possible for landing. Onboard participatory studies conducted during 2011 revealed that during the year, 10.44% of the catch was discarded at Veraval during the monsoon and post monsoon months (August to December) when the demand for the trash fish is loo low due to erratic weather conditions. This was the general trend during the earlier years also but on introduction of modern technologies in fishing, the speed for the trawlers has increased and often the catches were more than the fish hold capacity. The trash landing at Veraval was more than 50,000 t in 2011. In major landing centres of Mumbai, Maharashtra percentage of trash fish landed remained around 5%, and the trash fish landed were only those caught during the last day of the voyage. In Mangalore, Karnataka as in other centres, single-day trawlers bring all the catch to shore and the trash consisted of 30 to 40 %of total catch. On the other hand, multiday trawlers

bring the trash in semi-preserved form suitable for fish meal and fertilizer producers. In Mangalore also a strong market chain exist for the LVB and the business is becoming a very prominent economic activity in fisheries of Karnataka. In Mangalore fisheries harbour the increase in trash landing was phenomenal, the trash landing which formed only 3% (3,000 t) of the trawl landing in 2008 increased to 26% of the total fish landed (12,000t) in 2011, the percentage of LVB was 3, 14, 21, 26 in 2008, 2009, 2010 and 2011 respectively. This increase in LVB landing was the result of increased demand from an array of fish meal plants operating all along the Karnataka coast. In Karwar the LVB landed by single day operating trawls was about 42 % (2,310 t) in 2011. In Calicut also there was high demand for the LVB by fishmeal plants and in this centre, LVB landing in 2011 was 12,000 t forming 26% of the landed catch. At Munambam fisheries harbour (in Kochi), the total estimated LVB landed in 2011 was 1,992 t forming 7.2% of total trawl landings and in Sakthikulangara fisheries harbour the estimated LVB in 2011 was 11% of the total landing. In Chennai, the observations on LVB was carried out at Kasimedu fisheries harbour and the estimated LVB landing was 13% (3,000 t) of the total landing in 2008 which increased to 17% in 2011(5,800 t). In Visakahapatnam, estimated LVB landed show a steady increase from 2% (705 t) of the landing in 2008 to 21% (19,000t) in 2011. Average discarded bycatch estimated during 2008-11 was 22%.

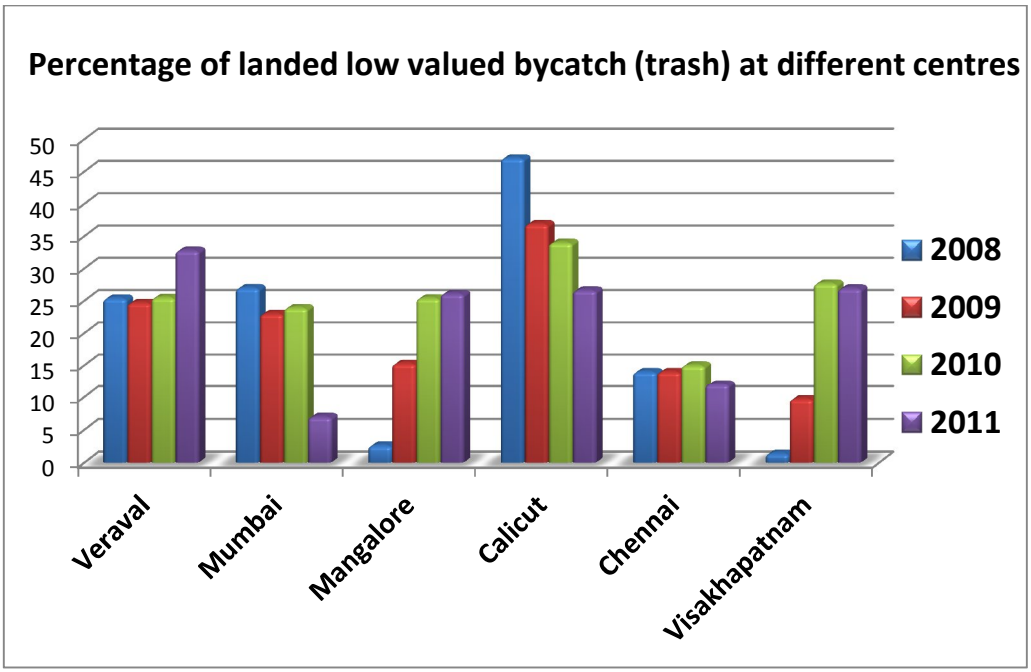


Fig.1. percentage of LVB landing in different centres

The demand and price of LVB is decided by the species composition of LVB and finfish dominated LVB had better demand. For assessing the sustainability of marine fisheries production it is imperative to understand the species composition and the juvenile composition of the fishes in the LVB.

Experimental trawling

Experimental trawling was conducted off Mangalore during pre -monsoon and post - monsoon months, 12 experimental trawling trials were conducted for collecting catch data and hydrographic and productivity parameters during premonsoon and post monsoon season of 2007 to 2011. The data were regularly collected from same fishing ground with help of GPS location fixing at 10, 15 and 25 m depths. The details colleced are: Time of shooting net, GPS reading, Depth, Length of wire rope, Sechi Disck visibility, Atm. Temperature, surface and bottom water temperature, pH, Salinity (ppt), Dissolved oxygen (ml/l), Phosphate (mg at/l), Nitrate (mg at/l), Nitrite (mg at/l) ,Silicate (mg at/l), Chlorophyll a (mg/m^3), Chlorophyll b (mg/m^3), Chlorophyll c (mg/m^3), Ext.coeff and BOD.The details of species wise catch, bycatch with its number and weight also were recorded.

Seasonal analysis of species composition was studied. During the first part of post monsoon and during the starting of fishery season, (October-November) *Johnius* sp (12.7 %) dominated the catch followed by *C. macrostomus* (11 %), Squilla (10 %), *P. stylifera* and *C. hoplites* (9 %) in the later part of the post monsoon (January-February) 27 % of the catch comprised of *C. hoplites* followed by squilla which constituted 26% of the catch. Other major species were *C. smithi* (12 %), *Cyanoglossus macrostomus* (9 %), *Nemipterus spp*. (7%) and *Thryssa sp* (6%). During pre-monsoon months (April-May) 14 % of the catch was contributed by *C. macrostomus*, followed by *P. stylifera* (12%) *Lagocephalus* (10 %) and *Saurida* spp (7%).

Species diversity indices (H' Log2) ranged from 3.67 to 4.17, highest in April and lowest in January. The evenness was in the range of 0.97-0.98.The cluster analysis showed a similarity between April and November to which January got linked. There is clearly a low level of similarity between samples J1 to J6, and the remainder of the samples (<50 % similarity). Majority of the other samples have more than 60% of similarity.

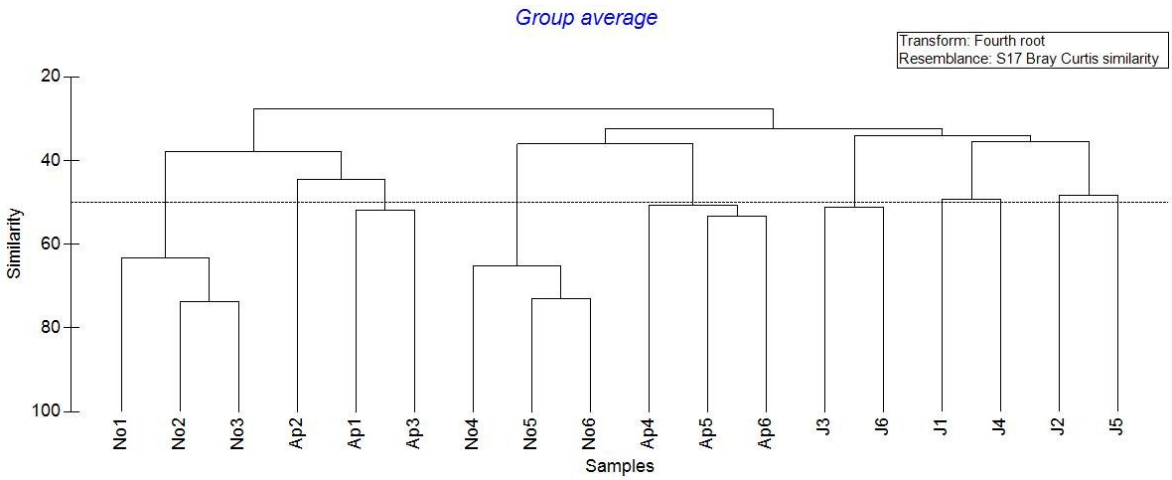


Fig. 3. Cluster Analysis showing similarity of species in different months.

All environmental parameters were assessed in different months. There was no significant difference between the environmental parameters between months.

