Proceedings of the Second Workshop on Scientific Results of *FORV Sagar Sampada*

Editors

V.K. Pillai
S.A.H. Abidi
V. Ravindran
K.K. Balachandran
Vikram V. Agadi

Department of Ocean Development
Government of India
New Delhi
1996

Department of Ocean Development (DOD)
Government of India
Mahasagar Bhavan, Block No-12
C.G.O. Complex, Lodi Road
New Delhi-110 003
India

ISBN : 81-900656-0-2

Citation Styles

For entire volume

Pillai, V.K. Abidi, S.A.H., Ravindran, V., Balachandran, K.K. & Agadi, V.V. (Eds.) 1996. *Proceedings of the Second Workshop on Scientific Results of FORV Sagar Sampada*, (Department of Ocean Development, New Delhi), pp. 564.

For individual article

Goswamy, S.C. & Shrivastava, Y. 1996. Zooplankton standing stock, community structure and diversity in the northern Arabian Sea, In: *Proceedings of the Second Workshop on Scientific Results of FORV Sagar Sampada*, edited by V.K. Pillai, S.A.H. Abidi, V. Ravindran, K. K. Balachandran & V.V. Agadi, (Department of Ocean Development, New Delhi), pp. 127-137.

Designed and Printed by:

Publications & Information Directorate
Council of Scientific & Industrial Research
Pusa Campus, New Delhi-110 012
India

Proc. Second Workshop Scient. Resul. FORV Sagar Sampada, 1996, pp. 363–374

Threadfin breams and lizard fish resources in the shelf waters of the Indian EEZ

K.V.S. Nair, R. Reghu, K. Balachandran, N. Gopinatha Menon, S.K. Chakraborty, P.U. Zacharia, E. Vivekanandan, G. Mohanraj, V.S. Rengaswamy & S.G. Raje

Central Marine Fisheries Research Institute, P.B.No. 1603, Cochin - 682 014

ABSTRACT

The regional and seasonal distribution and abundance of threadfin breams and lizard fish are presented as revealed by the bottom trawling operations of *FORV Sagar Sampada* during cruises 56-91 (1989 and 1992). The threadfin breams occurred in 49 and lizard fish in 25% of the total number of bottom trawling stations surveyed. The most productive grounds for threadfin breams were located in the southwest coast between 8° and 15° N latitudinal zones, with the area 11°/75° yielding the highest average catch rate of 1794 kg/hr. Very high congregation and concentration of threadfin breams, composed mainly of *Nemipterus mesoprion* and *N. japonicus*, was observed in the southwest in 41- 80 m depth zones during southwest monsoon period. Lizard fish resources, composed mainly of *Saurida tumbil* and *S. undosquamis* were also relatively more dominant in the southwest coast than along the east coast and in the EEZ of Andaman-Nicobar islands. The size distribution of *N. japonicus* and *N. mesoprion* showed that smaller modal groups were dominant in shallower depth zones. The potential yield of threadfin breams in the southwest zone was estimated to be 2.05×10^5.

INTRODUCTION

The threadfin breams constituted mainly by *Nemipterus mesoprion* and *N. japonicus* form an important constituent of the exploited demersal fishery resources of India. The estimated annual production of this resource is only 67000 tonne (average for 1988-90), which is caught mainly by small mechanised shrimp trawlers from the coastal waters of the shelf within 50 m depth. The exploratory survey conducted by the larger vessels have indicated very rich fishing grounds for threadfin breams in relatively deeper depth zones of the shelf above 50 m depth (Silas, 1969; Sudarsan *et al.* 1988, 1989). James *et al.* (1987) have identified threadfin breams as one of the most promising resources existing along both the coasts having good potential for increased exploitation. The lizard fish, comprising mainly of *Saurida tumbil* and *S. undosquamis*,

is another important component of the demersal resources along the coasts of India. Against an estimated potential of 48000 tonne, the average annual landing of the resource is only about 24000 tonne. James & Pillai (1989) have listed threadfin breams and lizard fish as two major exploited resources offering scope for increased production from depths beyond 50 m. Nair & Reghu (1989), and Sivakami (1989) also indicated these resources to be more abundant in 50-100 m depth zones along both the coasts. The present paper deals with the areawise, bathymetric and seasonal distribution and abundance of threradfin breams and lizard fish on the shelf mainly beyond 50 m depth, in the EEZ of India.

