Observations on Deep Sea Demersal Resources in the Exclusive Economic Zone off Southwest Coast of India

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Results of 60 deep sea trawling operations conducted from FORV *Sagar Sampada* in the Exclusive Economic Zone off southwest coast of India, during cruise Nos. 97 and 99, January-April 1992, are presented in this paper with a view to substantiate or update the existing database on deep sea resources. 95.7 tonnes of fish and shellfish were landed during a total trawling effort of 55 h 30 min spread over 17-7°N lat., within 50-500 m depth. *Nemipterus* was the most dominant species contributing 66.7% of the total landings, followed by *Decapterus* sp. 9.7%, *Priacanthus* sp. 5.9%, *Centrolophus* sp. 5.0%, *Chlorophthalmus* sp. 2.3%, large elasmobranchs 1.2%, *Saurida* sp. 1.2%, *Trichiurus auriga* 1.1%, deep sea prawns 0.8%, *Sphyraena* sp. 0.5%, deep sea lobster 0.4%, cephalopods 0.4%, high value perches 0.2%, *Neopinnula* sp. 0.2%, *Psenes* sp. 0.2%, swarming crabs (*Charybdis* sp.) 0.2%, catfish 0.1% and miscellaneous fish 3.9%. Distribution of CPUE for total catch and for quantitatively and economically significant species groups are given by depth and latitude zones.

Fishery investigations in the recent past have given a fairly clear picture of the potential for deep sea resources in the Indian EEZ, beyond 50 m depth. Several resource categories such as bullseye (*Priacanthus* sp.), Indian drift fish (*Psenes* sp.), black ruff (*Centrolophus* sp.), greeneye (*Chorophthalmus* sp.) and deep sea prawns are known to occur in fishable concentrations and several others such as threadfin bream (*Nemipterus* sp.), scad (*Decapterus* sp.), ribbonfish (*Trichiurus* sp.) lizard fish (*Saurida* sp.), barracuda (*Sphyraena* sp.), catfish (*Arius* sp.), mackerel (*Rastrelliger* sp.) and deep sea lobster (*Puerulus sewelli*), are known in areas beyond their traditional fishing zones (Joseph, 1984; Oommen, 1985, 1989; Sivaprakasam, 1986; James *et al.*, 1986; James & Narayana Pillai, 1990; Sivakami, 1990; Bande *et al.*, 1990; Somasekharan Nair & Reghu, 1990; Suseelan *et al.*, 1990a,b; Sudarsan *et al.*, 1991).

Recent information on the availability of deep sea fish and shellfish resources off southwest coast of India, between Ratnagiri and Cape Comorin, is presented in this paper, based on the results of deep sea trawling operations conducted from FORV *Sagar Sampada*, during January and March-April 1992.

Materials and Methods

The data for the present study were obtained during cruise Nos. 97 (Second lap: 10-27 Jan. 1992) and 99 (10 March-10 April 1991) of FORV *Sagar Sampada*. FORV *Sagar Sampada* is a dedicated fishery oceanographic research vessel owned by Department of Ocean Development, Govt. of India. A stern trawler of 71.5 m LOA, 2285 hp at 775 rpm, equipped with sophisticated gear handling and acoustic instrumentation, it has the capability of bottom trawling upto 1000 m depth.

A total of sixty deep sea trawling operations were conducted in the Exclusive Economic Zone off southwest coast of India, between 17° and 7°N lat., within 50-500 m depth (Fig.1). Specifications of demersal trawls used for the fishing operations are given in Table 1. 38 m High Speed Demersal Trawl II, 38 m Hybrid trawl and 32 m

Bobbin trawl are described by Panicker (1990). Design details of 50 m Large Mesh Rectangular trawl and 50 m Large Mesh HSDT-II are given in Figs. 2 and 3, respectively. Gear dependant variation was assumed to be not significant for purposes of arriving at areawise catch rates.

Mean catch per unit effort ($kg.h^{-1}$) was computed for each degree latitude from 17° to 7°N among three different depth zones viz., 50-100, 100-200, 200-500 m. Catch composition was analysed for the three depth zones in the northern (17-13°N lat.), central

Table 1. *Particulars of bottom trawling gear and accessories and operational details.*

(a) Trawl gears:

1. *38 m High Speed Demersal Trawl - II (HSDT-II)*

   Two - panel construction with two bridles; headrope: 38.0 m; footrope: 44.5 m; rubline; ca. 750 kg; mesh size: 40 mm in the codend gradually increasing to 130 mm in the front trawl sections.