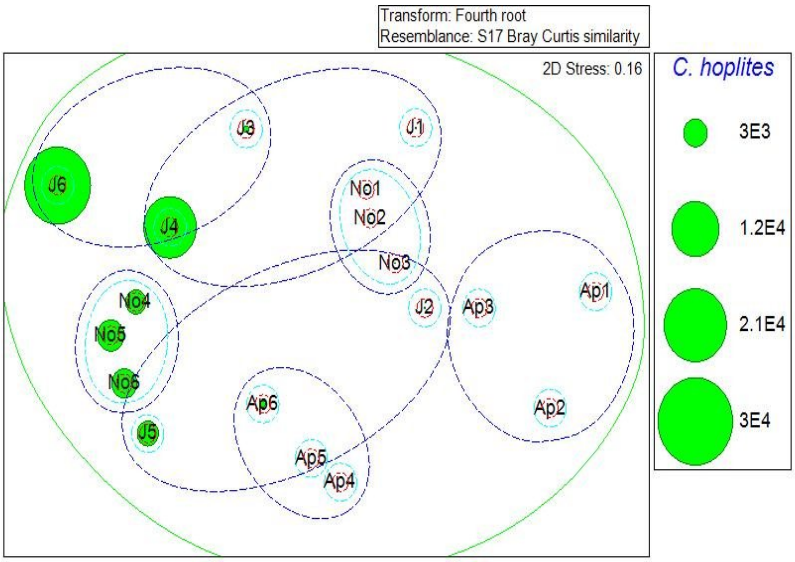


Fig 4: A non-metric, MDS ordination plot showing similarities between samples. Bubbles show the relative size of *C. hoplites*. Outer circle shows the similarity between different months.

In January *C. hoplites* dominated the catch while in other two months *C. macrostomus* and *Squilla* dominated. Hence dissimilarity of the species is evident from the cluster analysis and MDS. All environmental parameters were assessed in different months.

Objective 2: ***To assess the quantities of juveniles landed by selective fishing gears such as 'dol' nets, minitrawls and thalluvalai.***

Quantification of fishes and shrimps landed by 'dolnets' at Mumbai, 'minitrawls' at Cochin, 'thallumadi' at Tuticorin and 'thalluvalai' at Mandapam was also carried out.

Dolnet fishery

In 2008 'Dolnets' in Sassoon docks, Mumbai landed 147 t of fishes with a catch rate of 1.7 kg/hr. Non-penaeid shrimps (24%), penaeid shrimps and Bombayduck (19% each) were the main components. Species diversity showed 83 different species of marine organisms in dolnets. About 17 species of finfishes and shellfishes represented in the 'dolnet' were juveniles. At Arnala, 'dolnets' landed 2,869 t of fishes with a catch rate of 17 kg/hr. *Harpadon nehereus* (30%) dominated the catch followed by engraulids (26%) and non-penaeid shrimps (20%).About 74 species of marine organisms were represented and of these 44 species were finfishes. About 24 species of finfishes and shellfishes landed were below size at first maturity and therefore juveniles. In 2011 Dol net fishery observation was done in Arnal, Sassoon Dock and Versova. Duration of each haul of the dolnet was 3 hours. Total catch in dolnet in Arnala was estimated at 4,819t for the effort of 53,154 (hauls) and catch rate was 90 kg/hr. Major groups contributing to dolnet fishery at Arnal were Bombay duck (32%), nonpenaeid prawn (31.5%), anchovies (1.5%) and more than 50% of the catch comprised of juveniles. In Sasoon dock (Dolnet) total catch was estimated at 123 t for an effort of 18,232 hauls and the catch rate was 9 kg/hr. Major groups contributing to the fishery were anchovies (27%), non penaeid prawns (17%), croakers (15 %), sardine (7.5 %), bombay duck (7%), ribbonfish (6%).Versova (Dolnet): Total catch was estimated at 36 t for the effort of 221 units and catch rate was 41 kg/hr. Major groups contributing to dolnet fishery at Versova were Bombay duck (50%),non penaeid prawns (15 %), anchovies (12%) and Ribbon fish (6%).

Minitrawls

In 2008, minitrawls at Pallithode along the Alleppey/Ernakulam coast landed 111 t of fishes and shellfishes of which shrimps formed 89.6%. *Metapenaeus dobsoni* (49.2 %) and *Parapenaeopsis stylifera* (46.5%) are the two major species. The size of shrimps

ranged from 31-115 mm TL. Annual mean size of *M. dobsoni* is 64 mm total length and the modal length is 61-65 mm TL. The mean size of *P. stylifera* landed were 70.9 mm TL and size ranged from 26-125 mm TL. Percentage of juveniles in minitrawl landings was 57.5% and 47% for *M. dobsoni* and *P. stylifera*, respectively. Destruction of juveniles by minitrawls was about four times more than the commercial trawlers. In 2009, estimated 99.4 t of shrimps were landed by minitrawls at Pallithode with a CPH of 4.1 kg. *Metapenaeus dobsoni* (49%) and *Parapenaeopsis stylifera* (46.5%) were the major constituents. Peak landings of both species were in December. About 57.5% of *M. dobsoni* and 31.8 % of *P.stylifera* females were below size at first maturity. In 2011 an estimated catch of 82 t of prawns were landed by mini trawlers of which *P. stylifera* and *M. dobsoni* together constituted 98% of total catch. About 63% of females of *P. stylifera* were in immature stage.

Thallumady and thallu valai

In 2009, Thallumady' operation at Mottagopuram, Tuticorin coast landed 74.8 t of shrimps with a cpue of 75.5 kg of which juvenile shrimps formed 22.4 t (30%). An estimated 31.9 t of shrimps were landed at Alangarathattu of which 10% were juveniles. *P. semisulcatus* ranging from 50-93 mm was the dominant species. At Mandapam, an estimated 42.9 t of *P. semisulcatus* with a catch rate of 4.7 kg/unit were landed by 'thalluvalai' at Tiruppulaikudi, Ramanathapuram district, Tamilnadu. At Devipatnam an estimated 36.3 t was landed with a catch rate of 6.6 kg/unit. The size of *P. semisulcatus* landed at Tiruppalaikudi ranged from 56-186 mm and at Devipatnam size varied from 83-181 mm total length. At Thiruppalaikudi and Devipatnam 74.6 % and 80.4% of female shrimps landed respectively, were juveniles. In October alone, 2.1 million (49.5%) juvenile female shrimps were landed at Tiruppulaikudi, showing the amount of destruction to the resource as these are caught even before first spawning. In 2009 an estimated 92.6 t of shrimps with a catch rate of 4.5 kg/hr were landed by 'thallumadi' at Tuticorin. 43.6 t of shrimps with a CPUE of 4.1 kg were landed at Mottagapuram and 49 t at Alangarathattu of which juveniles formed 21%. *Penaeus semisulcatus* formed 85% of total landings. The sizes of juveniles ranged from 43 to 83 mm TL. The shrimps were sold at Rs. 65/kg. The economic loss to the fishermen by exploiting the juvenile shrimps of *P. semisulcatus* was estimated at Rs. 80 lakhs/year. At Tiruppalaikudi and Devipatnam along the Palk Bay coast, an estimated 74 t of *P. semisulcatus* was landed by 'thalluvalai'.

An estimated 5.1 million females of shrimp below 125 mm (size at first maturity) were harvested which would have otherwise given an additional revenue of Rs. 2.13 crores if allowed to grow, and if they actually could, to adult size (minimum 25g). In 2010'Thallumadi' fishery at Tuticorin- average monthly catch per unit effort of prawns varied from 12-25 Kg. In *P. semisulcatus* and *Fenneropenaeus indicus,* the two commercially important species, female prawns landed were all in immature stage. *Penaeus semisulcatus* dominated (92%) of the total catch. The size of prawns varied from 31-170 mm in total length. In 2011, at Tuticorin the annual catch of thallumadi was estimated as 104.7 t with a CPUE of 15 kg. Out of this prawns formed 41% (43 t), crabs 46% (48.5 t), fishes 7 % (7 t) and cephalopods 6% (6 t).

3. ***Recruitment dynamics of penaeid prawns along Indian coast (*CF/IDP/03; 2009-2012)**

Past data collected during 1997-2006 were subjected to analysis on calendar year basis for reproductive biology, egg production, number of recruits and relationships between egg production and recruitment of *P. stylifera* and *P. merguiensis* at Mumbai, *P. stylifera* at Kochi, *M. dobsoni* and *M. monoceros* at Mangalore, *P. stylifera* and *M. dobsoni* at Cochin, *P. indicus*, *P. stylifera* and *M. dobsoni* at Calicut, *M. dobsoni* and *P. maxillopedo* at Chennai and *M. monoceros* at Visakhapatanam. However, results obtained for only one species at each centre are presented below:

- The relationships between month-wise recruits and egg production (spawning stock) were related with a time lag of 5 months for *P. stylifera* at Mumbai, 6 months in case of *M. dobsoni* at Mangalore, 4 months at Kochi and 4-6 months at Calicut.

- At Mumbai *P. stylifera* exhibited two peaks of egg production and recruitment that suggested two discrete cohorts every year. The egg production during March-May period (pre-monsoon) gave recruitment in November-December (Cohort I) while the same in October-December (post-monsoon) gave recruitment in March-April (Cohort II). The monthly estimated number of recruits and the spawning stock biomass of *P. stylifera* revealed a dome shaped Ricker's relationships with parameters: $\alpha = 11.184$ $\beta = 0.0279$ ($r^2 = 0.84$).

