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FISHABLE CONCENTRATIONS OF FISHES AND CRUSTACEANS IN THE OFFSHORE AND DEEP SEA AREAS OF THE INDIAN EXCLUSIVE ECONOMIC ZONE BASED ON OBSERVATIONS MADE ONBOARD FORV SAGAR SAMPADA

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ABSTRACT

Bottom trawling data of FORV *Sagar Sampada* pertaining to a total of 350 fishing hauls with a duration of 330 effective trawling hours for depths beyond 40 m was utilized in the present study. Abundance of selected fishery resources such as threadfin bream, bull's eye, drift fish, lizard fish, ribbon fish, cat fish, barracudas, mackerel, deep sea prawns and deep sea lobster in the offshore and deep sea waters of the Indian EEZ in space and time is indicated. Comparatively high fishable concentrations of threadfin bream was observed at depths beyond 50 m in the fishing squares 8/76 (average CPUE from 650 to 2,610 kg during June-July), 7/76, (1,067 to 3,540 kg during July-August), 11/75 (8,180 kg during September-December), 13/73 (2,500 kg during June-August), 15/73 (1,400 kg during June-August), 20/70 (2,400 kg during September-December) and 22/68 (1,260 kg during September-December). Good concentrations of bull's eye were found along southwest coast in fishing squares 7/76 (4,900 kg in August), 15/73 (1,500 kg in September) on the central west coast and in 14/80 and 16/81 (800 to 1,200 kg in September) along northeast coast. For drift fish higher concentrations were found at 19/85 along northeast coast between 62 and 68 m (CPUE 8,000 kg during February). Higher concentrations of lizard fish were observed at 8/76 and 9/75 along southwest coast (250 to 750 kg during June). For ribbon fish good fishing grounds were observed in fishing squares 20/70 and 22/68 along northwest coast (900 kg in September to 1,900 kg in November). Comparatively higher concentrations of cat fish were observed in the fishing square 10/75 along southwest coast at a depth of 50 m (2,400 kg in June). Fishable concentrations of barracudas were observed all along the west coast and northeast coast at a depth of 50 m (300 kg in October and 5,670 kg in August). Mackerel was found in good concentrations along northeast coast between 70 and 85 m in fishing squares 19/86 and 20/87 (1,470 to 2,850 kg during October). Comparatively good fishing grounds for deep sea prawns at depths between 130 and 770 m in fishing square 8/75 were located (620 kg during December-January and 2,200 kg during February). Deep sea lobster was found in good concentrations between 200 and 400 m in the fishing square 8/75 (250 kg in February).

The comparatively high CPUE of the above mentioned fishery resources based on averages worked out for specific fishing areas and seasons is discussed to indicate the possibilities of commercial exploitation of some of these resources which are yet to be exploited on a commercial scale from the offshore and deep sea areas of the Indian EEZ.

INTRODUCTION

Till recently trawling operations were mostly undertaken within the coastal waters upto a depth of 50 m in the Indian Exclusive Economic Zone using comparatively smaller commercial/research/exploratory and experimental survey vessels except for observations made by a few of the larger vessels of the Fishery Survey of India, Integrated Fisheries Project (erstwhile Indo-Norwegian Project) and erstwhile UNDP/FAO Pelagic Fisheries Project. Based on the results of smaller vessels the fishing industry also concentrated their efforts within the narrow coastal belt mainly for the exploitation of shrimp which fetched high export value.

Investigations made by Alcock (1901, 1906), Hornel (1916), Gravely (1929), Sundera Raj (1939, 1942), John (1948, 1959), Sivalingam (1957, 1969),

Kurien (1965), Mendiz (1965), Menon and Joseph (1969), Silas (1969), Oommen and Remoey (1971), Pillai and Ramachandran (1972), Peruma *et al.* (1972), Mohamed and Suseelan (1973), Rao and George (1973), Tholasilingam *et al.* (1973), Oommen (1974, 1980, 1985), Oommen and Philip (1976), George *et al.* (1977), Joseph (1984, 1986), Ninan (1984), Philip *et al.* (1984), James (1986, 1987), Pillai and Sathiarajan (1986) etc. have contributed to our knowledge regarding the occurrence and relative abundance of both demersal and pelagic fishery resources around the sub continent.

The Department of Ocean Development, Government of India acquired a 71.5 m OAL modern sophisticated Fishery Oceanographic Research Vessel, *Sagar Sampada* in December, 1984. The scientific management of the vessel was entrusted with

the Central Marine Fisheries Research Institute under the Indian Council of Agricultural Research. The vessel started regular scientific cruises in January, 1985.

During the period January, 1985 to December, 1988, the vessel conducted bottom trawling operations (representative coverage) in almost 80% of a total of 2 million km² area of the Indian EEZ (Fig.1). For convenience sake the entire EEZ is divided into fishing squares depicting 1° lat./long. squares each representing an area of about 12,373 km². Trawling operations carried out by the vessel in different fish-

ing grounds employing different kinds of trawling gear expending a total of more than 300 effective trawling hours confirmed the distribution and relative abundance of 7 major already exploited fish resources offering scope for increased production from deeper waters and another 5 under-exploited deep water and oceanic resources.

DATA AND METHODS

The 71.5 m OAL vessel is essentially a stern trawler with capability for trawling upto a depth of 1000 m. There are two main trawl winches each to take 3,200 m of 22 mm dia. wire rope with a pulling