   No of hauls: 14; total towing duration: 13 h 25 min; towing speed: 3-3.5 kn; mean catch rate: 1677.8 kg. h^{-1}

2 *38 m Hybrid trawl*

   Two - panel construction with two bridles; headrope: 38.0m; footrope: 46.0 m; rubline: ca. 750 kg; mesh size: 50 mm in the codend gradually increasing to 200 mm in the front trawl sections.

   No. of hauls: 10; total towing duration: 9h 15 min; towing speed: 3-3.5 kn; mean catch rate: 2837.6 kg. h^{-1}

3. *50 m Large Mesh Rectangular trawl*

   Four - panel construction with two bridles; headrope: 50.0 m; footrope: 70.0 m; rubline: ca. 750 kg; mesh size: 50 mm in the codend gradually increasing to 300 mm in the front trawl sections.

   No. of hauls: 22; total towing duration: 20 h 15 min; towing speed: 3-3.5 kn; mean catch rate: 1095.2 kg. h^{-1}.

4. *50 m Large Mesh HSDT-II*

   Two - panel construction with two bridles; headrope: 50.0 m; footrope: 65.0 m; rubline: ca. 750 kg; mesh size: 50 mm in the codend gradually increasing to 300 mm in the front trawl sections.

   No. of hauls: 12; total towing duration: 11 h 35 min; towing speed: 3-3.5 kn; mean catch rate: 1873.6 $kg.h^{-1}$

5. *32 m Bobbin trawl*

   Two - panel construction with two bridles; headrope: 32.0 m; footrope: 43.0 m; bobbin rig (rubber roller bobbins): ca. 1500 kg; mesh size: 50 mm in the codend, gradually increasing to 140 mm in the front trawl sections.

   No. of hauls: 2; total towing duration: 1 h; towing speed: 3-3.5 kn; mean catch rate: 3007.0 $kg.h^{-1}$

(b) *Trawl doors*

PERFECT (Denmark) Economy model V-shaped trawl doors of 285x180 cm size and approximately 2800 kg weight per set, with through flow and square keel with wearing surface.