- At Mangalore, the average number of eggs per spawner ranged from 48,380 to 64,224 and only 0.05% of the eggs reached recruitment; the relationship between

egg production and the number of recruits 6 months later, showed poor relationship (r^2 =0.021). However, egg production and the recruitment of *M. dobsoni* in relation to rainfall (pre & post monsoon) gave fairly good relation ((r^2 =0.55). The Ricker model gave better fit with parameters α = 620.8, β = 0.37 (r^2 = 0.86).

- At Calicut, the average biomass of females was 15.24 t and that of spawning (54%) females 6.71 t, which gave production of 9.66*10^10 eggs, but the survival of eggs to recruitment was 0.039%. Although primary peak of spawning was in February, recruits could not be estimated 4-5 months later as the fishing operations were closed in monsoon. The secondary peak of spawning females observed in certain years in August did not give clear relation between either spawner biomass or the egg production to the recruitment. Monsoon closure of the trawl fishery therefore beneficial to the young recruit.

- At Cochin (Sakthikulanga, Needakara and Cochin Harbour) the maximum spawning stock biomass and the recruits were recorded in May and June and minimum in October and March. Since both stock biomass and the number of recruits were highest in the same period they are related to intensity of landings and therefore, further detailed analysis of egg production and recruitment is required.

- At Chennai, peaks of spawning biomass were noticed in July-August (primary) and January-March (secondary) but the recruitment 5 months later gave an apparent Ricker's dome shaped SR curve (r^2=0.43).

- At Visakhapatam, although standing stock biomass of spawning females ranged between 0.01 t to 33.6 t and the recruitment 4 months later gave Ricker's relationship showing density dependence.

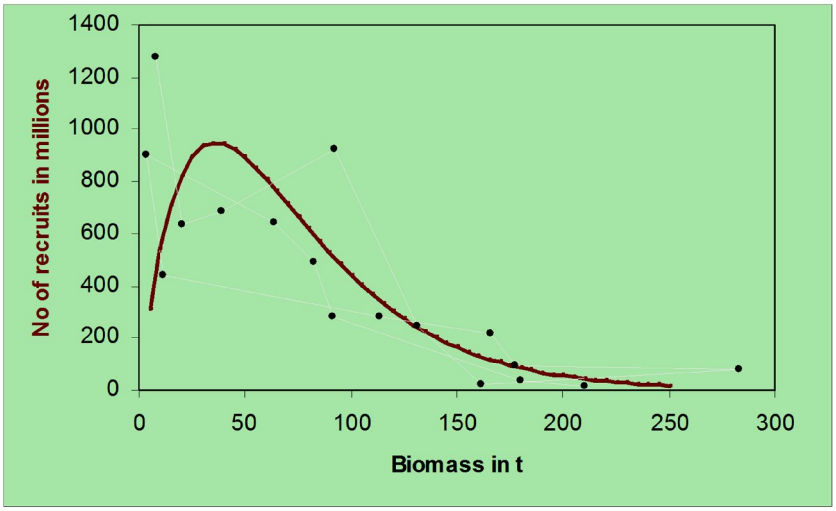


Fig. S-R relationship of *P. stylifera* at Mumbai.

Stock parameters of important species of penaeid prawns for SR relationships at each centre

Centres	**Mumbai**	**Mangalore**	**Calicut**	**Kochi**	**Chennai**	**Vizag**
Species	***P. stylifera***	***M.dobsoni***	***M.dobsoni***	***P.stylifera***	***M.dobsoni***	***M.monoceros***
Abundance	Dec & Sep	Jan-Mar	Jan& Nov-Dec	Aug	Nov-Feb	Dec-Mar
Spawners nos. 10^6	219.3	4.5-14.5	NA	NA	NA	NA
Spawning stock in t	1185 t		11.43	0.54-3787	3.6-416.6	0.03-45.66
Size at maturity mm	61.3 & 78.1	64 & 71	77.5	70	69	115
Spawning peak months	Apr & Dec	Feb-May & Nov.	Feb & August	Aug	Feb & Nov	Feb-Apr
Fecundity size relationship	$0.0000695L^{4.342}$	$0.192*L^{2.847}$	$5.58*10^{-8}*L^{6.074}$	NA	$0.4245*L^{2.66}$	F=-507+4.96L
Egg-production in 10^6	210,000	40.9-246 million	$9.6*10^{10}$	NA	NA	NA
Peaks of egg production	Oct-Dec & May,	Nov-Dec & May-June	Primary: Jan Secondary: Mar	NA	NA	Feb-Apr
No of Recruits in million	Cohort I: 383 Cohort II: 568	NA	39.4	0.0012-2.7	0.109-934	NA
Recruitment peaks	May & Aug-Sep.	May-June & Nov-Dec	NA	Aug	NA	Aug-Oct
Suitable SR model	Ricker	Ricker	Ricker	NA	Ricker	Ricker
Environmental relations	Rainfall	Rainfall	NA	NA	NA	NA

4. ***Development of fishery management plans for sustaining marine fisheries of Maharashtra.*** **FISHCMFRISIL20121000010 (2012-2014)**

The marine fish landings in Maharashtra during 2013 were estimated at 3.64 lakh t valued at Rs. 2,480 crores. The total fish landings increased by 15.7% over 3.15 lakh t in 2012 and the revenue increased by 16.9%. During the year pelagic finfishes contributed to the total landings 35.1%, demersals 25.3%, crustaceans 33.4% and molluscs 6.2%. In the year crustacean landings increased remarkably by 44% while pelagic and demersal fishes registered 10.4%, 3.4% increase respectively; however, molluscan resources recorded 3% decline.

The major fishing gears that contributed to the landings in the State were trawl net (39.9%), bag net (36.5%), purse seine (13.6%) and gill net (8.1%), while traditional non-mechanized shore seines, bag nets and hooks & lines together landed 1% of the total fish catch. Motorized gill nets, bag nets and hooks and lines also contributed about 1.9% to the landings. When compared to 2012, the bag net fishery recorded unprecedented increase in catch by 84% due to heavy landings of non-penaeid prawns. The landings also increased for gill nets (39.9%) and non-mechanized gears (119%). However, both purse and trawl fisheries suffered economic loss and many of them were laid off between February and May 2013. The purse seiners recorded 31% decline while trawler landings declined marginally by 0.3%. Owing to sparse catch rates, the trawlers mostly undertook multi-day fishing trips lasting for 6-18 days.

The prominent species/groups that contributed to the fishery in the order of abundance were non-penaeid prawns (23.9%), penaeid prawns (8.1%), croakers (7.7%), Bombay duck (7.5%), squid & cuttlefishes (6.1%), catfishes (5.1%) and ribbonfish (5%). The landings of oil sardine and mackerel recorded decline in 2013 and contributed to 4.7% and 2.5% respectively. During the year among the 58 listed resources 37 registered increase while 21 registered decline in the catch when compared to 2012.

The high abundance of oil sardine and mackerel noticed in 2011-12 did not last in 2013, as a result purse seining was not profitable. However, some purse seiners targeted catfishes and Jew fish (*Ghol*) *Pseudosciaena diacanthus* that fetched a fortune (with revenue exceeding Rs 1 crore) in some fishing trips. Some of the fishers in Raigad district were supported by potential fishing zone (PFZ) advisories through NAIP assisted “m-

Krishi" mobile service which enabled mini purse seiners with inboard as well as outboard engines to have better catch of oil sardine in the nearshore waters.

5. ***GIS based resources mapping of distribution and abundance of finfishes and shellfishes off Indian Coast for suggesting operational based strategies for fisheries management.***

For this objective the data are being collected from trawl, gill net, purse seine, ring seine, dol net, hook and line and traditional gears operated along the Indian coast, from ten centres of CMFRI covering all maritime states from Veraval to Visakhapatnam.

Objective 1: *Inventory of fish landing centres*: For GIS mapping basic data requirement is the information regarding the fish landing centres around Indian coast. This information forms the basic layer of the resource mapping on which resource data layer will be stacked. The data collected area, name of landing centre, district, its location with latitude and longitude (GPS reading), gears operated from the landing centre, seasonality of each gear operation, distance covered for fishing from the centre, seasonal changes in direction of fishing activity, are also incorporated in the Inventory of landing centres. List of dominant species in each gear from each fishing centre is also incorporated in the inventory. Example of GIS inventory made for Maharashtra is given in the figure1. Data collection from 1200 landing centres along the Indian coast was completed during the year, 2013. The data gaps are being identified and getting filled up.