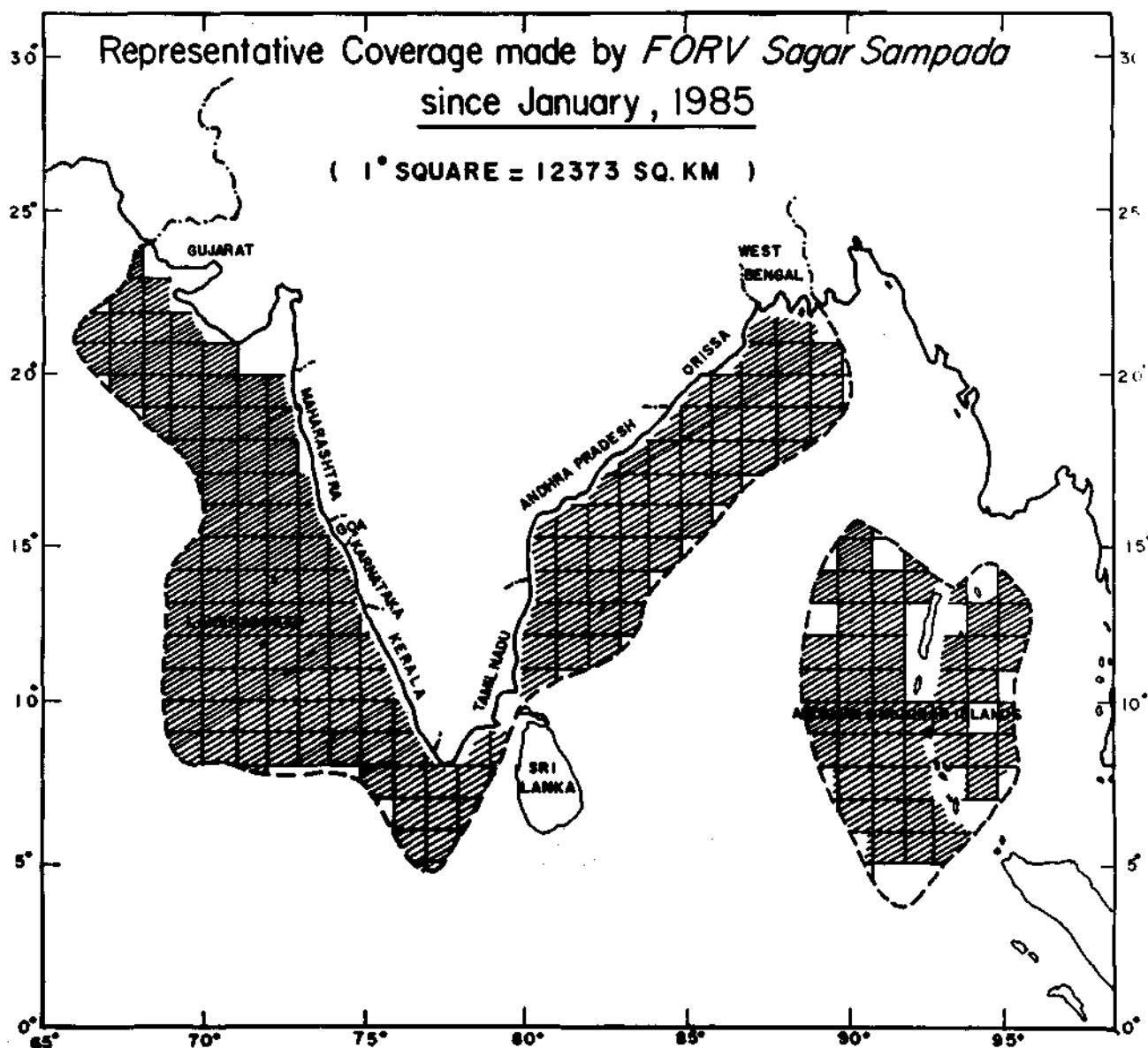


Fig. 1. Representative coverage made by *FORV Sagar Sampada* since January, 1985.

FISHABLE CONCENTRATIONS OF FISHES AND CRUSTACEANS IN THE INDIAN EEZ

TABLE 1. Details of bottom trawling gear and accessories operated on board FORV Sagar Sampada during the period Jan., '85-Feb., '89

A. Imported fishing gear received along with the vessel			
Sl. No.	Specifications of gear	Trawl doors	Measured vertical opening (centre)
1.	G.C.V. <i>Chalut</i> 400 X 100 mm 80 m = 77 m excluding selve edge - 2 panel with 3 bridles	perfect - V Trawl doors model economy 750 kg each and Perfect -V 2,000 kg each model groen-land	Upto 7 m
2.	Star model 500 X 100 mm 100 m = 97 m excluding selve edge - 2 panel - 2 bridles	- do -	- do -
3.	Large Granton 400 x 70 mm 56 m = 54 m excluding selve edge - 2 panel, 2 bridles	- do -	- do -
B. Indigenous fishing gear designed and fabricated by Central Institute of Fisheries Technology			
1.	High speed Demersal Trawl - I	- do -	-
2.	High Speed Demersal Trawl - II	- do -	-
3.	High Speed Demersal Trawl - III	- do -	-

capacity of 30 tonnes. The vessel is fitted up with an auto trawl system which will electrically control shooting, trawling and hauling from the fishing bridge, in addition to manual control from the deck.

The major types of bottom trawls used onboard are given in Table 1. While arriving at averages, special care was taken to see that results obtained from operating the same type of gear alone were considered for calculation of averages.

Bottom trawling operations were undertaken at random on the basis of echo sounder/fish finder recordings indicating the bathymetric profile, type of sea bottom and also the availability of fishable concentration of fishes and other marine life. Depth of operation of the gear was decided on the basis of the above observations. Normally the gear was dragged for a minimum of one hour duration. The details with regard to shooting, duration of fishing, hauling and also the quantity as well as quality of the catch (species wise) were recorded in the fishing log maintained by the Fishing Master. The catch was sorted and analysed immediately after the operation in the wet fish laboratory onboard. Length-frequency measurements as well as collection of specimens/organs for biological studies were done immediately and a representative sample was preserved for further detailed study at the shore laboratory.

Fishing operations onboard were conducted

by a team of 2 experienced fishing masters and 6 fishing hands drawn from Central Marine Fisheries Research Institute and Central Institute of Fisheries Technology under the supervision of fishing gear scientists from the latter. Samples were brought to the shore in the frozen condition or preserved in formalin for specific studies. Simultaneous hydrographic, phytoplankton/zooplankton and samples with IKMT were also collected at each fishing station as well as all the fixed hydrographic stations during each cruise to attempt correlation studies.

DISCUSSION

A. Major exploited resources offering scope for increased production

The major exploited resources offering scope for increased production from depths beyond 50 m are threadfin bream (*Nemipterus* sp.) ribbon fish (*Trichiurus* sp.), lizard fish (*Saurida* sp.), barracudas (*Sphyraena* sp.), cat fish (*Tachysurus* sp.), Indian mackerel (*Rastrelliger kanagurta*) and deep sea lobster (*Puerulus sewelli*).

1. *Threadfin bream*: The potential yield of perches within the Indian EEZ is estimated to be about 2,50,000 tonnes while the present yield of threadfin bream is only around 39,829 t. They are mainly concentrated along the southwest, centralwest and northwest coasts. Following are the areas (fishing squares) where threadfin bream were

available in fishable concentrations. (CPUE: 500 kg and above/hr of trawling) (Fig. 2)

7/76,77	16/72, 81, 82
8/76	17/72, 82, 83
9/75, 76	18/71, 84
11/74, 75, 79, 80	19/70, 84, 85, 86, 87, 88
12/74, 80	20/69, 70, 87
13/73, 74, 80, 94	21/69
14/73, 94	22/68

15/73, 80

23/67

Along the southwest coast, threadfin bream is mainly concentrated in fishing squares 7/76 (CPUE 5-10 t/hr), 8/76, 9/75, 13/73 and 15/73 (CPUE 1-5 t/hr), during June, July and August. Along the central and northwest coasts CPUE of 5-10 t/hr of trawling was obtained in fishing square 11/75 and 1-5 t in fishing squares 20/69, 20/70 and 22/68 during September, October, November and December. At all other fishing squares listed located along the west and east coasts, the CPUE was between 500 kg and 1 t/hr of trawling.