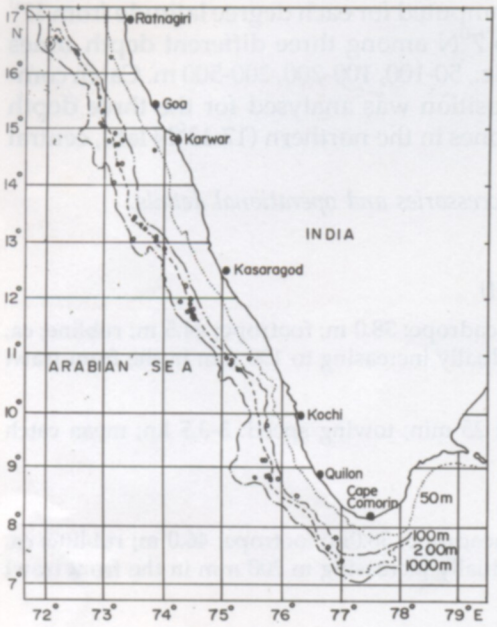

Fig 1. Demersal trawling stations

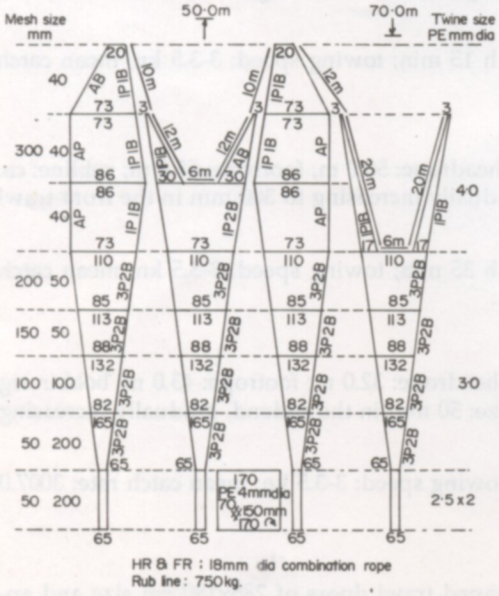

Fig 2. Design of 50 m large mesh rectangular trawl

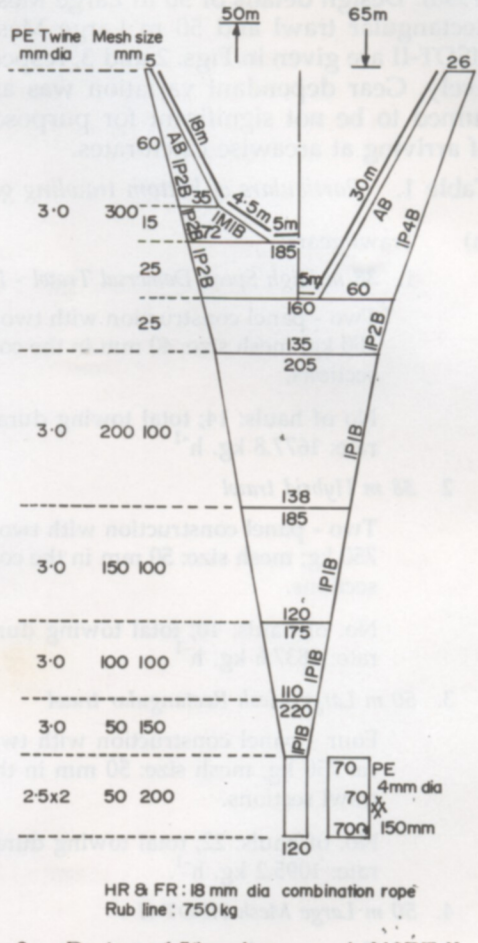

Fig 3. Design of 50 m large mesh HSDT-II

(13-9°N lat.) and southern (9-7°N lat.) sub-areas. Spatial distribution of CPUE for abundant and economically important species groups were individually analysed.

Results and Discussion

A total of 95.7 tonnes of fish and shellfish was landed during a total towing effort of 55h 30 min, realising an overall mean catch rate of 1723.3 kg. h^{-1}. Spatial distribution of effort is given in Table 2a. Distribution of yield (kg.h^{-1}) in terms of total catch is given in Table 2b. Catch rates of important species groups in different sub-areas and depth zones are given in Table 3.

Within 50-100 m depth zone, northern (17-13°N lat.) central (13- 9° N lat.) and southern (9-7°N lat.) sub-areas yielded respectively, 72.0, 142.5 and 115.0 kg.h^{-1}. Overall catch rate for the area covered under this depth zone was 105.5 kg.h^{-1}. The landings consisted of *Decapterus* sp. 39.6%, high value perches 17.6%, cephalopods 12.0%, catfish 7.6%, mackerel 5.2%, *Nemipterus* sp. 4.3%, large elasmobranchs 3.1%, *Priacanthus* sp. 0.9% and miscellaneous fish 9.7%.

Between isobaths of 100 and 200 m, northern sub-area yielded maximum catch rate of 3924.4 kg.h^{-1} followed by southern sub-area (1545.3 kg.h^{-1}) and central sub-area (682.0 kg.h^{-1}). Overall average for this depth zone was 2919.8 kg.h^{-1}. *Nemipterus* sp. which formed 77.3% dominated the landings, followed by *Decapterus* sp. 10.8%, *Priacanthus* sp. 6.6%, *Saurida* sp. 1.2%, large elasmobranchs 0.8%, *Sphyraena* sp. 0.6%, cephalopods 0.4%, swarming crabs (*Charybdis* sp.) 0.2%, *Psenes* sp. 0.2%, high value perches 0.1%, deep sea lobster 0.1%, and miscellaneous fish 1.7%.