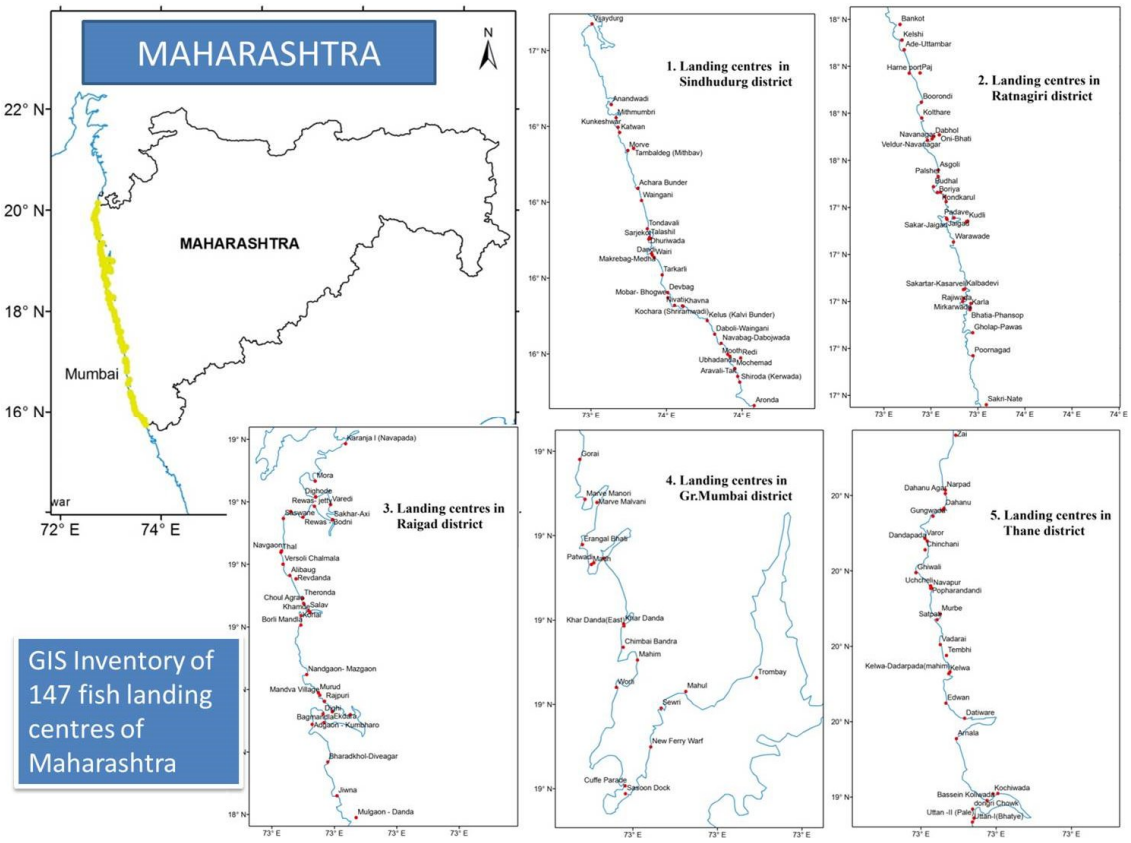


Fig.1. GIS inventory of fish landing centres along Maharashtra coast

Objective 2: To make resource maps of marine fishery resources and their abundance along Indian coast in space and time and to understand the status of exploitation of the species with different gears in space and time.

As a preliminary step for making resource maps of marine fishery resources and their abundance along Indian coast in space and time, the GIS and Remote sensing software with three licenses was procured and installed at three Centres - Mangalore, Veraval and Visakhapatnam. Regional training cum workshop for operation of the software was arranged to give hands on training to the associates and scholars. Before making the spatial maps the temporal pattern of the fishery is being studied in detail.

Temporal variation in the abundance of fishery resources:

Temporal variations in fish landings of different centres of all maritime states were carried out under this all India project. Details of Trawl, gillnet, purse seine, ring seine, dol net, hook and line, traditional gears operated along the Indian coast were collected from ten centres of CMFRI.

Second workshop of the project, inviting all the associates was conducted at CMFRI, Mangalore during January, 2014 in which work programs and the data collection at

different centres were reviewed. Important gears operated from the coast were identified for data collection to get information in seasonal (temporal) changes of the species composition and juvenile & spawner composition of selected species. The identified gears and selected species from different centres are:

Centre	Gears studied	Species studied
Veraval	Gillnet and trawl	Tunas, Ribbonfish,Crabs, Acetes Croakers, Perches
Mumbai	Trawl and dol net	Colia, Bombay duck, Ribbonfish
Karwar	Trawl (single day) and shore seine	Prawns and crabs
Mangalore	Gill net, trawl, ring seine, purse seine	Tunas, sardines, Stomatopods, Crabs, Threadfin breams, Whitefish, Seerfish, Mackerel
Calicut	Trawl	Croakers, Threadfin breams
Kochi	Ring seine, trawl, Chinese dip net	Crabs, Shrimps, Stomatopods, Gastropods, Shrimps,Threadfin breams, Whitefish
Vizhinjam	Gill net and hook and line	Lobsters, Tunas
Tuticorin	Gill net and trawl	Crabs,shrimps, Tunas , Ribbonfish
Chennai	Gill net, trawl, hook and line	Threadfin breams, Perches Crabs, Stomatopods, Gastropods
Visakhapatnam	Gill net, trawl, hook and line	Ribbon fish, Tunas Threadfin breams, Perches Crabs, Stomatopods, Gastropods

Objective 3: To understand the juvenile exploitation and spawner exploitation by different fishing methods.

Under this objective, the juvenile composition and spawners exploited by different gears operated at major fishing centres were collected as per the table given above. An example of the data collection, temporal pattern of abundance of juveniles and spawners of thread fin breams from trawling grounds off Calicut is given in figure 2. Similar studies are being carried out for different species along Indian coast.

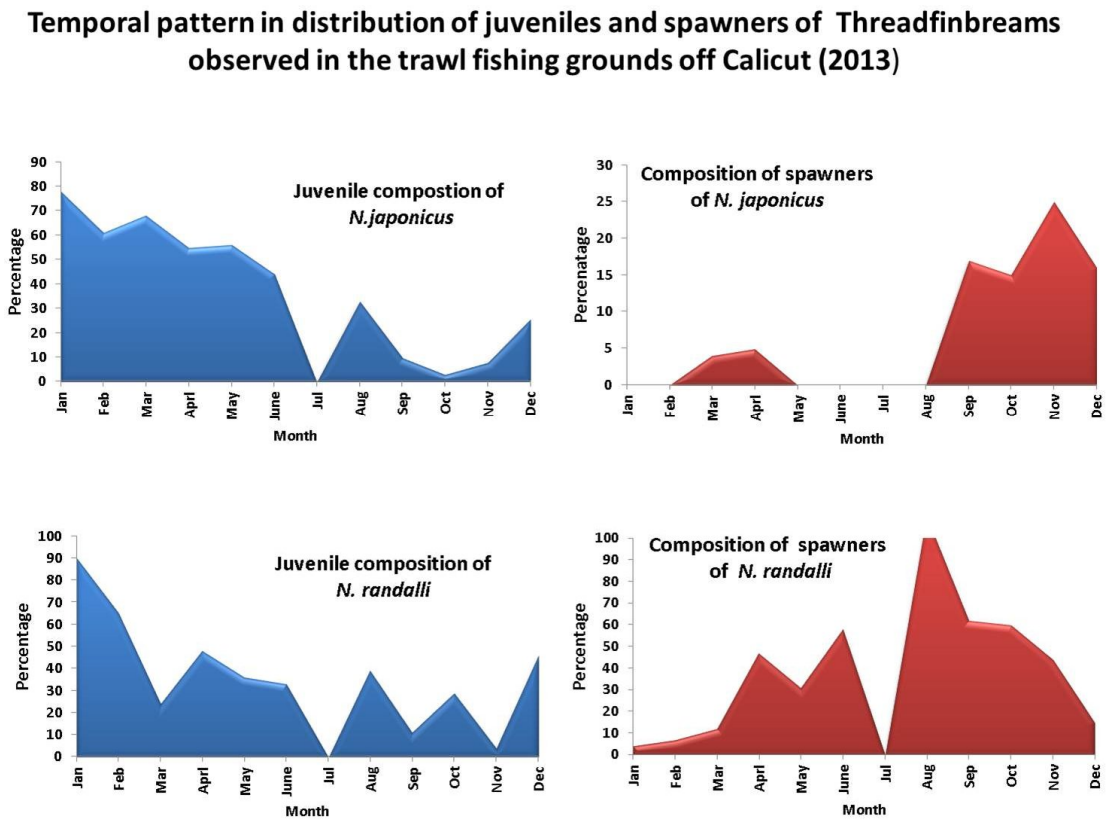


Fig. 2. Temporal pattern in abundance of juveniles and spawners of threadfin breams from Calicut.

Preliminary mapping of important resources off Mangalore has been completed and demonstrated to provide an insight on the project output.

GIS based resource mapping of juvenile and spawner abundance along Indian coast will provide database for the spatial and temporal closure or restriction in trawl fishery. GIS is found to be very handy tool for fishery resource mapping. Most important feature of the GIS maps is that, information on each group/species/juveniles/adults layers can be individually or collectively separated by queries and the layers can be studied in terms of its importance. GIS arranges the data collected periodically in different layers which can be retrieved as per the projections required and each layer can be analysed individually. The utility of the layer character of GIS in by-catch reduction is that, if juvenile exploitation in a specific species makes considerable impact on the stock position and economics of commercial species, effort restrictions can be imposed in that fishing ground and season with illustrative justifications. Studies on the repeatability of the juvenile abundance in these particular fishing grounds will help in identification of critical fishing grounds where seasonal and spatial closure of trawl fishery can be implemented to improve the fishery production in the long run. The resource maps can be

used as an excellent tool for the policy makers to weigh each fishing ground in terms of commercial value and juvenile abundance so that the policy making process will be much transparent. Illustrated maps with seasonal/ fishing ground wise distribution of juveniles and commercial fishes will help as a useful tool in awareness programs to extend the research findings to the stake holders.Here are some of the examples of mapping grounds of peak spawning and juveniles abundance of the commercial species which could be used as information base for suggesting seasonal and spatial closure of the fishery. Fig. 3 shows the fishing grounds and month of abundance of spawners and fig.4 shows the fishing grounds and month of abundance of juveniles.