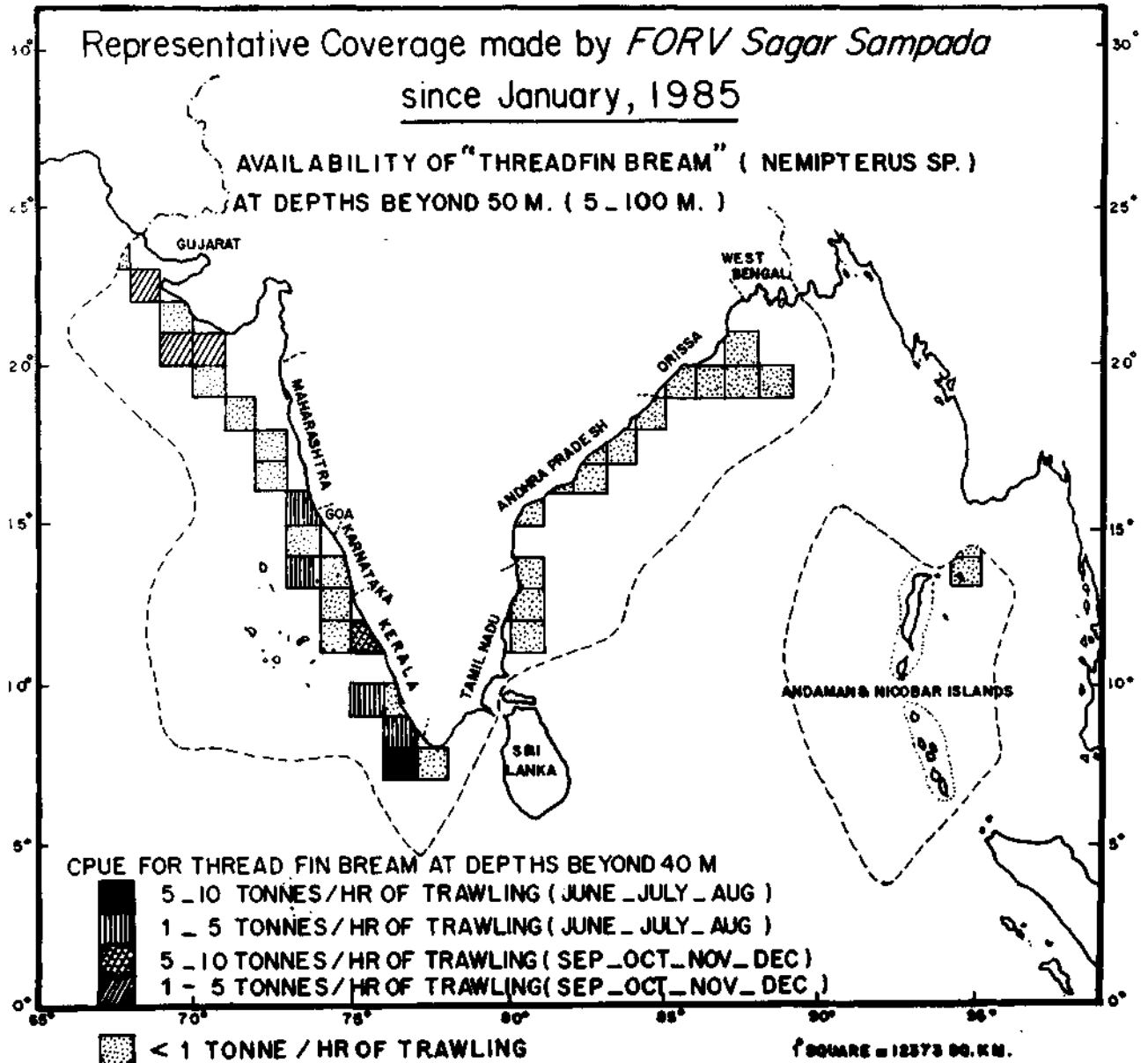


Fig. 2. Availability of Threadfin bream (*Nemipterus* sp.) at depths beyond 50 m (5-100 m).

2. *Ribbon fish*: The potential yield for ribbon fish in the EEZ of India is estimated to be around 2,70,000 t and the present yield is only 82,484 t. They are mainly found concentrated along the northwest, centralwest coast, southwest and northeast coasts. Following are the fishing squares where ribbon fish was found available in fishable concentrations (CPUE 500 kg & above (Fig.3).

8/75, 76	19/70, 88
10/75	20/70, 71, 87
15/73	21/69, 70

17/72, 83

22/68

Large concentration of ribbon fish was found along the northwest coast mainly in fishing squares 20/70 and 22/68 with CPUE varying between 900 kg and 1,900 kg/hr of trawling.

3. *Lizard fish*: The present total annual landings of lizard fish is only around 16,933 t. Large concentration of this fish was mainly found along the southwest coast during June, eventhough they were found all along the west coast and also along the northeast coast in fishable concentrations. (CPUE : 100 to 250 kg/hr).