MATERIALS AND METHODS

The catch and effort data collected by the bottom trawling operations of *FORV Sagar Sampada* during cruise no. 56-91 conducted between 1989 and 1992 were utilised for the study. The trawling was conducted usually for one hour at each of the bottom trawling stations. After recording the total catch, species composition etc. random samples were collected from each haul for biological investigations. For analysis of the data the area surveyed was divided into southwest, southeast, northeast and Andaman & Nicobar Island regions. The region was further divided into 1° fishing grids each representing an area of about 12372 km^2. The stock size by depth was computed at 20 m depth interval for each latitude zone. The depthwise species composition and size distribution of the dominant species were determined for each latitude zone. Standing stock for the 50-100 m depth zone was estimated using the swept area method (Gulland, 1971).

RESULTS

Threadfin breams

Geographical abundance - The most productive area for threadfin breams was the 50-100 m depth zone of the southwest region which gave an average catch rate of 698 kg/hr (Table 1). It accounts for about 66% of the total fish catch. The southeast region showed a catch rate of about 54 kg/hr, which formed 12% of the total trawl catch. The northeast zone realised a catch rate of 19 kg/hr, while the least productive zone was found to be the EEZ of Andaman and Nicobar islands. In the southeast zone the threadfin bream catch rates were relatively poor ranging from 0.5 to 2.3 kg/hr. In the northeast the potential yield was slightly higher compared to the southeast region. The fishing grid 19°N/85°E registered a catch rate of over 35 kg/hr. In the Andaman-Nicobar waters the resource was recorded mainly in the northern latitudes, the catch rates ranging from 0.3 to 1.5 kg/hr. It may be mentioned that comparatively lesser fishing effort only could be expended in the Andaman & Nicobar area due to the untrawlable nature of the sea bottom.

The areawise distribution and abundance of threadfin breams for each 1° grid within 100 m depth line of the Indian EEZ is given in Table 1. In the southwest zone

Table 1 - Area-wise abundance of threadfin breams in the Exclusive Economic Zone of India

Area (N°/E°)	Catch rate (kg/hr)	Area (N°/E°)	Catch rate (kg/hr)
Southwest		Southeast	
8°/76°	706	10°/80°	0
8°/77°	30	11°/70°	-
9°/75°	261	12°/80°	0
9°/76°	1390	13°/80°	2
10°/75°	1037	14°/80°	1
11°/74°	100	15°/80°	267
11°/75°	1793	Average	54
12°/74°	185	Northeast	
13°/74°	235	16°/81°	0
14°/73°	60	17°/82°	0
14°/74°	5	18°/84°	0
15°/73°	500	19°/85°	35
Average	698	19°/86°	0
Andaman & Nicobar islands		Average	19
10°/92°	0		
11°/92°	1		
12°/92°	0		
12°/93°	0		
13°/92°	0		
Average	0		