Beyond 200 m isobath, southern sub-area yielded the maximum catch with

Table 2a. *Distribution of fishing effort by latitude and depth zones*

Latitude	Trawling effort in min				
	50-100 m zone	100-200 m zone	200-500 m zone	Total	Percentage
17-16°N	90*	300	60	450	13.5
16-15°N	-	165	120	285	8.6
15-14°N	60	285	90	435	13.1
14-13°N	-	345	55	400	12.0
13-12°N	-	120	-	120	3.6
12-11°N	-	180	480	660	19.8
11-10°N	60	60	145	265	8.0
10-9°N	60	-	120	180	5.4
9-8°N	-	100	255	355	10.7
8-7°N	60	120	-	180	5.4
Total	330	1675	1325	3330	100.0
Percentage	9.9	50.3	39.8	100.0	

Table 2b. *Distribution of CPUE of total catch by latitude and depth zones*

Latitude	CPUE, kg.h^{-1}			
	50-100 m zone	100-200 m zone	200-500 m zone	Average 50-500 m
17-16°N	35.5*	2940.0	45.0	1986.3
16-15°N	-	3789.8	30.0	2206.7
15-14°N	28.0	6420.4	24.7	4215.5
14-13°N	-	2783.0	5.5	2401.1
13-12°N	-	1013.0	-	1013.0
12-11°N	-	650.3	573.1	594.2
11-10°N	250.0	115.0	578.5	399.2
10-9°N	35.0	-	292.5	206.7
9-8°N	-	2949.0	1609.9	1987.1
8-7°N	115.0	440.0	-	331.7
Average	105.7	2919.7	613.9	1723.3

*Includes a single operation of 30 min duration at <50 m depth on Angria bank; - no trawling operations

1824.5 kg.h^{-1} followed by central sub-area with 529.0 kg.h^{-1} and northern sub-area with 27.1 kg.h^{-1}. Overall average was 614.0 kg.h^{-1}. and dominant catch components were *Centrolophus* sp. 35.6% and *Chlorophthalmus* sp. 16.1%, followed by *Trichiurus auriga* 7.4%, *Nemipterus* sp. 5.9%, deep sea prawns 5.4%, large elasmobranchs 3.3%, deep sea lobster (*Puerulus sewelli*) 2.1%, *Priacanthus* sp. 2.1%, *Decapterus* sp. 1.5%, *Neopinnula* sp. 1.4%, *Saurida* sp. 1.3%, cephalopods 0.3% and miscellaneous fish 17.6%.

Distribution of CPUE of most abundant and economically important species groups are given in Table 4. *Nemipterus* sp. was the most abundant single species and formed 66.7% of the total landings. Maximum yield of *Nemipterus* sp. was obtained from 100-200 m depth zone. In this depth zone 15-14°N lat. yielded the maximum CPUE of 6089.5 kg.h^{-1}, followed by 16-15° N lat. (3458.2 kg.h^{-1}), 17-16°N lat. (2615.0 kg.h^{-1}), 14-13°N lat (1391.7 kg.h^{-1}) with diminution of catches to further south. Within 50-100 m depth catches were poor

Table 3. *Catch rates of important species groups in different sub-areas and depth zones*

	Northern sub-area 17-13°N lat.	Central sub-area 13-9°N lat.	Southern sub-area 9-7°N lat.	Total 17-7°N lat.
(a) 50-100 m depth zone:				
Decapterus sp.	6.0	100.0	15.0	41.8
High value perches	10.0	2.0	73.0	18.6
Cephalopods	10.0	12.5	20.0	12.7
Catfish	16.0	-	4.0	8.0
Mackerel	12.0	-	-	5.5
Nemipterus sp.	-	12.5	-	4.5
Large elasmobranchs	6.0	-	3.0	3.3
Priacanthus sp.	-	2.5	-	0.9
Misc. fish	12.0	13.0	-	10.2
Total	72.0	142.5	115.0	105.5
(b) 100-200 m depth zone:				
Nemipterus sp.	3262.0	580.0	-	2257.2
Decapterus sp.	462.8	1.7	100.0	316.3
Priacanthus sp.	43.7	7.0	1205.3	192.0
Saurida sp.	44.5	12.5	24.0	35.0
Large elasmobranchs	31.2	8.3	16.0	24.4
Sphyraena sp.	27.6	-	-	18.1
Cephalopods	8.8	8.3	2.6	10.4
Swarming crabs	-	24.7	18.7	5.3
Psenes sp.	7.8	-	-	5.1
High value perches	4.4	-	5.3	3.6
Deep sea lobster	-	-	24.0	3.2
Misc. fish	28.7	39.5	149.3	49.2
Total	3924.4	682.0	1545.3	2919.8
(c) 200-500 m depth zone:				
Centrolophus sp.	1.6	266.6	400.0	218.5
Chlorophthalmus sp.	0.7	38.5	453.3	98.8
Trichiurus auriga	-	8.2	240.0	45.4
Nemipterus sp.	0.9	-	213.3	36.5
Deep sea prawns	4.6	41.8	49.3	33.0
Large elasmobranchs	-	23.4	42.7	20.4
Deep sea lobster	-	22.7	77.1	13.1
Priacanthus sp.	14.8	-	53.3	12.7
Decapterus sp.	-	-	53.3	9.1
Neopinnula sp.	-	6.9	29.3	8.8
Saurida sp.	-	5.7	45.6	7.7
Cephalopods	1.3	2.0	4.0	2.1
Misc. fish	1.2	113.2	257.3	107.9
Total	27.1	529.0	1824.5	614.0