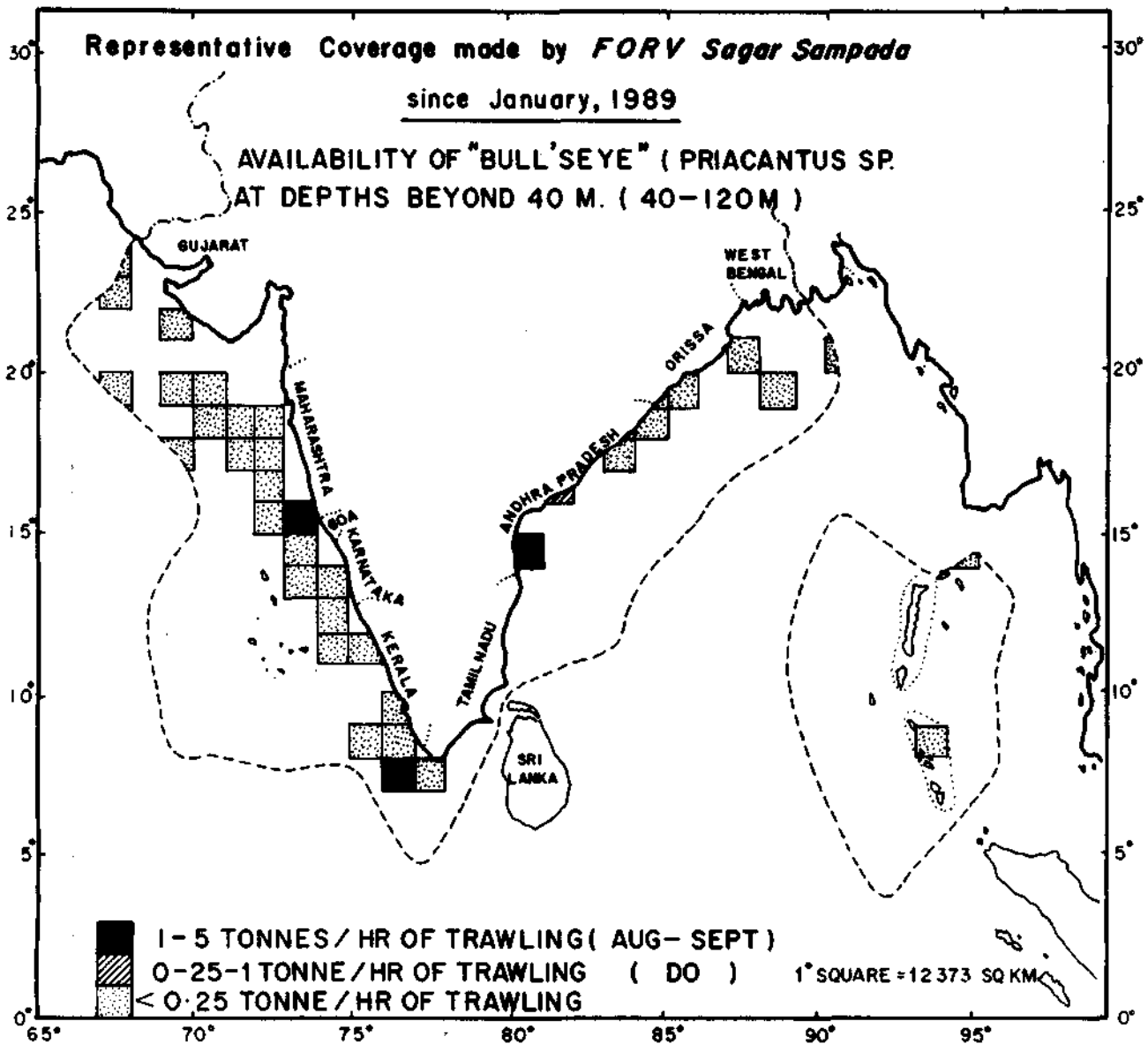


Fig. 3. Availability of Bull's eye (*Priacanthus* sp.) at depths beyond 40 m (40-120 m).

Following are the fishing squares where lizard fish was found available in fishable concentrations (Fig. 4).

7/77	15/73
8/75, 76	16/72, 82
9/75, 76	17/83
10/75	18/71, 84
11/74, 75	19/70, 84, 85, 87, 88
12/74, 80	20/69, 70, 71, 86, 87

13/73, 74, 93, 94	21/69, 70
14/73, 94	23/67

Large concentration of Lizard fish was found along the southwest coast mainly in fishing squares 8/76 and 9/75 with the CPUE varying between 250 to 950 kg/hr of trawling in June.

4. *Barracuda*: Barracudas were found distributed all along the east coast, in the Wadge Bank area and also at selected fishing squares along the west coast. One to five t/hr of trawling was obtained in fishing squares 7/77, 8/78 and 16/81 during June-

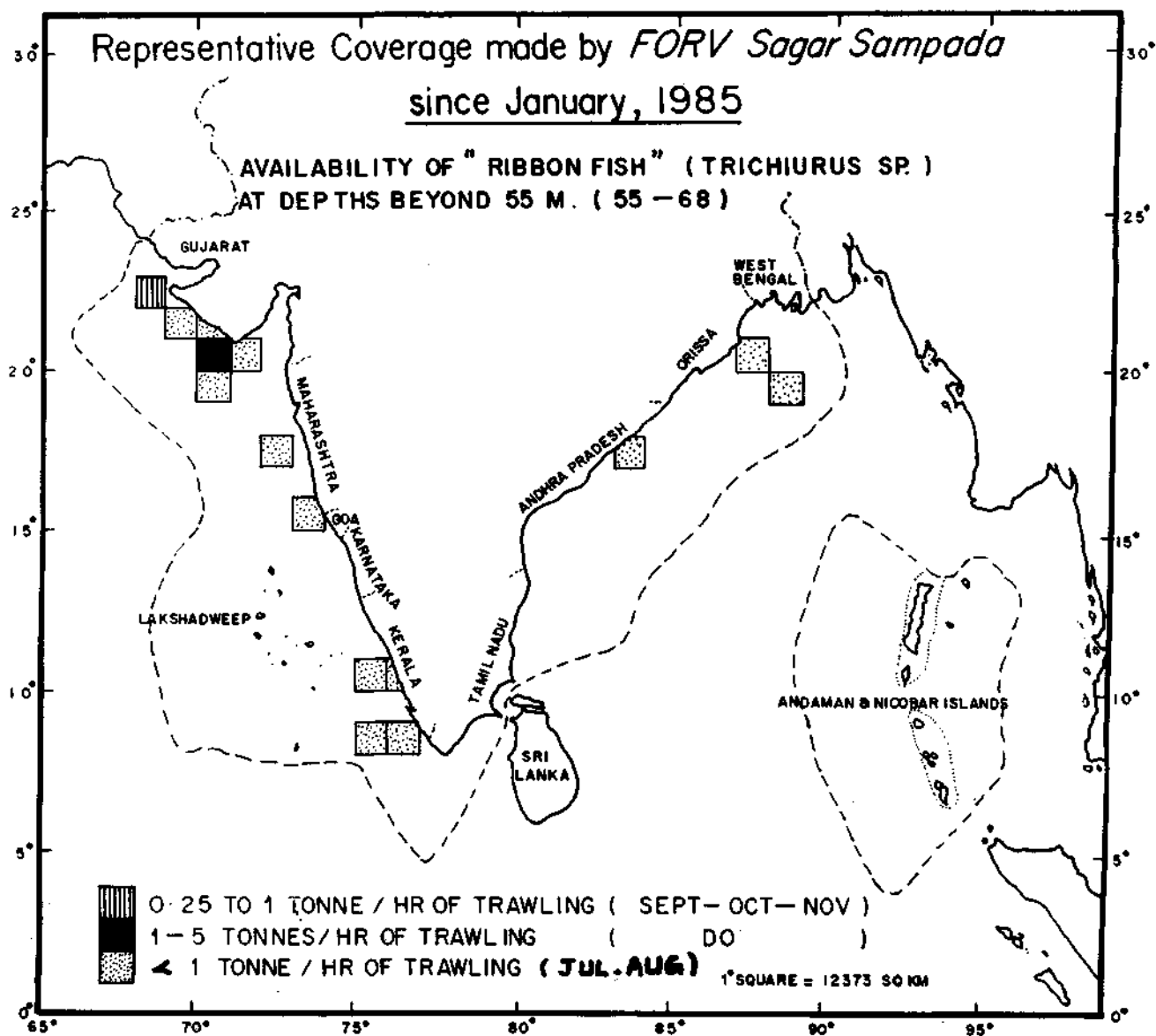


Fig. 4. Availability of Ribbon fish (*Trichiurus sp.*) at depths beyond 55 m (55-68 m).

October. Values between 300 kg and 1 t/hr of trawling was obtained from 18/72 during the same period. The various fishing squares where fishable concentration of barracuda was obtained (above 300 kg/hr of trawling) are listed below. (Fig. 5).

7/77	15/80
8/78	16/81
11/75, 79, 81	17/83
12/80	18/72, 84
13/73, 80	19/85, 86, 88
14/73	

5. *Catfish*: The potential yield for cat fish (*Tachysurus* sp.) in the Indian EEZ is estimated to be around 3,10,000 t out of which only 44,709 t is being exploited at present. They are found mainly distributed along the southwest, centralwest and northeast coasts with higher concentrations (CPUE 1-5 tonnes per hour of trawling) in fishing square 10/75 in June. At all other fishing squares the fish was found in lesser concentrations (CPUE less than 1 t/hr) mainly during June and part of July. The fishing squares where fishable concentrations were found are listed below (Fig. 6).