the fishing sector 11°N/75°E yielded the highest average catch rate of 1793 kg/hr. The area 9°N/76°E and 10°/75°E also recorded catch rates of above 1000 kg/hr. Comparatively rich grounds yielding catch rates of over 500 kg/hr were observed in 8°N/76°E and 10°N/78°E. The fishing sector 8°N/77°E, 11°N/74°E, 14°N/73°E and 14°N/74°E indicated relatively low yield for this resource. During the course of the survey very high concentration of threadfin breams was noticed in the 50-100 m depth zone of the southwest region particularly during the southwest monsoon period. Some of the bottom trawling stations which recorded such very high catch rates were 11°75'N/23°04' E (14 tonne), 8°54'N/19°06'E (5.6 tonne/hr), 9°19'N/76°02'E (10 tonne/hr), 9°N/76°04'E (4.9 tonne/hr), 9°52'N/75°53'E (1.8 tonne), 10°30'/75°40' (7.0 tonne/hr), 11° N/75°24'E (2.4 tonne/hr), 11°28'N/75°07'E (2.3 tonne/hr) and 15°N/73°38'E (1.5 tonne/hr).

Bathymetric distribution and abundance - The depth-wise abundance showed that for the southwest region as a whole the depth zone 61-80 m was the most productive with a mean catch rate of 2175 kg/hr (Table 2). The depth zone 41-60 m at an average catch rate of 510.8 kg/hr, was also comparatively rich. The depth-wise abundance along different latitudinal zones indicated the threadfin breams to be more abundant at 60-80 m depth range between 9° and 11°N latitudes. In the southeast region the maximum abundance of threadfin breams was seen in 80-100 m depth zones. In 15°N zone the highest catch rate was recorded at 80-100 m depth range, while in southern latitudes the peak catch rates occurred at 60-80 m depths. In the northeast the bathymetric zone 80-100 m was the most productive, with catch rate of 46 kg/hr. In both southeast and northeast regions the catch rates of threadfin breams showed a decreasing trend with decreasing depth. In the EEZ of Andaman and Nicobar islands also the catch rates were relatively higher in deeper grounds.

Seasonal abundance - The seasonal distribution of the resource in the southwest region indicated that threadfin breams generally migrate and concentrate in the 40-80 m depth zones during the southwest monsoon season especially during July-August (Table 3). This congregation of the resource is more pronounced between 8° and 11°N latitudinal zones, where it supports a lucrative monsoon fishery. The season-wise coverage in the EEZ of southeast, northeast and Andaman-Nicobar waters is not sufficient to arrive at a conclusion on the seasonally of the distribution, availability and abundance of the resource.

Species composition - In the southwest region the threadfin breams in the shallower depth zones up to 60 m depths is composed almost equally of *Nemipterus japonicus* and *N. mesoprion* along with small quantities of *N. tolu*. Along 9° and 10°N latitudes *N. japonicus* predominated in the inner shelf (Table 4). In the deeper zones, *N. mesoprion* was the predominant species constituting about 80% of the catch. Along with *N. japonicus* and *N. mesoprion* in the southeast region *N. metopias* and *N. bleekeri* also formed a significant portion of the catch. In the northeast zone *N. mesoprion* formed the major species in 60-80 m depth strata while in 80-100 m depth

Table 2 - Depthwise abundance of threadfin breams along different latitudes in the Exclusive Economic Zone of India (kg/hr)

Lat. (°N)	Depth range			Average
	40-60 m	60-80 m	90-100 m	
Southwest				
8°	806	-	6	406
9°	995	1755	-	943
10°	67	3507	0	1191
11°	494	5597	200	2097
12°	470	15	-	242
13°	470	-	-	470
14°	32	-	-	32
15°	750	0	-	375
Average	510	2175	68	698
Southeast				
10°	-	1	0	0
11°	-	-	-	-
12°	0	-	-	0
13°	0	7	0	2
14°	1	-	-	1
15°	-	3	532	267
Average	0	3	177	54
Northeast				
16°	0	-	-	0
17°	0	-	-	0
18°	-	0	-	0
19°	1	16	46	21
Average	0	8	46	19
Andaman & Nicobar islands				
6°	0	-	-	0
8°	0	-	-	0
10°	-	10	0	0
11°	-	0	3	1
12°	-	0	0	0
13°	0	1	-	-
Average	0	10	1	1

Table 3 - Seasonal abundance of threadfin breams (kg/hr) along different latitudes in the Exclusive Economic Zone of India