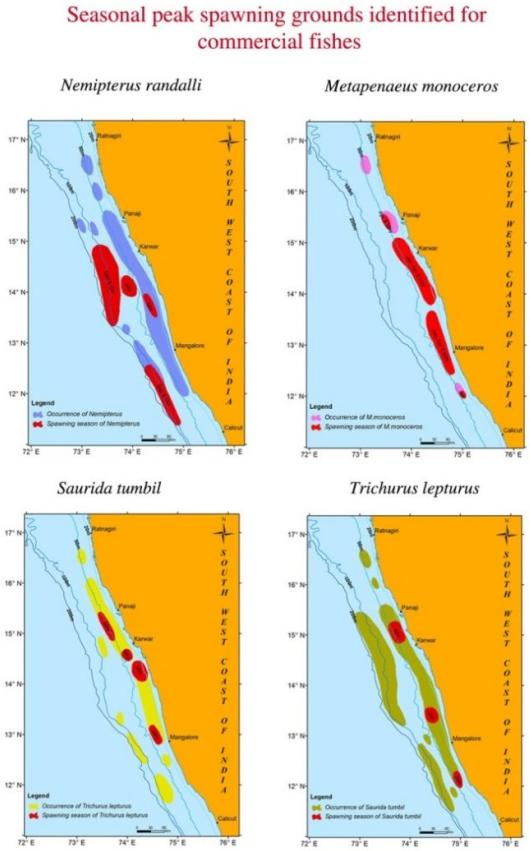


Fig.3. Seasonal peak spawning grounds identified for *N. randalli, M. monoceros, S. tumbuil* and *T. lepturus* based on the GIS studies. Peak spawning months and area of occurrence is indicated in the map.

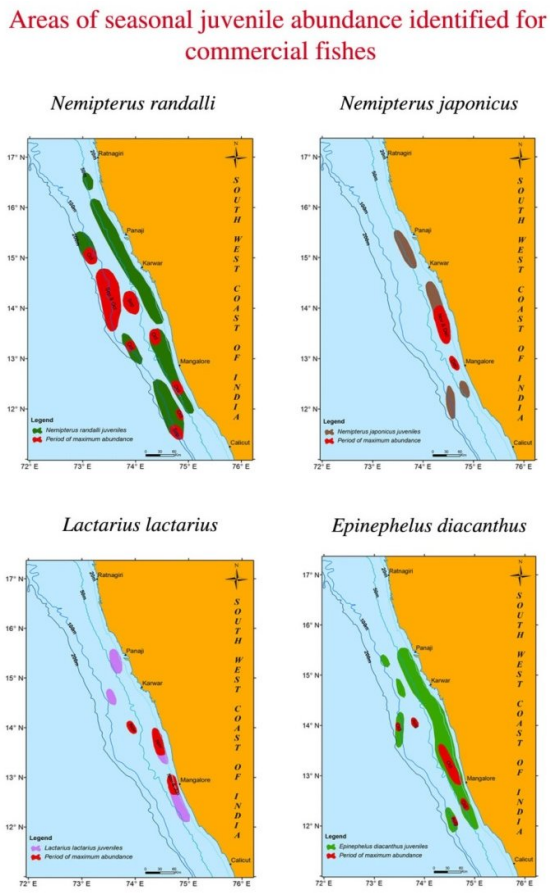


Fig. 4. Seasonal juvenile abundance grounds identified for *N. randalli, N. japonicus, L. lactarius* and *E. diacanthus* based on the GIS studies. Months of juvenile abundance and area of occurrence is indicated in the map.

6. **Integrative Taxonomy of deep sea shrimp resources along the Southern Coast of India (SR/FT/LS-73/2012), DST-SERB PROJECT (Life Sciences)**

Deep sea shrimp samples were collected from Sakthikulangara, Kallamukku fishing harbours in Kerala, and from Tuticorin fisheries harbor in Tamil Nadu, along the south-east coast of India. Methodology was standardised for taking the desired shrimp measurements and isolation of genomic DNA from deep sea shrimp samples.

Deepsea shrimp species belonging to the major families: *Penaeidae, Aristeidae, Pandalidae and Solenoceridae* were collected. The following are the list of species collected, belonging to these families.

Aristeus alcocki, Metapenaeopsis andamanensis, Solenocera hextii, Parapenaeus investigatoris, Penaeopsis jerryi, Heterocarpus woodmasoni and *Heterocarpus gibbosus.*

Identification of these deep sea shrimps to species level was done by following the standard conventional taxonomical procedures by morphometric and meristic characters. Diagnostic characters for shrimp include: body length, color of the specimen, carapace with crests and grooves, rostral teeth on the dorsal and ventral side, presence of pincers on the pereiopods, specific shape and structure of the copulatory organs *i.e.,* petasma in males and thelycum in females and many other minute characteristics.

Samples were further segregated according to sex (male & female) and preserved in 4% formalin in each sample box separately. Identification using various morphometric measurements was made to get a clear understanding of the stock. The Truss network system used for identification using various landmarks 35 distances were measured on the body of the shrimp.

Fig.1. Deep sea shrimp landings at Sakthikulangara fishing harbour during 2013-14

- Specimens measured (nos.) during Feb 2013 to March 2014 are as follows:
  - **Kerala- Sakthikulangara (Feb 2013-March 2014)**
    - *Heterocarpus gibbosus* – Male – 135 and Female - 189
    - *Plesionika martia* - Male – 15 and Female – 20
    - *Heterocarpus woodmasoni* - Male – 50 and Female – 140
    - *Acanthephyra sanguinea* - Male – 54 and Female – 125
    - *Acanthephyra armata* - Male – 7 and Female – 8
  - **Kerala- Kalamukku (Feb 2013-March 2014)**
    - *Heterocarpus gibbosus* – Male –90 and Female – 100
    - *Heterocarpus woodmasoni* - Male – 35 and Female – 31
    - *Plesionika martia* - Male – 11 and Female – 10
  - **Tamil Nadu- Tuticorin (Jan 2014)**
    - *Heterocarpus gibbosus* – Male – 78 and Female – 121
    - *Heterocarpus woodmasoni* - Male – 16 and Female – 10
    - *Plesionika martia* - Male – 3 and Female – 2

Molecular outputs:

1. About 5 species of deep-sea shrimp DNA was extracted following the manufacturer's protocol.
2. The extracted DNA was electrophoresed through 0.8% agarose gel containing ethidium bromide and quantified by using UV spectroscopy.

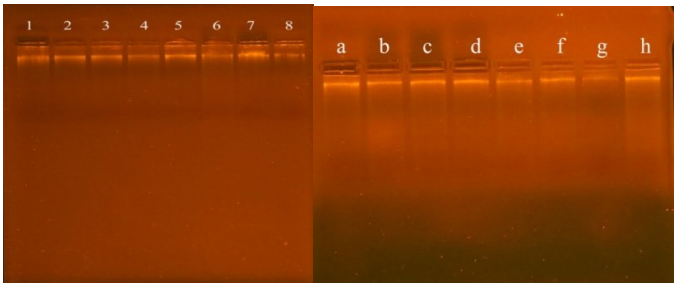


Fig.2. Agarose gel electrophoresis (0.8%) showing DNA isolated from deepsea shrimps

3. The polymerase chain reaction (PCR) standardized to amplify target regions of two mitochondrial genes 16S rRNA and COI and the same has been amplified in 3 species of deep sea shrimps.
4. PCR products were purified by purificiation kit. The PCR products were viewed by electrophoresis (1.5% agarose gel containing ethidium bromide).