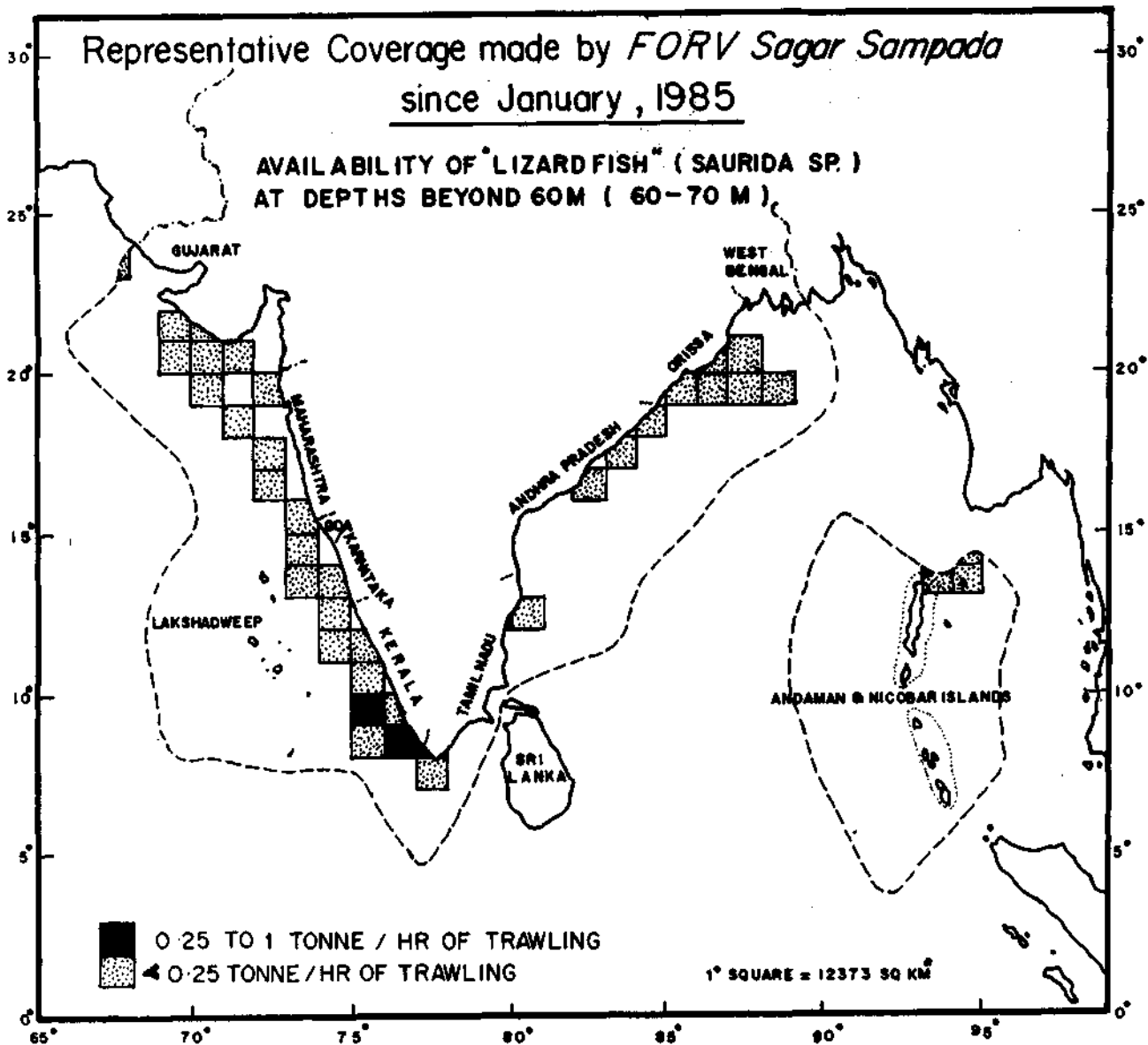


Fig. 5. Availability of Lizard fish (*Saurida* sp.) at depths beyond 60 m (60-70 m).

7/77	15/73
9/76	17/72
10/75	18/84
11/75, 13/73,74	19/72, 85, 86
14/73	20/87

6. *Indian mackerel*: By the acoustic and exploratory surveys conducted by the erstwhile Pelagic Fisheries Project along the southwest coast and Gulf of Mannar, the average annual biomass of mackerel has been estimated as 0.27 million tonnes. Definite indications of large stocks of mackerel in the depth

zone of 50-200 m have also come from the recent surveys along the east and west coasts of India (Joseph, 1984 and Ninan *et al.* 1984). The surveys conducted by *Sagar Sampada* confirmed the availability of fishable concentrations of mackerel at depths between 70 and 85 m mainly along the northeast coast and also at selected fishing squares located along the centraleast coast, Wadge Bank and the centralwest coast. Highest concentrations (CPUE 1-5 t/hr) were found in fishing squares 19/86 and 20/87 off Orissa coast during October. Fishing squares with minimum CPUE of 300 kg/hr are listed below (Fig. 7).