Lat. (°N)	Premonsoon	Monsoon	Postmonsoon
7°	-	-	-
8°	30	1397	2
9°	0	1351	14
10°	-	2333	123
11°	10	2687	107
12°	437	201	2
13°	470	-	-
14°	15	-	37
15°	1500	-	-
Average	308	1594	48

N. japonicus and *N. bleekeri* also formed a significant constituent of the resource. In the Andaman and Nicobar area the threadfin bream resource is composed of *N. japonicus, N. luteus* and *N.tolu.*

Size distribution and maturity condition of dominant species- The depth-wise size distribution of *N. mesoprion* showed that in most of the latitudinal zones the dominant modes occur at relatively smaller size groups in shallower depth zones. In *N. japonicus* also relatively smaller size groups were seen in shallower grounds. In both *N. mesoprion* and *N. japonicus* the percentage of gravid, spent and spent resting fish was found to be comparatively higher in deeper depth zones than in shallower depth strata.

Lizard fish

Geographical abundance - The survey showed that the southwest region yielding an average catch rate of 25 kg/hr was the most productive area for the lizard fish (Table 5). It formed about 2.5% of the total demersal resources in the 50-100 m depth realm. The production of lizard fish in the outer shelf of the southeast zone was relatively poor at an average catch rate of 1.8 kg/hr. It formed only about 1% of the total demersal catch of the area. In the northeast and Andaman-Nicobar area also the potential yield was comparatively poor. The areawise abundance of lizard fish for each 1° grids/sectors is given in Table 5. The area 14°N/74°E yielded the highest average catch rate of 150 kg/hr which was followed by 15°N/73°E. The lizard fish abundance in the fishing grids/sectors along most of the southern latitudes was relatively poor. The average

Table 4 - Depthwise species composition (%) of threadfin breams at different latitudinal zones in the EEZ of India

	Depth range (m)											
	41-60 m				60-90 m			81-100 m				
	N.j	N.m	N.t	N.b	N.j	N.m	N.t	N.j	N.m	N.t	N.me	N.l
Southwest												
8°N	0	98	2	-	-	-	-	-	-	-	-	-
9°N	99	0	-	-	48	51	-	-	-	-	-	-
10°N	90	9	-	-	21	79	-	-	-	-	-	-
11°N	34	66	-	-	5	95	-	23	76	-	-	-
12°N	7	93	-	-	-	100	-	-	-	-	-	-
13°N	-	100	-	-	-	-	-	-	-	-	-	-
14°N	26	74	-	-	-	-	-	-	-	-	-	-
15°N	-	100	-	-	-	-	-	-	-	-	-	-
Average	47	51	-	-	18	82	-	23	76	-	-	-
Southeast												
10°N	-	-	-	-	100	-	-	-	-	-	-	-
13°N	-	-	-	-	-	-	100	-	-	-	-	-
14°N	-	-	-	100	-	-	-	-	-	-	-	-
15°N	-	-	-	-	-	100	-	-	-	-	100	-
Average	-	-	-	100	6	6	86	-	-	-	-	-
Northeast												
16°N	-	-	-	-	-	-	-	-	-	-	-	-
18°N	-	-	-	-	-	-	-	-	-	100	-	-
19°N	-	-	-	-	1	98	-	100	-	-	-	-
Average	-	-	-	-	1	98	-	25	-	75	-	-
Andaman & Nicobar Islands							-					
11°N	-	-	-	-	-	-	-	11	-	1	-	87
12°N	-	-	-	-	-	-	-	-	100	-	-	-
Average	-	-	-	-	-	-	-	10	10	1	-	79

N.j = *Nemipterus japonicus*, N.m = *Nemipterus mesoprion*, N.t = *Nemipterus tolu* N.b = *Nemipterus bleekeri*, N.me = *Nemipterus metopias*, N.l = *Nemipterus luteus*.