and beyond 200 m isobath a catch rate of 188.2 kg.h^{-1} was obtained in 9-8°N lat. Somasekharan Nair & Reghu (1990) have observed maximum abundance of *Nemipterus* sp. within 41-80 m depth and comparatively poor yield in deeper waters beyond 100 m, along southwest coast. It is pertinent to note that, during the period of present investigations, maximum concentration of *Nemipterus* sp. was found to be between isobaths of 120 and 170 m. Catch rates of over 10 tonnes h^{-1} were obtained off Ratnagiri 16° 30-34' N lat. 72°13-16'E long. (150-170 m depth) and Karwar 14°23-42'N lat. 73° 13-18' E long. (151-166 m depth).

Decapterus sp. which formed 9.7% of the total landings gave maximum yield of 1120.2 kg.h^{-1} from 14-13° N lat. in the 100-200 m depth zone, followed by 11-10°N lat. in 50-100 m depth zone (200.0 kg.h^{-1}). Catch rates of over 130 kg.h^{-1} were obtained from latitudes 17-14°N, within 100-200 m depth zone. Beyond 200 m isobath, 9-8°N lat. yielded 47.1 kg.h^{-1}.

Priacanthus sp. which was widely represented above 100 m isobath, formed 5.9% of the total landings. Maximum CPUE of 2700 kg.h^{-1} was obtained from 9-8°N, followed by 102.1 kg.h^{-1} from 15- 14°N lat. in the 100-200 m depth zone. Much lower catch rates were realised in other latitude and depth zones.

Centrolophus sp. and *Chlorophthalmus* sp. formed 5.0% and 2.3% respectively of the total catch. Both the species were represented in depths beyond 200 m. Latitudes 12-11° and 10- 9°N yielded a catch rate of 350 kg.h^{-1} and above, of *Centrolophus* sp. followed by 11-10°N with 206.9 kg.h^{-1}. Maximum CPUE of 400.0 kg.h^{-1} of *Chlorophthalmus* sp. was obtained from 9-8°N lat.

Deep sea prawns formed 0.8% of the total catch and 5.4% of the landings from

Table 4. *Distribution of CPUE of abundant and economically important species groups by latitude and depth zones.*