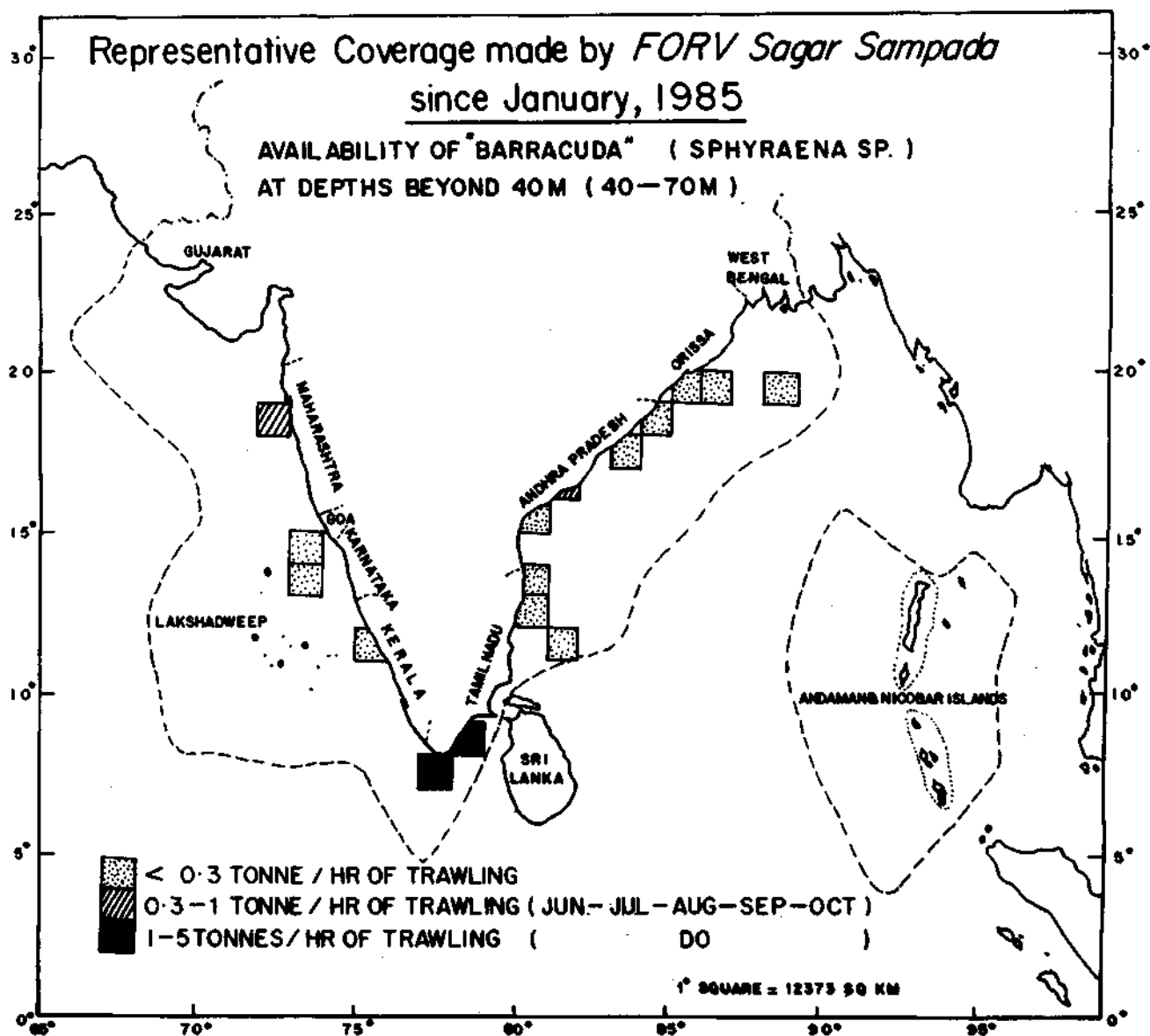


Fig. 6. Availability of Barracuda (*Sphyræna* sp.) at depths beyond 40 m (40-70 m).

7/77	16/72
8/78	17/72, 83
11/79	18/84
12/74	19/85, 86
13/80	20/86, 87

7. *Deep sea lobster*: The sustainable potential for deep sea lobster has been estimated at 8,000 t for southwest coast and 1,200 t for southeast coast out of which hardly 4% is exploited at present. Fishable concentrations of deep sea lobster were found only at a total of 3 fishing squares located off the Kerala coast at depths between 200 and 400 m with maximum

abundance between 180 and 270 m during February. The following are the fishing squares where fishable concentrations of deep sea lobster was found (Fig. 8).

8/75	(CPUE 125 kg to 250 kg/hr)
8/76	(CPUE below 125 kg)
9/75	(-do-)

B. Under-exploited deep water and oceanic resources

Oommen (1985) has estimated the standing stock of deep sea fishes along the southwest coast

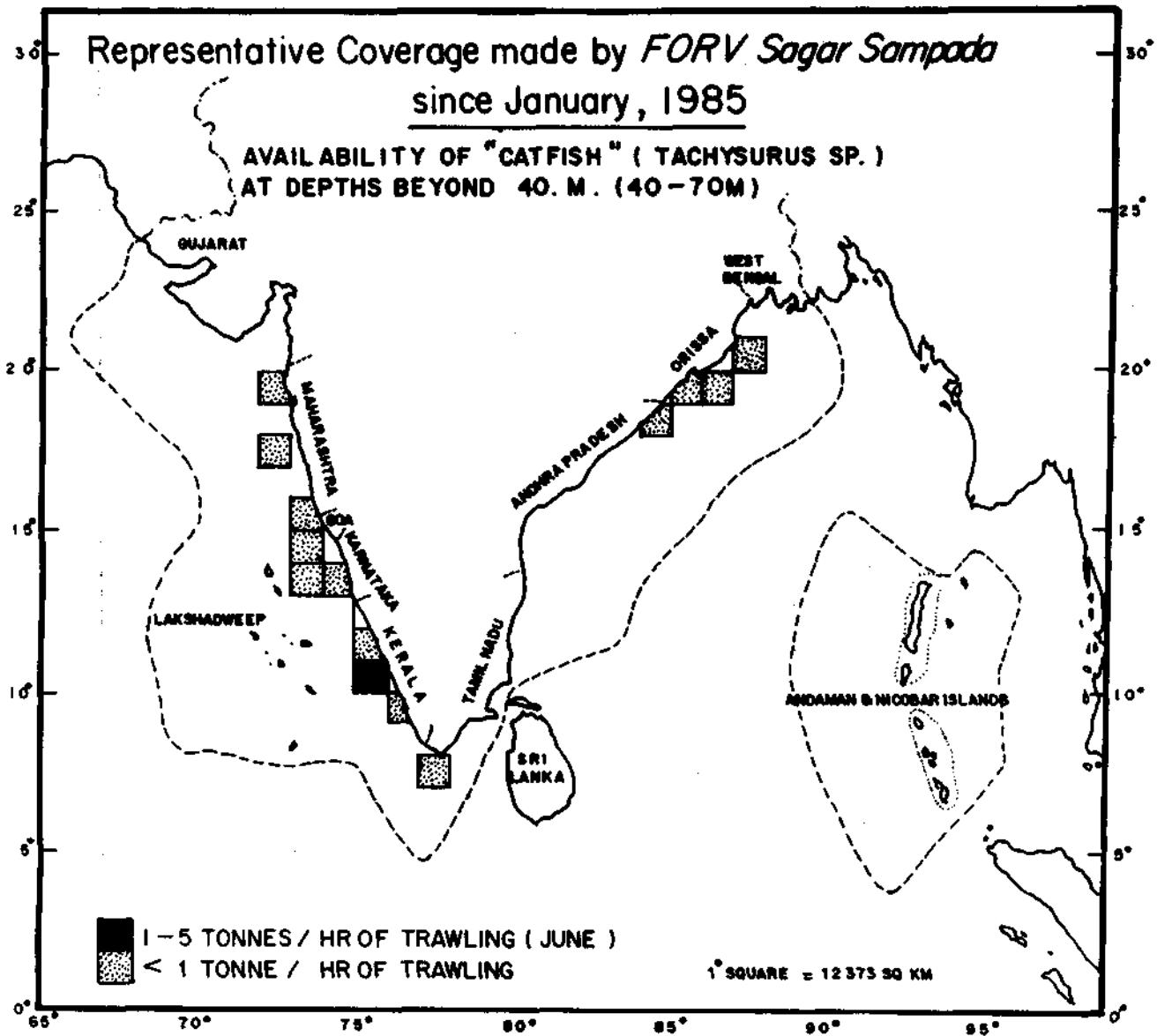


Fig. 7. Availability of Cat fish (*Tachysurus* sp.) at depths beyond 40 m (40-70 m).