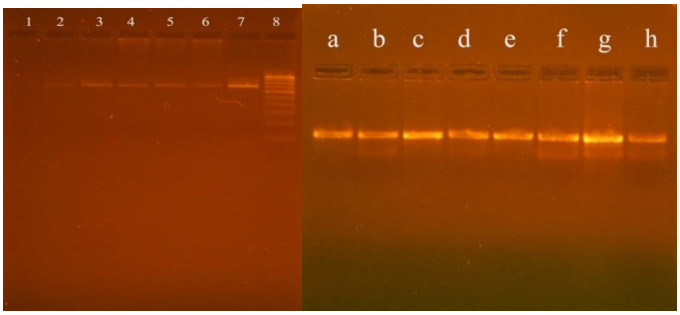


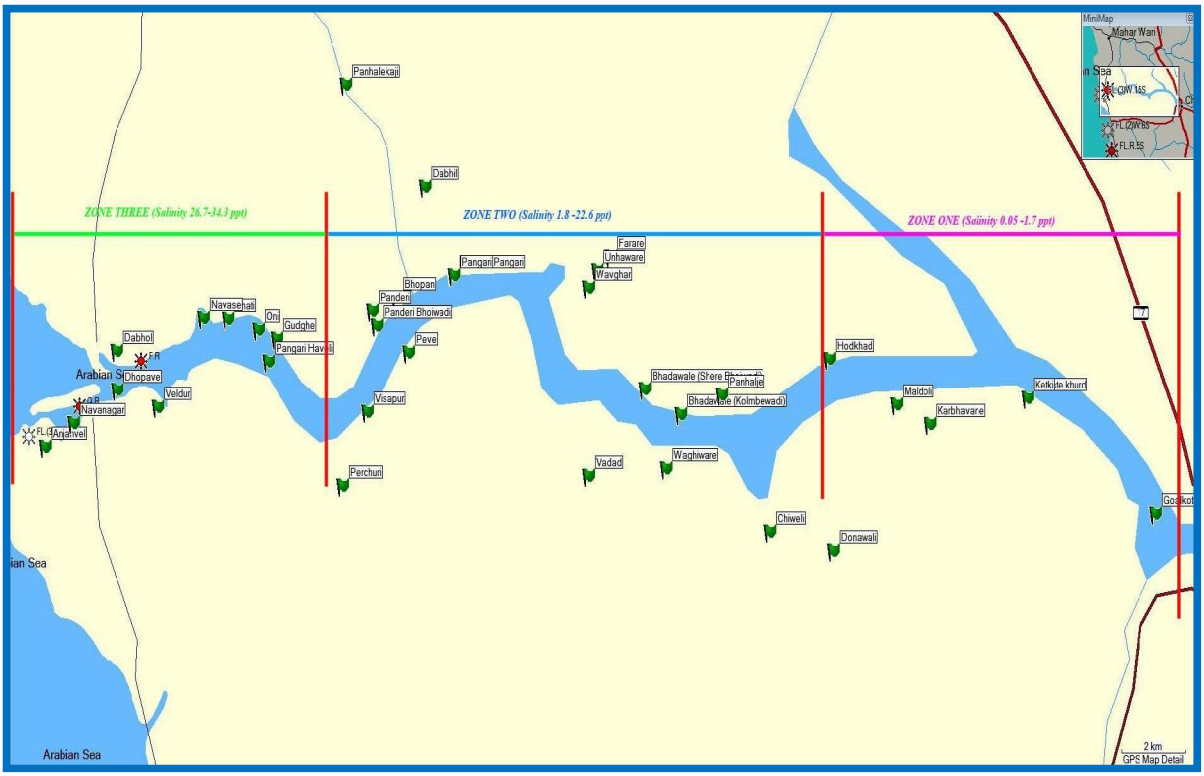
Fig.3. Gel electrophoresis amplifying PCR products- mitochondrial genes (16S rRNA & COI) from deep sea shrimp

5. PCR products were sequenced for both forward and reverse strands, edited and confirmed sequences were deposited to NCBI-GenBank.

7. **PROJECT: "Rapid assessment of fishery resource of Vasishti river estuarine system and possible impact of intake and discharge of water from thermal power plant on it"**

THE STUDY INCLUDED

- Identification of stakeholder fishing villages where major fishery resources of the river and creek are exploited for their livelihood.
- Collection of baseline fishery data data from primary and secondary sources for future impact assessment studies.
- Identified vulnerable species of fish, mollusks and crustaceans likely to be impacted.
- Suggested of mitigation measures for fishery of the creek.



Map of study area

The project has been completed and final report had been submitted to the client.

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1. A poster on **" Portunid crab resources of India", (S. Lakshmi Pillai**, **Josileen Jose**, G. Maheswarudu, P. Thirumilu, P. K. Baby and M. Radhakrsihnan, Crustacean Fisheries Division, CMFRI, Kochi) was released by Dr. A Goplakrishnan, Director, CMFRI at HQ on 20.08.2013.

2. A poster on **Poster on "Marine Penaeid Prawn Fishery Resources of India."** designed and prepared by Crustacean Fisheries Division, CMFRI, Kochi was released by Dr. G. Maheswarudu, Head, Crustacean Fisheries Division on behalf of the Director, CMFRI at Mangalore Research Centre of CMFRI on 17th August, 2012.

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99. Uma Mahesh, V., M .V. Hanumantha Rao, M. Satish Kumar, Shubhadeep Ghosh and **G. Maheswarudu.** 2013. Rare landing of the wahoo, *Acanthocybium solandri* (Cuvier, 1831) at Visakhapatnam Fishing Harbour, Andhra Pradesh. *Marine Fisheries Information Service; Technical and Extension Series* (215): 26-27.

100. Ram Mohan, K., Shubhadeep Ghosh, M.V.Hanumantha Rao,V. Uma Mahesh and **G. Maheswarudu.** 2013. Unusual heavy landings of dolphinfish, *Coryphaena hippurus* at Visakhapatnam Fishing Harbour. *Marine Fisheries Information Service; Technical and Extension Series* (215): 29.

101. Sundaram, Sujit and **Deshmukh, V D** . 2013. Gastropod operculum - An unique trade. *Marine Fisheries Information Service; Technical and Extension Series* (217): 20-22.

102. Purushottama, G B, **Deshmukh, V.D**, Singh, V V, Ramkumar, S and Syamala, Karthireddy 2013. *Mass envenomation during Ganesh idol immersion at Girgaum-Chowpathy beach, Mumbai, Maharashtra. Marine Fisheries Information Service; Technical & Extension Series* (218):34-35.

103. **Divipala, Indira** and Thirumilu, P. 2013. Rare occurrence of two stomatopod species from Chennai coast. *Mar. Fish. Info. Serv. (T &E Ser.)* (215):32-33.

104. Behera, Pralaya Ranjan, **Rajendra Naik, N**, Edward, Loveson and Muktha, M. 2013. Olive ridley turtles released back into the sea at Visakhapatnam, Andhra Pradesh - A note. *Marine Fisheries Information Service; Technical and Extension Series* (217): 14.

2014

105. Mohammed Koya K., Vinay Kumar Vase., **Gyanaranjan Dash**., Sreenath K. R., Swatipriyanka Sen Dash., and Suresh Kumar Mojjada.2014. Fisheries students complete their industrial work experience programme at Veraval RC –Yet another initiative of CMFRI to support sea cage farming industry in India, *Cadalmin CMFRI News letter* Vol.no. 140:8.

106. **Gyanaranjan Dash**, Mohammed Koya, K, Sreenath K.R., Vinay Kumar Vase, Suresh Kumar Mojjada and H.M. Bhint. 2014. Capacity building of Sidi tribals on best farm management practices at Veraval RC. *Cadalmin CMFRI News letter* Vol.no. 140: 20

107. **Dineshbabu, A P**, Thomas, Sujitha and Rohit, Prathibha.2014. GIS-based spatial data analysis for marine fisheries management as a pre-requisite for mariculture development. *Fishing Chimes*, 33 (10 - 11): 91-93.

108. Loveson L Edward, Sekar Megarajan, Pralaya Ranjan Behera, **N. Rajendra Naik**.2014. Site selection and water quality requirements for cage culture. In training manual on cage culture of finfishes, 2014: 7-15.

109. 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.

6. AWARDS/RECOGNITION/HONORS:

2009

Dr. G.Maheswarudu

Biography has been included in Who's Who in the World 2010, Marquis Publication from USA

Dr. Rekhadevi Chakbraborty
Jawaharlal Nehru Award for outstanding Post-Graduate Agricultural Research 2009 in the field of Biotechnology (Fishery)

2010

Dr. G.Maheswarudu

1. Name was included among **TOP 100 SCIENTIST-2010 by** the International Biographical Centre, Cambridge, England.

2. Biography has been listed in the following titles:
   a. **2000 Outstanding Scientists -2010**, IBC publication from England.

b. **2000 Outstanding Intellectuals of the 21 st Century-2009/2010**, IBC publication from England.

c. **Who's Who in Science and Engineering-2011-2012**, 11th Edition, Marquis Publication from USA.

d. **Who's Who in Medicine and Healthcare-2011-2012**, 8th Edition, Marquis Publication from USA.

e. **Great Minds of the 21st Century-2010**, Publication from American Biographical Institute, Inc., USA .

f. **500 Great Leaders-2011**, Publication from American Biographical Institute, Inc., USA.

g. **Dictionary of International Biography**, 35th Edition by International Biographical Centre, England.

3. Nominated to receive Gold Medal for India (2010), American Biographical Institute, Inc., USA.

2011

Dr. G.Maheswarudu

1. Bharat Jyoti Award was presented (in absentia) by Dr. BhishmaNarain Singh at a Seminar on Economic Growth &National Integration at New Delhi on 16-07-2011, organised by India International Friendship Society.

2. The Best Citizen of India Award-2011 was given by International Publishing House, New Delhi.

Mrs. K.N.Saleela

Best Poster Award (I[st]) won in the theme, Aquaculture Production **- 9th Indian Fisheries Forum .** Anil, M. K., Santhosh. B**,**. Prasad. B.O, **Saleela. K.N.** and Unnikrishnan. C. 2011. Larval rearing of scarlet skunk cleaner shrimp, *Lysmata amboinensis* and fire shrimp, *Lysmata debelius*. In Gopalakrishnan, A. *et*. *al*., (Eds.), Renaissance in Fisheries: Outlook and strategies – Book of Abstracts, 9th Indian Fisheries Forum, CMFRI, Kochi and Asian Fisheries Society, Indian Branch, 2011, Chennai, India, 117 pp.