Table 5 - Areawise abundance of lizard fishes in the Exclusive Economic Zone of India

Area (°N/°E)	Catch rate (kg/hr)	Area (°N/°E)	Catch rate (kg/hr)
Southwest		Southeast	
8°/76°	3	10°/80°	0
8°/77°	3	11°/70°	-
9°/75°	7	12°/80°	0
9°/76°	11	13°/80°	0
10°/75°	0	14°/80°	-
11°/74°	0	15°/80°	4
11°/75°	9	Average	1
12°/74°	22	Northeast	
13°/74°	0	16°/81°	0
14°/73°	0	17°/82°	3
14°/74°	150	18°/84°	0
15°/73°	50	19°/85°	0
Average	25	19°/86°	0
Andaman & Nicobar islands		Average	1
10°/92°	0		
11°/92°	1		
12°/92°	0		
12°/93°	0		
13°/92°	0		
Average	0		

catch rate in the southeast region was only 1.8 kg/hr, with the highest abundance being noticed at 15°N/80°E. In the northeast and Andaman-Nicobar region also the lizard fish production was very poor. In the southwest region high catch rates of over 100 kg/hr were recorded at some of the bottom trawling stations like 12°35'N/74°40'E, 14°N/74°40'E and 15°N/73°38'E.

Bathymetric distribution and abundance - The depthwise abundance showed that generally in the EEZ of the southwest region the lizard fish resource was relatively more abundant at 41-60 m depth zones (Table 6). The depthwise abundance along different latitudes also showed that in 11° and 12°N and 14° - 15°N latitudinal zones the catch rates were comparatively higher in the shallower areas of the shelf. In southern latitudes higher concentration of the resource was noticed in 60-100 m depth strata. In the southeast coast the lizard fish resource was poor, the highest catch rate recorded being only 7 kg/hr in the 80-100 m depth range followed by 60-80 m depths.

Seasonal distribution, abundance and species composition — The seasonal distribution of lizard fish showed that in the southwest region the resource abundance in the shallower depth zones was the maximum during premonsoon months. During monsoon and postmonsoon period the catch rates were comparatively poor (Table 7). *Saurida undosquamis* formed the major component during premonsoon season, whereas *S. tumbil* was the predominant species during monsoon and postmonsoon periods. The size distribution of *S. tumbil* showed the occurrence of relatively larger size groups in 40-60 and 60-80 m depth strata in 9°- 11°N zones in the southwest coast, while smaller size groups predominated in 40-60 m depth zones in the southeast region.

Potential yield - The standing stock and potential yield of threadfin breams for the depth zone 60-100 m have been worked out for the major fishing zones. For the southwest the potential yield of threadfin breams was estimated at 2.05×10^5 tonne. The potential yield was estimated to be 2700 tonne and 2100 tonne respectively for the southeast and northeast zones respectively. The potential yield of lizard fish for the southwest region in the 50-100 m depth zone was estimated to be 5500 tonne. The estimates for the southeast and northeast zones were only 205 and 75 tonne respectively.

DISCUSSION

The intensive bottom trawling operations conducted by *FORV Sagar Sampada* during the second phase of the operation of the vessel have further confirmed the existence of rich and fishable concentrations of threadfin breams and lizard fish beyond 50 m in EEZ of India. During the course of the survey very high density pockets of threadfin breams were noticed in 50-100 m depth zones between 8° and 15°N latitudes during the monsoon months of July and August, often the entire catch being composed of threadfin breams. A catch rate of up to 14 tonne/hr has been realised during some of the cruises of this period. Sudarsan *et al.* (1988) also reported that threadfin breams form the most dominant component of the demersal finfish resource in 50-100 and 100-200 m depth strata between 8° and 11°N latitudes along the southwest coast. Sudarsan *et al.* (1989) estimated the potential yield for threadfin breams as 26600 tonne for depth strata below 50 m; 15200 tonne for 50-100 m and 10600 tonne for 100-200 m depth zones. The maximum sustainable yield of threadfin breams along the southwest coast of India was estimated to be 5800 tonne by Joseph