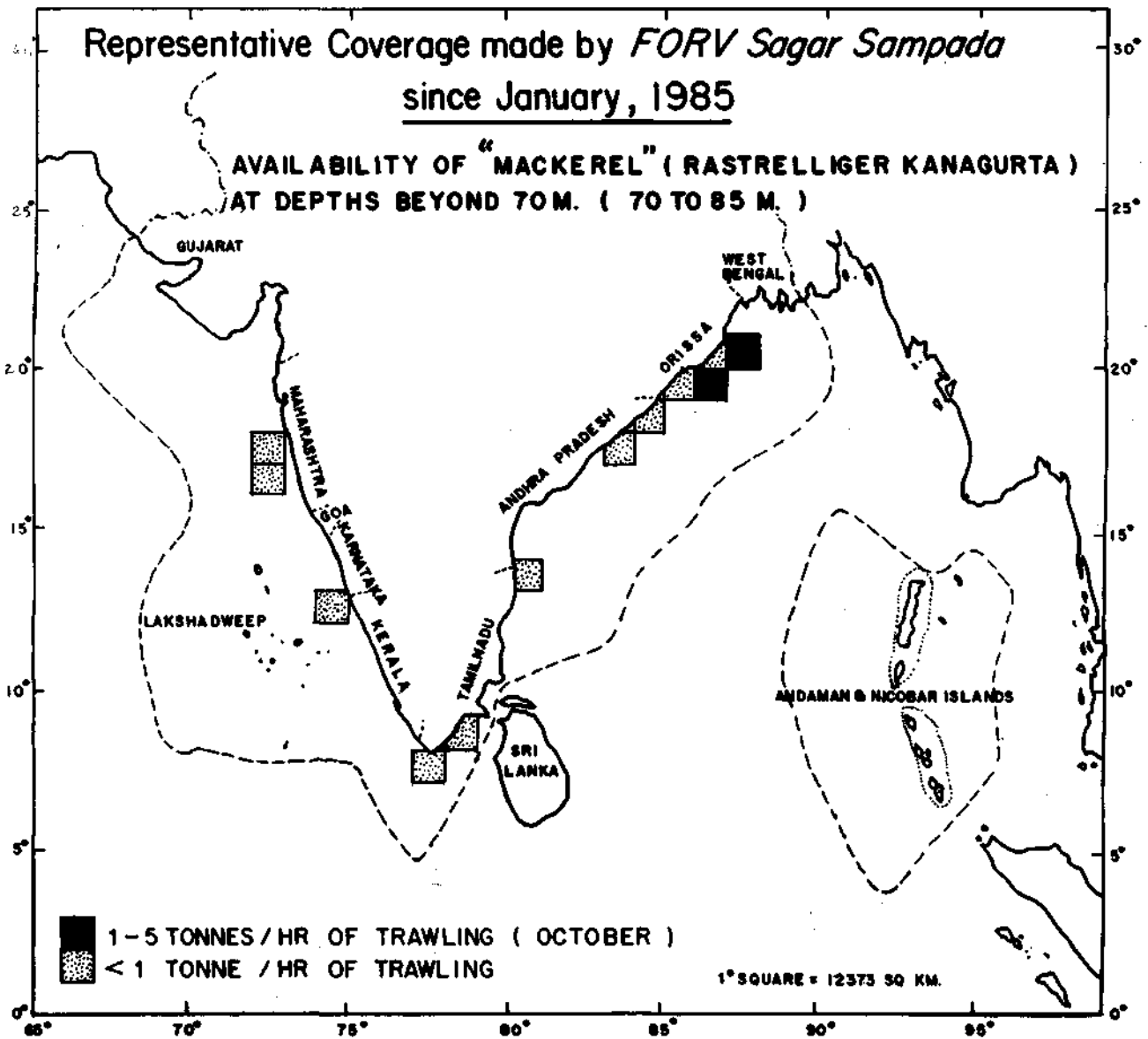


Fig. 8. Availability of Mackerel (*Rastrelliger kanagurta*) at depths beyond 70 m (70-85 m).

(lat. 7° to 13°N) as 8,136 t. Out of this hardly 4 to 5% is being exploited at present.

1. *Bull's eye*: Average CPUE obtained was between 800 kg and 4.9 t/hr of trawling. Comparatively rich grounds were located in the Wadge Bank (August), off Goa (September) and off Andhra Pradesh (September). Maximum CPUE was found at a depth of 120 m. The fishing squares where fishable concentrations of bull's eye were observed (CPUE above 250 kg/hr of trawling) are listed below: (Fig. 9).

7/76, 77	15/72, 73
8/75, 76, 93	16/72
9/76	17/69, 71, 72, 83
11/74, 75	18/70, 71, 72, 84
12/74	23/67
13/73, 74	20/87, 90
14/73, 80, 94	21/69
19/67, 69, 70, 85, 88	22/67

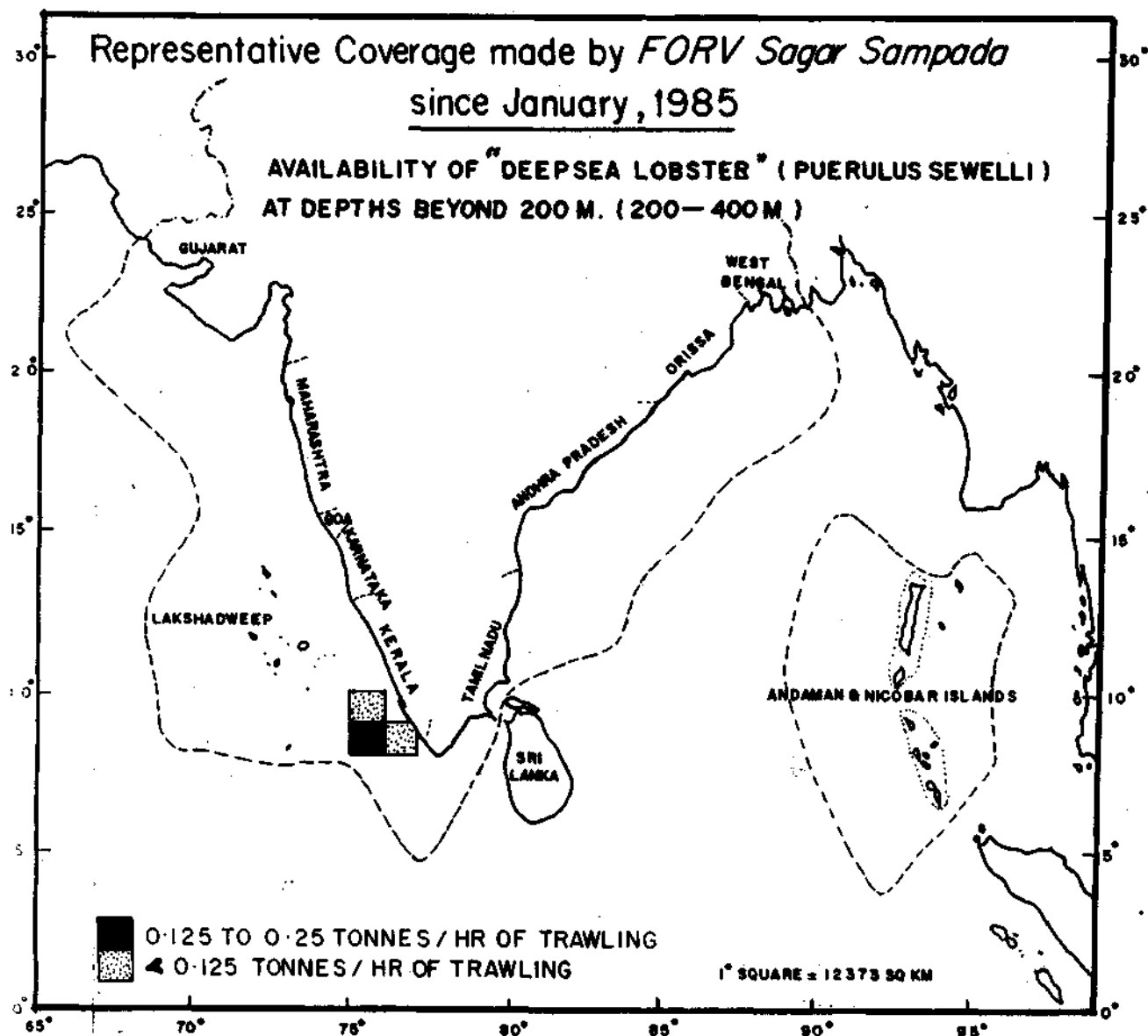


Fig. 9. Availability of deepsea lobster (*Puerulus sewelli*) at depths beyond 200 m (200-400 m).