Dr. S. Lakshmi Pillai

Bestpresentation: *चेन्नई और नीण्डकरा बन्दरगाह में अवतरित ब्राकिचूरन कर्कटों की जैवविविधता– एकझलक.* जैवविविधता–विशेषप्रकाशन, 106:26-31, S Lakshmi**Pillai,** Radhakrishnan, E V.,Thirumilu, P and Sajeev, C K.2011, during the Hindi seminar on Biodiversity held on 10.10.2011 at CMFRI, Kochi.

Dr. Rekhadevi Chakbraborty

1. Short listed for making a presentation for **INSA Young Scientist Award 2011.**

2. Awarded '**Prof. T.J. Pandian and A.J. Matty Award**" for the year 2011 during the **Indian Fisheries Forum, Asian Fisheries Society (Indian Branch)** held at Chennai on 19th - 23rd December.

2012

Dr. G.Maheswarudu.

1.Invited to participate in "**Photon Innovations-2012" by Photon Foundation,USA.**

2.Biography has been included in **Who's Who in Asia-2012,** Marquis Publication from USA.

2013

Dr. G.Maheswarudu.

"Thomas Edison Award-2013" by **Photon Foundation, UK.**

Dr. A.P. Dineshbabu

1.Best paper award in International Symposium, (Greening Fisheries) on Towards green Technologies in Fisheries, 21-23 May, 2013 Cochin: 73-74.

2. Best paper award in International Conference on Ecosystem conservation, climate change and sustainable development 3rd to 5th October 2013 Thiruvananthapuram, Kerala, India.

Mrs. Saleela. K. N.

1. Best paper: Santhosh. B ,Anil M. K, Vijayan K.K, Gopakumar. G, **Saleela. K. N.** Unnikrishnan. C, Udayakumar. A, Jose Kingsley. H, Anukumar A, Vinod. S. Mary Rinju. R and Prasad. B. O. 2013. Case studies on diseases of brood stocks of clown fishes in the National Seminar on Emerging Trends in Indian Aquaculture Dept. of Aquatic Biology and Fisheries, University of Kerala, Thiruvananthapuram, 28-30 March.

2.Best paper: Santhosh. B, Anil M. K, Gopakumar G, Rani Mary George, Jasmine.S. **Saleela**, **K. N.** Unnikrishnan. C, Vinod S,. Mary Rinju. R and, Prasad. B. O. 2013. Mass production trials of three species of carangid copepods suitable for feeding fish larvae National Seminar on Emerging Trends in Indian Aquaculture Dept. of Aquatic Biology and Fisheries, University of Kerala, Thiruvananthapuram, 28-30 March.

Dr. Josileen Jose

Thomas Edison Award - 2013, Photon Foundation, UK (for the best paper – Co-author).

2014

Dr. G.Maheswarudu

1. Invited to participate in "**Photon Innovations-2014" by Photon Foundation, UK.**

2. Who's Who in the World- 5 year anniversary- Biography has been included for five consecutive years, from 2010 to 2014 in **Who's Who in the World -** Marquis Publication from USA.

7. PRODUCTION, PROCESS, TECHNOLOGIES DEVELOPED WITH CREDITED SCIENTISTS, PATENTS:

1. Maheswarudu,G., Syda rao, G., Subhadeep Ghosh, Ritesh Ranjan, Biswajit Dash and Muthkrishnan,P. 2011. An experimental study on culture of black tiger prawn, *Penaeus monodon* (Fabricius) in open sea floating cage,p71. In: Gopalakrishnan,A. *et al.* (Eds.), *Renaissance in Fisheries : Outlook and strategies*- Book of Abstracts, 9th Indian fisheries Forum, Central Marine Fisheries Research Institute, Kochi and Asian Fisheries Society, Indian Branch,19-23 December 2011, Chennai, India,381 pp.

2. Maheswarudu,G., Syda Rao,G., Biswajit Dash,Venkatesh, R.P. and Muthukrishanan,P. 2011. Culture of Asian sea bass, *Lates calcarifer* (Bloch,1790) in open sea floating cage off Kakinada coast in the bay of Bengal, p95. In: Gopalakrishnan,A. *et al.* (Eds.), *Renaissance in Fisheries : Outlook and strategies*- Book of Abstracts, 9th Indian fisheries Forum, Central Marine Fisheries Research Institute, Kochi and Asian Fisheries Society, Indian Branch,19-23 December 2011, Chennai, India,381 pp.

3. **Maheswarudu,G**., Syda rao, G., Subhadeep Ghosh, Ritesh Ranjan, Biswajit Dash and Muthkrishnan,P. 2011. Development of nursery rearing system for Asian sea bass, *Lates calcarifer* (Bloch,1790) in the floating cage in sea, p72. In: Gopalakrishnan,A. *et al.* (Eds.), *Renaissance in Fisheries : Outlook and strategies*- Book of Abstracts, 9th Indian fisheries Forum, Central Marine Fisheries Research Institute, Kochi and Asian Fisheries Society, Indian Branch,19-23 December 2011, Chennai, India,381 pp.

4. Ritesh Ranjan, Biji Xavier, Loveson Edward, **Maheswarudu,G.,** Syda Rao,G. and Biswajit Dash. 2011. Open sea floating cage- a device for domestication and broodstock development of gresy grouper, *Epinephelus tauvina* (Forsskal,1775) off Visakhapatnam in the Bay of Bengal, p79. In: Gopalakrishnan,A. *et al.* (Eds.), *Renaissance in Fisheries : Outlook and strategies*- Book of Abstracts, 9th Indian fisheries Forum, Central Marine Fisheries Research Institute, Kochi and Asian Fisheries Society, Indian Branch,19-23 December 2011, Chennai, India,381 pp.

8. INFRASTRUCTURE AND PHYSICAL FACILITIES DEVELOPED (HEAD QUARTERS ONLY):

2009-10

- New photomicrographic equipment procured.
- Two digital vernier calipers procured.
- About 6 balances were procured.
- A data base on low value bycatch along the Indian coast was prepared.
- Video film on lobster conservation in four languages was completed

2010-11

- About 4 numbers of Primer 6.1 software were procured and three were sent to Mumbai, Mangalore and Chennai Research Centres of CMFRI each and one at Cochin.
- The equipments procured under the projects were maintained. A new digital microscope and multiparameter water quality environmental analyzer equipment were procured for the division.

- Specimens of all the species of prawns were collected and brought from Veraval, Mumbai, Karwar, Mangalore, Calicut, Cochin, Vizhinjam, Tuticorin, Mandapam, Chennai, Kakinada and Visakhapatnam, preserved and kept in the division museum for future analysis.
- Tissue samples were collected for molecular taxonomy and handed over to Marine Biotechnology division.
- A new species of lobster recorded from Indian coast *Enoplometopus macrodontus* was entrusted with the National Repository Museum of CMFRI.
- Dissection microscope was procured.

2011-12

The following equipements were procured.

1. Computer (HP)
2. Electronic weighing machine
3. RICOH colour laser printer
4. Canon LBT 3300 laserjet printer
5. Olympus monocular microscope
6. Deep freezer – Horizontal

2012-13

The following equipements were procured.

1. PCR machine (DST project)
2. Gel Documentation system (DST project)
3. Wipro computer
4. HP colour Laser printer

2013-14

The following equipements were procured

1. Binocular compound microscope with image analysis software and digital
2. Data logger
3. Projector
4. Lenova computer

Laboratory facilities developed during 2012-2013: by Dr. Rekha Devi Chakraborty

A store room of all the items present in Room No. 433 was cleaned for a period of 4 months by hiring labours and useful items were stored in wooden racks and unwanted spoiled items were disposed. A wooden partition was made with trasperant glass. A 'L' shaped wooden cupboard was made with a granite on the top for putting all the sophisticated instruments like PCR, Gel documentation system procured from DST-funded project and other items which are needed for research work. An air conditioner was procured from the institute fund which was required for proper working of this equipments. This partition room was painted and curtains were made for the windows. All the research equipments procured from the year 2005 onwards are arranged and maintained properly in this lab.

9. HRD:

HRD Trainings conducted/co-ordinated/organised

1. **Training programme on fish identification:** A training programme under NICRA was conducted on 'Identification of Marine Fin fishes and shell fishes' at VRC of CMFRI, Visakhapatnam from 19th to 25th March, 2012 where staffs of VRC of CMFRI, Visakhapatnam and FRAD staffs from outstation field centres (30 participants) and 8 resource persons participated **(Co-ordinator:Dr.G.Maheswarudu)**

2. **Training programme on open sea cage culture**:A training programme under NICRA was conducted on 'Open Sea cage Culture of Marine Fishes' at VRC of CMFRI, Visakhapatnam with trainees of fishermen community/Society from different parts of Andhra Pradesh from 12-18 March, 2012 under NICRA **(Co-ordinator:Dr.G.Maheswarudu).**

3. Project inception workshop of GIS based resource mapping of distribution and abundance of finfishes and shellfishes off Indian coast for suggesting operational based strategies for fisheries management at Mangalore on August 17 & 18, 2012 **(Co-ordinators: Dr.G.Maheswarudu & Dr.A.P.Dineshbabu)**

4. Workshop on the project "GIS based resource mapping of distribution and abundance of finfishes and shellfishes off Indian coast for suggesting operational based strategies for fisheries management" at CMFRI Mangalore on 7th - 10th January 2014 **(Co-ordinators: Dr.G.Maheswarudu & Dr.A.P.Dineshbabu)**.