Table 6 - Depthwise abundance of lizard fishes (kg/hr) along different latitudes in the Exclusive Economic Zone of India

Lat. (°N)	Depth range			Average
	40-60 m	60-80 m	80-100 m	
Southwest				
8°	3	-	10	6
9°	0	34	-	16
10°	-	-	-	-
11°	16	10	10	12
12°	36	30	-	23
13°	-	-	-	-
14°	90	-	-	-
15°	75	-	-	75
Average	27	24	10	25
Southeast				
10°	-	-	-	-
11°	-	-	-	-
12°	-	-	-	-
13°	-	1	-	0
14°	-	-	-	-
15°	-	2	7	4
Average	-	1	2	1
Northeast				
16°	-	-	-	-
17°	2	-	-	2
18°	-	-	-	-
19°	-	-	-	-
Average	1	-	-	1
Andaman & Nicobar island				
6°	-	-	-	-
8°	-	-	-	-
10°	-	-	-	-
11°	-	-	3	0
12°	-	-	-	-
13°	-	-	-	-
Average	-	-	1	1

Table 7 - Seasonal abundance of lizard fishes (Catch/hr) along different latitudes in the Exclusive Economic Zone of India

Lat. (°N)	Premonsoon	Monsoon	Postmonsoon
Southwest			
8°	11	-	0
9°	16	8	0
10°	-	-	-
11°	-	10	5
12°	50	3	40
14°	75	-	15
Average	37	3	6

(1987) and 52400 tonne by Sudarsan *et al.* (1987). The MSY estimate by John (1987) for the Kerala coast is only 27000 tonne. The relatively high potential yield estimate obtained during the present study is probably due to the extremely high catch rates obtained for this resource during the high speed demersal trawling operations of the vessel. The potential yield for perches consisting predominantly of threadfin breams estimated is only 125000 tonne in depths beyond 50 m (Anon, 1991).

The resource appraisal surveys of the demersal resources off Kerala showed that between December and April most of the nemipterid stocks occur in 100-200 m depth zone, while between July and October the major part was found at depths below 100 m (John, 1987). The threadfin breams which are more abundant in relatively deeper waters are known to move into shallower areas during monsoon period resulting in high catch and catch rates along Kerala coast (Nair & Jayaprakash, 1986). In the trawling grounds off Sakthikulangara and Cochin very high catches were obtained by small mechanised shrimp trawlers during the monsoon months of June-August, the catches during this period accounting for over 80% by weight of the total annual threadfin bream landings at these centres (Murty *et al.* 1992). Nair & Reghu (1989) also have shown that along the southwest coast the threadfin breams migrate and concentrate in 41-80 m depth strata during June-September.

James (1989) has pointed out that the bottom trawling operations of the exploratory survey vessels have clearly indicated that the commercially exploitable demersal resources including threadfin breams and lizard fish are confined mainly to the continental shelf region within a depth of 100 m which is well within the range of operation of medium trawlers of 17 m and that in most of the regions the 100-200 m depth zone forms only a minor percentage of our EEZ. So for exploitation of the threadfin bream resources of the deeper waters a redeployment of some of the medium trawlers operating along Indian coast may be attempted.

Recently to simulate interest in deep sea fishing the Govt. of India has given licenses for about 144 vessels belonging to 40 foreign companies. Some of the foreign vessels have already started trawling operations in Indian waters and a directed fishery for threadfin breams by 'Surimi' factor trawlers is emerging (Bhoopendranath & George, 1994). However, while permitting large scale targetted exploitation of this

resource by factory trawlers extreme care has to be taken to see that such joint venture projects would not lead to any harmful depletion of this important demersal resource.