Latitude	CPUE, kg.h^{-1}			CPUE, kg.h^{-1}		
	50-100 m zone	100-200 m zone	200-500 m zone	50-100 m zone	100-200 m zone	200-500 m zone
	(1) *Nemipterus* sp			(2) *Decapterus* sp.		
17-16°N	0.0	2615.0	5.0	0.0	166.0	0.0
16-15°N	-	3458.0	0.0	-	134.5	0.0
15-14°N	0.0	6089.5	0.0	15.0	169.5	0.0
14-13°N	-	1391.7	0.0	-	1120.2	0.0
13-12°N	-	925.0	-	-	0.0	-
12-11°N	-	533.3	0.0	-	0.0	0.0
11-10°N	25.0	30.0	0.0	200.0	10.0	0.0
10-9°N	0.0	-	0.0	0.0	-	0.0
9-8°N	-	0.0	188.2	-	0.0	47.1
8-7°N	0.0	0.0	-	15.0	187.5	-
	(3) *Priacanthus* sp.			(4) *Centrolophus* sp.		
17-16°N	0.0	4.0	25.0	0.0	0.0	0.0
16-15°N	-	60.0	17.5	-	0.0	4.0
15-14°N	0.0	102.1	13.3	0.0	0.0	2.0
14-13°N	-	22.3	0.0	-	0.0	3.3
13-12°N	-	1.0	-	-	0.0	-
12-11°N	-	0.0	0.0	-	0.0	350.0
11-10°N	5.0	40.0	0.0	0.0	0.0	206.9
10-9°N	0.0	-	0.0	0.0	-	5.0
9-8°N	-	2700.0	47.1	-	0.0	352.9
8-7°N	0.0	10.0	-	0.0	0.0	-
	(5) *Chlorophthalmus* sp.			(6) Deep sea prawns		
17-16°N	0.0	0.0	0.0	0.0	5.0	5.0
16-15°N	-	0.0	0.0	-	0.0	6.0
15-14°N	0.0	0.0	1.3	0.0	0.0	5.3
14-13°N	-	0.0	2.2	-	0.0	0.0
13-12°N	-	0.0	-	-	0.0	-
12-11°N	-	0.0	29.4	-	0.0	34.5
11-10°N	0.0	0.0	74.9	0.0	0.0	17.8
10-9°N	0.0	-	30.0	0.0	-	100.0
9-8°N	-	0.0	400.0	-	0.0	43.5
8-7°N	0.0	0.0	-	0.0	0.0	-
	(7) Deep sea lobster			(8) Cephalopods		
17-16°N	0.0	0.0	0.0	13.3	1.0	7.0
16-15°N	-	0.0	0.0	-	10.9	0.0
15-14°N	0.0	0.0	0.0	5.0	11.8	0.0
14-13°N	-	0.0	0.0	-	12.2	0.0
13-12°N	-	0.0	-	-	12.5	-
12-11°N	-	0.0	16.3	-	8.3	0.0
11-10°N	0.0	0.0	60.8	10.0	0.0	0.0
10-9°N	0.0	-	2.5	15.0	-	12.5
9-8°N	-	54.0	1.7	-	6.0	14.1
8-7°N	0.0	0.0	-	20.0	0.0	-

200-500 m depth zone. Maximum CPUE of 100 kg. h^{-1} was obtained from 10-9°N lat., followed by 43.4, 34.5 and 17.8 kg. h^{-1} from latitudes 9-8°, 12-11° and 11-10°N. Deep sea lobster (*Puerulus sewelli*) formed 0.4% of the total catch and 2.1% of the yield of 200-500 m depth zone. Within 100-200 m depth zone, a CPUE of 54.0 kg.h^{-1} was obtained in 9-8°N lat. Beyond 200 m depth, a CPUE of 60.8 kg.h^{-1} was obtained in 11-10°N lat. followed by 16.3 kg.h^{-1} in 12-11°N lat. Earlier resource surveys have revealed the potential of deep sea crustacean resources off southwest coast (Mohamed & Suseelan, 1973; Oommen, 1980; Suseelan, 1974, 1990a,b). During the period of present investigations, catch rates for deep sea prawns of 100-125 kg. h^{-1} were obtained specifically from 11°45-48'N lat. 74°25-29'E long. (334-450 m depth) off Tellicherry and catch rates of 75-100 kg. h^{-1} were obtained from 8°48'-9°07'N lat. 75°36-54'E long (306-339 m depth) off Quilon. For deep sea lobster, catch rate of 90 kg. h^{-1} was obtained from 8°50-53'N lat. 76°04'E long. (166-220 m depth) off Quilon. Catch rates of 100-130 kg.h^{-1} were obtained from 11° 43-45'N lat. 74°28-29'E long. (334-450 m depth) and 10°51-53'N lat. 75°14-16'E long. (282-286 m depth) off Ponnani - Tellicherry. Solitory obstructions hazardous to deep sea trawling were occasionally noticed in the grounds off Ponnani.