2. *Drift fish* : *Psenes indicus*, popularly known as Indian drift fish is another deep water resource found all along the east and west coasts. Fishable concentrations of this fish with CPUE exceeding 1 t/hr of trawling were mainly found along the northeast coast at depths between 62 and 68 m in February. Highest concentrations were found off the Orissa coast in the fishing squares 19/86 and 20/87 with maximum CPUE of 7.5 t/hr in February.

3. *Scad* : Comparatively rich grounds were found mainly along the northeast coast in fishing squares 19/86 and 20/87 off the Orissa coast with a maximum CPUE of 6 t/hr in February.

4. *Deep sea prawns*: The potential yield of deep sea prawns within the Indian EEZ is estimated to be about 3,000 t and the present landings are hardly 5% of the potential yield. *Sagar Sampada* came across fishable concentrations of deep sea prawns (*Potocaris* sp., *Parapandalus* and *Aristaeus* sp.) mainly along the southwest, centralwest and centraleast coasts between depths of 130 and 770 m. Comparatively rich grounds were located mainly in the Quilon Bank off Kerala coast during December-February. Fishable concentration of deep sea prawns with CPUE above 250 kg/hr were found at the following fishing grounds:

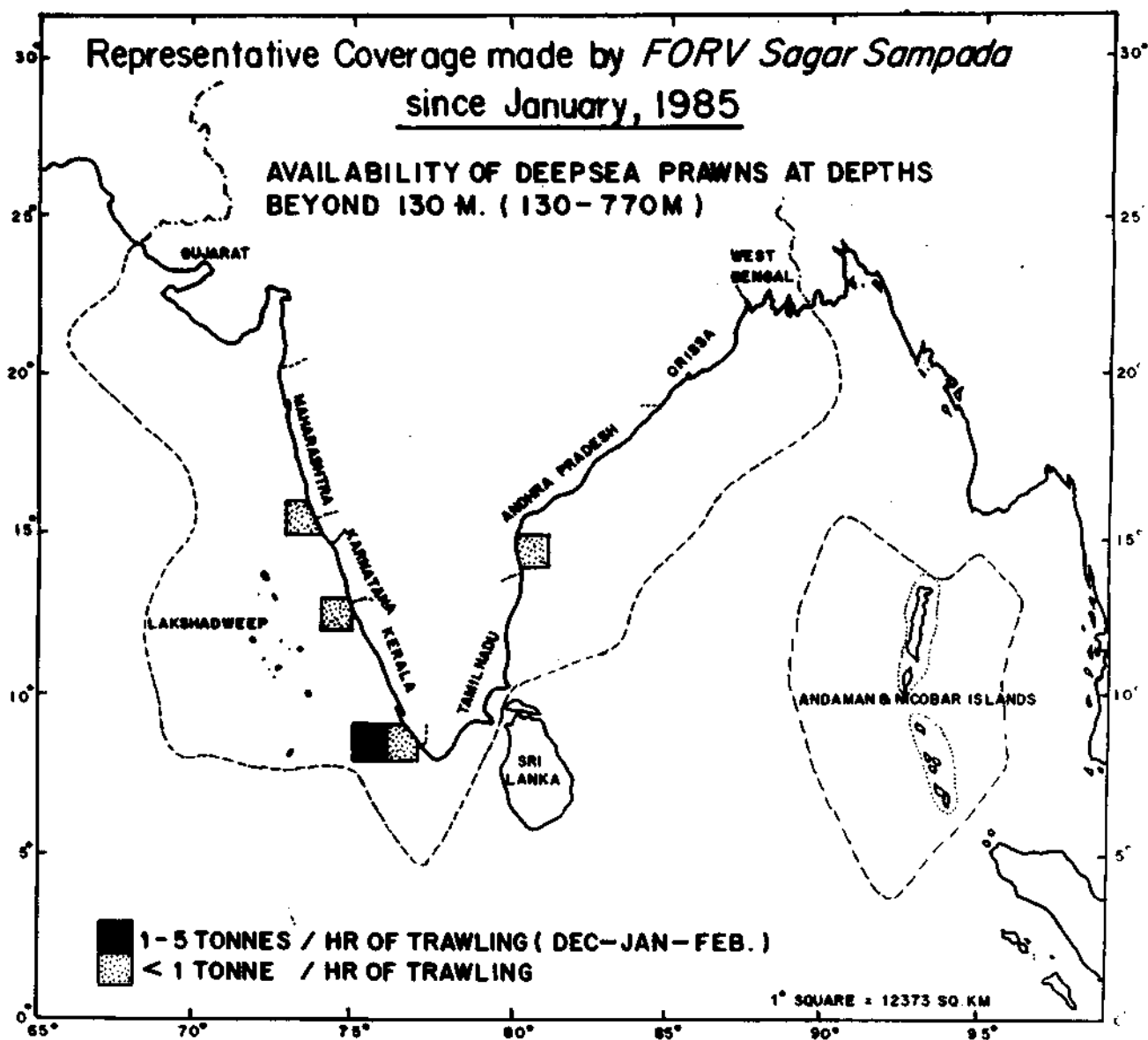


Fig. 10. Availability of deep sea prawns at depths beyond 130 m (130-770 m).

8/75	(CPUE 1 to 5 t/hr)
8/76	(CPUE less than 1 t/hr)
12/74	-do-
14/80	-do-
15/73	-do-

CONCLUSION

Fishing operations conducted by FORV *Sagar Sampada* threw light on the immense potentiality of the deeper and oceanic waters beyond 50 m depth

especially the abundance of fishable concentrations of exploited resources such as threadfin bream, ribbon fish, lizard fish, barracuda, cat fish, Indian mackerel and deep sea lobster beyond the presently exploited zone and also under-exploited deep water resources such as bull's eye, drift fish, scad and deep sea prawns within the Indian EEZ. The observations confirmed the existence of fairly rich grounds for deep sea lobster in the Quilon Bank off Kerala coast.

Based on the above results which threw light on the relative abundance of selected deep water

fishery resources in time and space, the fishing industry could venture into the deeper waters by introducing suitable craft and gear for a commercial exploitation of these resources.

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