ACKNOWLEDGEMENT

Authors are grateful to Dr. P.S.B.R. James, former Director and Dr. P. Bensam, Head, Demersal Fisheries Division for their guidance and constant encouragement.

REFERENCES

Anon, 1991. Report of the working group on revalidation of the potential marine fishery resources of the Exclusive Economic Zone of India. (MPEDA, Cochin).

Bhoopendranath, M.R. & George, V.C. 1994. Commercial application of the results of deep sea fishing investigations of CIFT onboard *FORV Sagar Sampada, Second Workshop on Scientific Results of FORV Sagar Sampada,* (15-17 February 1994), Abstract 69.

Gulland, J.A. 1971. *The fish resources of the oceans* [Fishing News (Books) Ltd, London] pp. 255.

James, P.S.B.R. 1989. Growth profile of marine fisheries in India, *Bull. Cent. Mar. Fish. Res. Inst.* 44 (1): 261-272.

James, P.S.B.R., Alagarswamy, K., Narayana Rao, K.V., Muthu, M.S., Rajagopalan, M.S., Alagaraja, K. & Mukundan, C. 1987. Potential marine fishery resources of India *CMFRI. Sp. Publication* 30 : 44-74.

James, P.S.B.R. & Narayana Pillai, V. 1989. Fishable concentration of fishes and crustaceans in the offshore and deep sea areas of the India Exclusive Economic Zone based on observations onboard *FORV Sagar Sampada.* In : *Proc. First Workshop. Scient. Resul. FORV Sagar Sampada*, edited by K.J. Mathew, (CMFRI, Cochin) 201-213.

John, M.E. 1987. Population dynamics and stock estimates of the threadfin bream *(Nemipterus japonicus)* off Kerala, India, In: *Contributions to tropical fish stock assessment in India*, 45-62.

Joseph, K.M. 1987. The fish resources of Indian Exclusive Economic Zone, Paper presented at the *National Seminar on Planning Expert Strategy for Indian Marine Fisheries.*, New Delhi.

Murty, V.S., Nair, K.V.S., Thomas, P.A., Lazarus, S., Chakraborty, S.K., Raje, S.G., Gopal, C., Zacharia, P.U. & Velayudhan, A.N. 1992. Present status of exploitation of fish and shell fish resources: Threadfin breams, *Bull. Cent. Mar. Fish. Res. Inst.* 45 : 154-168.

Nair, K.V.S. & Jayaprakash A.A. 1986. A note on the monsoon fishery for threadfin breams off Cochin, *Indian J. Fish.* 33 : 106-112.

Nair, K.V.S. & Reghu, R. 1989. Studies on the threadfin bream and lizard fish resources in the Exclusive Economic Zone of India based on the demersal trawling operations of *FORV Sagar Sampada,* In : *Proc. First Workshop. Scient. Resul. FORV Sagar Sampada,* edited by K.J. Mathew (CMFRI, Cochin) 239-255.

Silas, E.G. 1969. Exploratory fishing by *R.V. Varuna, Bull. Cent. Mar. Fish. Res. Inst.* 12: 1-86.

Sivakami, S. 1989. Observations on the demersal fishery resources of the coastal and deep sea areas of the Exclusive Economic Zone of India, In: *Proc. First Workshop Scient. Resul. FORV Sagar Sampada* edited by K.J. Mathew, (CMFRI, Cochin) 215- 231.

Sudarsan, D., Sivaprakasam, T.E., Somavanshi, V.S., John, M.E., Nair, K.N.V. & Joseph, A. 1988. An appraisal of the marine fishery resources of the Indian Exclusive Economic Zone, *Bull. Fish. Survey India.* 18: 1-85.

Sudarsan, D., John, M.E. & Joseph A, 1989. An assessment of demersal stocks in the southwest coast of India with particular reference to the exploitable resources in the outer continental shelf and slope. *Bull. Cent. Mar. Fish. Res. Inst.* 44 (1) : 261- 272.

* * *