Cephalopods (squids, cuttlefish and octopus) have a wide representation in different latitude and depth zones. Catch rates ranged from 5 to 15 kg.h^{-1} among different latitudes in the 50- 100 m depth zone. Catch rates ranging from 8.3 to 12.5 kg.h^{-1} were obtained from latitudes 16-11°N, in the 100-200 m depth zone. Beyond 200 m depth, higher catch rates of 12.5 and 14.1 kg.h^{-1} were realised from 9-8° and 8-7°N lat followed by 7.0 kg.h^{-1} from 17-16°N lat.

Cost of production of deep sea resources, it is generally recognised, tends to be com-

paratively high in view of depth, distance from the shore and greater capital and operational investment on vessel and equipment (Sivaprakasam, 1986; Srivastava *et al.*, 1991). Besides, the current market value of most of the deep sea demersal resource components is poor except for a few having export market such as deep sea lobster and cephalopods. Enhanced utilization of deep sea resources, hence, would involve optimisation of harvesting logistics so as to minimise overall cost of unit production, on the one hand and on the other, generation of favourable market forces by consumer education on nutritional aspects of deep sea fish and shellfish and development of diversified, value-added products including surimi based specialities with greater consumer appeal and export demand. Resource categeories which would attract special attention along the southwest coast are threadfin bream, scad, bullseye, black ruff, greeneye, elasmobranchs, lizardfish, ribbonfish, barracuda, cephalopods, perches, crabs, drift fish and catfish. Deep sea crustacean resources along southwest coast which are currently under varying degrees of commercial fishing pressure need to be carefully monitored to ensure that the yield does not exceed the maximum sustainable level.

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References

Bande, V.N., Gopinatha Menon, N. & Balachandran, K. (1990) *Proc. First Workshop Scient. Resul. FORV Sagar Sampada* 5-7 June 1989, Cochin, 233

James, P.S.B.R., Alagaraswamy, K., Narayana Rao, K.V., Muthu, M.S., Rajagopalan, M.S., Alagaraja, K. & Mukundan, G. (1986) *Potential marine fishery resources of India.* Seminar on Potential Marine Fishery Resources held on April 23, 1986, CMFRI, Cochin

James, P.S.B.R. & Narayana Pillai, V. (1990) *Proc. First Workshop Scient. Resul. FORV Sagar Sampada* 5-7 June 1989, Cochin, 201

Joseph, K.M. (1984) *Bull. Fish. Surv. India,* **13**,*1*

Mohammed, K.H. & Suseelan, C. (1973) *Proc. Symp. Living Resources of the Seas around India Spl. Pub. CMFRI, India,* 614

Oommen, V.P. (1980) *Integrated Fisheries Project Bull.* **4**, 49 p

Oommen, V.P. (1985) *Integrated Fisheries Project Bull.* **11**, *83 p*

Oommen, V.P. (1989) *Integrated Fisheries Project Bull.* **12**, 106 p

Panicker, P. A. (1990) *Proc. First workshop Scient. Resul. FORV Sagar Sampada* 5-7 June 1989, Cochin, 427.

Sivaprakasam, T.E. (1986) *Fish. Surv. India Occasional paper* **4**

Sivakami, S. (1990) *Proc. First Workshop Scient. Resul. FORV Sampada* 5-7 June 1989, Cochin, 215

Somasekharan Nair, K.V. & Reghu, R. (1990) *Proc. First Workshop Scient. Resul. FORV Sagar Sampada* 5-7 June 1989, Cochin, 239

Srivastava, U.K., Dholakia, B.H., Vathsala, S. & Chidambaram, K. (1991) *Fishery Sector of India.* CMA Monograph 148, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 436 p

Sudarsan, D., John, M.E. & Somavanshi, N.S. (1991) *Bull. Fish. Surv. India,* **20**

Suseelan, C. (1974) *J. Mar. Biol. Ass. India,* **16**(2), 491

Suseelan, C., Nandakumar, G. & Rajan, K.N. (1990a) *Proc. First Workshop Scient. Resul. FORV Sagar Sampada* 5.-7 June 1989, Cochin, 337

Suseelan, C., Muthu, M.S., Rajan, K.N., Nandakumar, G., Kathirvel, M., Neelakanda Pillai, N., Surendranatha Kurup, N. & Chellappan, K. (1990b) *Proc. First Workshop Scient. Resul. FORV Sagar Sampada* 5-7 June 1989, 437