5. Crustacean Fisheries Division *brainstorming Meeting* at Chennai Research Centre of CMFRI during 25-27th April 2012 **(Co-ordinator: Dr.G.Maheswarudu).**

6. Workshop on 'Prawn taxonomy: recent advances and revision of nomenclature' from 14th February to 19th February 2011at CMFRI, Cochin ((**Co-ordinators: Dr.E.V.Radhakrishnan & Dr.Josileen Jose)**

7. Training programme on '**Taxonomy and identification of commercially important crustaceans of India'** during **20-24, August 2013. Twenty** participants attended the programme. All the participants were from outside CMFRI, representing various organisations/universities of Indian states, viz., Gujarat, Maharashtra, Kerala, Tamil Nadu & Lakshadweep **(Convenor: Dr.Josileen Jose).**

8. Training Programme on **Taxonomy and identification of commercially important crustaceans of India' during 22-24, January, 2014.** Twenty participants from various Universities and Colleges in and around Kochi participated **(Convenor: Dr.S.Lakshmi Pillai)**.

9. 3 -days hands on Training from 7th to 9th February 2012 on "Marine cage fabrication and installation techniques" for 35 beneficiaries under **NICRA HRD** fund at Veraval Regional Centre of CMFRI **(Co-coordinator: Dr.Gyanranjan Dash).**

10. 37-days training programme from 23rd to 29th February 2012 on "Methodology in Fishery biology, data analysis and record keeping" for 20 beneficiaries under **NICRA HRD** fund at Veraval Regional Centre of CMFRI at Veraval RC of CMFRI **(Co-coordinator: Dr.Gyanranjan Dash).**

11. National level 21 days training on capacity building of members of 'Sidi' Adivasi tribe of Gujarat on open sea mariculture practices during 24th July to 8th August 2012 for 37 beneficiaries under TSP **HRD fund** at Veraval RC of CMFRI **(Co-coordinator: Dr.Gyanranjan Dash).**

    .

12. 21 days training on Better management practices in lobster farming in open sea cages during 22nd February to 13th March 2012 for 25 beneficiaries under **NICRA HRD** fund at Veraval RC of CMFRI **(Co-coordinator: Dr.Gyanranjan Dash).**

    .

Other trainings, workshops, seminars conducted/organised

1. Workshop on 'Analytical methods in fish stock assessment with special emphasis on tuna and tuna like resources' from 7-11 March 2011 under the NAIP Project on A value chain on oceanic tuna fisheries in Lakshadweep sea' at CMFRI, Kochi **(Co-ordinators:Dr.E.V.Radhakrishnan & Dr.Josileen Jose).**

2. **NACA GC meeting** held at Ramada Hotel, Kumbalam, Kochi during 9-11th May, 2011 (**Dr. Josileen Jose**, Member, Organising Committee and represented CMFRI).

3. **NACA/CMFRI International Seminar on 'Emerging issues in Asian Aquaculture',** held at CMFRI HQ, on 12th May, 2011. The seminar was organized jointly by **CMFRI** and **NACA** (*Network of Aquaculture Centers in Asia –Pacific*, intergovernmental organization promotes rural development through sustainable aquaculture), in continuation with the 22nd NACA Governing Council Meeting in Cochin, during 9-11th May, hosted by Government of India. Seminar was attended by delegates from NACA member governments, regional lead centres and international partner organisations (total 20), DDG ICAR, Directors of all Fisheries Institutes of ICAR, All scientists (27) from CIFT Cochin, all Scientists from HQ, Regional and Research centres of CMFRI (101), Senior officials from MPEDA (2), KUFOS (2), ADAK (2), FFDA (2) and Matsyafed (1) and other departments of State Fisheries participated in the programme. (**Dr. Josileen Jose**, **Organiser, for the entire programme** -complete planning & execution without any committee)**.**

4. Workshop on 'Reproductive dynamics and stock assessment of crustaceans' organized by the Crustacean Fisheries Division, CMFRI, Kochi during October, 2009 **(Co-ordinators: Dr.E.V.Radhakrishnan & Dr.V.D.Deshmukh).**

5. Workshop on 'Reproductive dynamics and stock assessment of crustaceans' organized by the Crustacean Fisheries Division, CMFRI, Kochi during 17-23 July, 2011 **(Co-ordinators: Dr.E.V.Radhakrishnan, Dr. Josileen Jose & Dr.V.D.Deshmukh).**

6. Workshop on classification of Invertebrates' on19.8.2009 to the teachers of Sarva Shiksha Abhayan **(Conducted: Dr.P.T.Sarada).**

7. Workshop for compilation of Institute Project 'Resource damage assessment in marine fisheries: impact of selective fishing of juveniles and by- catch and discards in trawl fisheries' (CF/IDP/02) during 27-28th January, 2012 **(Co-ordinator: Dr.Josileen Jose).**

8. National training programme on **Marine Designer Pearl Production**, held at Central marine Fisheries Research Institute, Vizhinjam Research Centre during 19-21 February 2014 (**Co-coordinator: Dr.K.N.Saleela).**

10. BUDGET AND FINANCE:

2009-10

Other charges Rs. 3 lakh w.e.f. 1.8.2009

2010-11

No.	Head	Plan (Rs. In lakh)	Non-Plan (Rs. In lakh)
1	Travelling Expenses	0.50	
2	A. Research Expenses	0.30	0.50
	B. Operational Expenses	0.70	1.50
	Total	**3.5**	

2011-12

No.	Head	Plan (Rs. In lakh)	Non-Plan (Rs. In lakh)
1	Travelling Expenses	0.50	
2	A. Research Expenses	1.00	1.00
	NICRA	1.00	
	B. Operational Expenses	0.70	1.50
	NICRA	3.00	
	Total	**8.7**	

2012-13

No.	Head	Plan (Rs. In lakh)	Non-Plan (Rs. In lakh)
1	Travelling Expenses	1.00	
2	Research Expenses	2.50	2.00
	Operational Expenses	1.00	
	Total	**6.5**	

2013-14

No.	Head	Plan (Rs. In lakh)	Non-Plan (Rs. In lakh)
1	Travelling Expenses	0.50	
2	Research Expenses	2.50	2.50
	Operational Expenses	1.00	
	Total	**6.5**	

11. SWOFT ANALYSIS OF THE DIVISION:

STRENGTH

The division has expertise to conduct stock assessment of all commercially important species of crustacean resoures that are contributing to fishery along all maritime states of India.

STAFF REQUIREMENT

1. This division needs two scientists, one at MRC of CMFRI, Mumbai and the other at MRC of CMFRI, Mandapam Camp to carry out the work under different in house research projects.

2. At present this division is having only two technical staff at Head quarters (Kochi) for assisting four scientists. We need atleast three technical staff.

Centre	Name	Designation	Remarks
Veraval	Gyanaranjan Dash	Scientist	Working in CFD from 14-06-2010 onwards.
Mumbai	Dr.V.D.Deshmukh	Principal Scientist & SIC	Retired on 31-01-2014.
Karwar	Dr.K.K.Philippose	Principal Scientist & SIC	Transferred from CFD to Mariculture Division w.e.f. 15-05-2012.
Mangalore	Dr.A.P.Dineshbabu	Principal Scientist	SIC, MRC of CMFRI, Mangalore up to 13.09.2013
Cochin	1.Dr.E.V.Radhakrishnan	Principal Scientist & Head, CFD	Retired on 31-01-2012.
	2.Dr.G.Maheswarudu	Principal Scientist& Head, CFD	Scientist-in-Charge, VRC of CMFRI, Visakhapatnam up to 14-05-2013. Assumed charge as Head (ASRB selection), CFD from 16-05-2013 onwards.
	3.Dr.Josileen Jose	Principal Scientist	Transferred from Mariculture Division to CFD w.e.f. 14-06-2010.
	4. Dr.S.Lakshmi Pillai	Senior Scientist	Transferred from Chennai to Kochi in 2010
	5.Dr.Rekhadevi Chakaraborty	Senior Scientist	
Vizhinjam	Mrs.K.N.Saleela	Scientist(SS)	
Tuticorin	Mrs. P.T. Sarada	Senior Scientist	Transferred from Calicut to Tuticorin on 09-08-2010.
Mandapam	Dr.M.Rajamani	Principal Scientist	Retired on 31-05-2010.
Chennai	Indira Divipala	Scientist	Working in CFD from 23-04-2012 onwards.
Visakhapatnam	Rajendra Naik	Scientist	Working in CFD from 27-04-2012 onwards.