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Bulletins are issued periodically by Central Marine Fisheries Research Institute to intetpret current knowledge in the various fields of research on marine fisheries and allied subjects in India.

Citation : **Bapat, S. V. *et al.*,**
Bull. cent. mar. Fish. Res. Inst., 33, 1982.

Published by

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CONTENTS

PREFACE

Deep-sea fishing has but a relatively brief history in India. A serious attempt at studying and understanding the nature of the fish resources beyond the traditional (inshore) fishing grounds started with the operations, off the Bombay and Gujarat coasts, of the chartered Japanese vessel TAIYO MARU followed by the Government of India's ASHOK and PRATAP in the fifties. As a result of these survey operations, a general picture of the nature of the grounds and the distribution of the fish resources available for exploitation upto the 50 m depth was available and in the years that followed a well-structured and substantial commercial fishery grew, exploiting these resources, mainly upto the 50 m mark.

Beyond this depth, the vast areas of the continental shelf and slope remained more or less unsurveyed and unknown, except for occasional cruises, like those of ANTON BRUUN and METEOR during the International Indian Ocean Expedition, when some additional information was obtained regarding the resources of these waters and about the fishery-associated hydrographical factors like upwelling and other seasonal changes in the environment and their impact on the fish resources. Similarly, India's own efforts, in the form of the exploration of the further shelf areas by M. V. KALAVA and R. V. VARUNA, in which CENTRAL MARINE FISHERIES RESEARCH INSTITUTE had a pioneering role, resulted in the marking out of some resources near the shelf edge and slope. But for these occasional studies, the extensive areas of the shelf and beyond remained largely unexplored till recently.

An opportunity to study this area became available with the decision of the Government of India to charter a large fishing vessel from Poland to do commercial fishing in these waters, and as a result of this Indo-Polish Agreement, the vessel MURENA, belonging to the Sea Fisheries Institute, Gydnea, was commissioned to undertake a year-long survey, consisting of six cruises using both demersal and pelagic gears, covering the area from 15° to 24°N lat. and from 55 to 360 m depth.

M. T. MURENA is a B-23 type freezer trawler, with the following specifications :

Length overall (m)	69.34
Breadth(m)	11.00
Moulded draft(m)	5.05
Horse power of main engine	1620
Speed in knots	13.50
Gross tonnage (BRT)	1005
Pull of winch (tons)	12
Freezing capacity (tons/day)	12
Fish meal production capacity (tons/day)	2
Fish storage capacity (m^3)	600
Cold storage temperature	—27°C
Fish meal storage capacity (m^3)	46
Ice production per day (ton)	5
Fuel capacity (m^3)	360.3
Fresh water capacity (m^3)	60
Fresh water production per day (tons)	5
Endurance (days)	50
Crew capacity (persons)	44
Output of generators (KW)	665
Ice storage capacity (m^3)	8.6 at — 6°C

The survey programme was implemented in 1977, with the Exploratory Fisheries Project as the co-ordinating organization and with the additional participation of other national research institutions such as NPOL, CIFE and CMFRI.

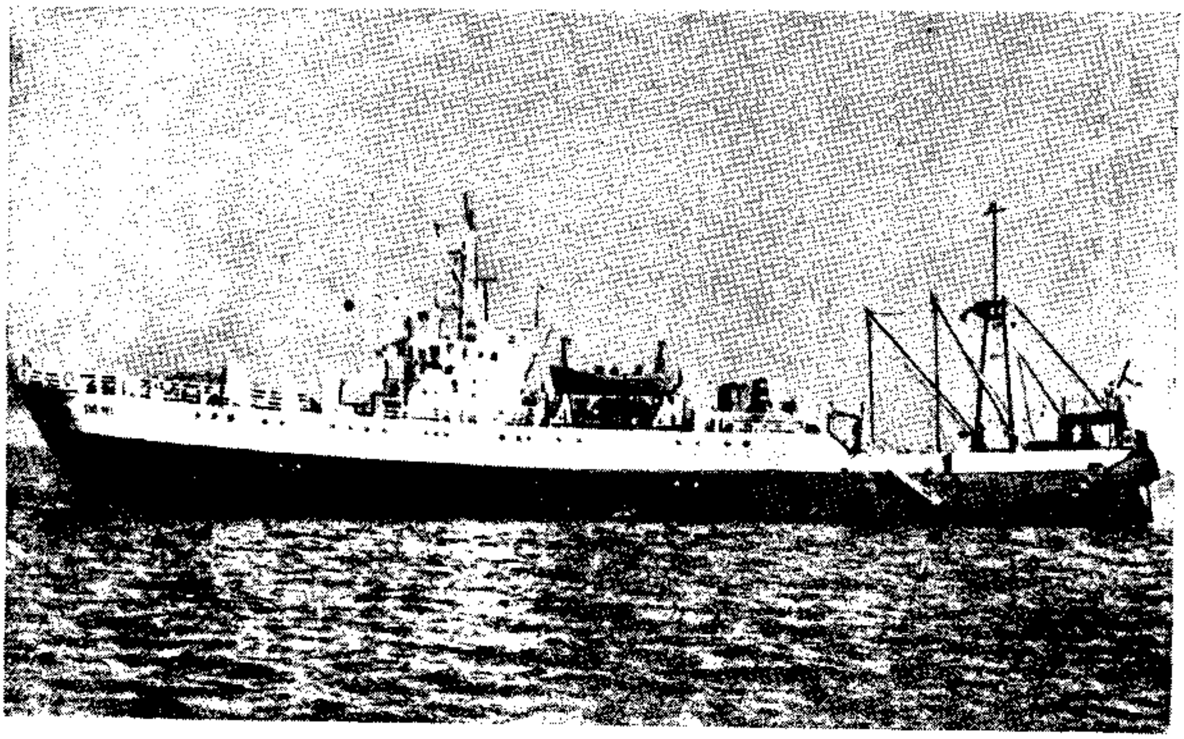
The CMFRI was entrusted with the work, in addition to that of participation in the cruises, of collecting the biological data on the resources and assessing the stocks available for exploitation. However, some deviations from the original programme, effected during the implementation, made the data not quite adequate for a proper stock assessment study of individual resources. The study, nevertheless, has given us an idea of the total resources that are available for exploitation in these waters. It is necessary that this is followed up by more fishing surveys in the areas marked out as major grounds in this report. There is no doubt that the M. T. MURENA survey and the significant results reported here form the first major step in the country's attempts in the utilization of its oceanic resources.

The staff of this Institute not only participated in all the six cruises of MURENA, but also did considerable follow-up work on the analyses and study of samples, additionally collected on board, regarding length-frequency, maturation, age and food of fishes as also environmental factors like temperature, salinity and dissolved oxygen and plankton. In a study of such magnitude, a number of scientists of the Institute, from the HQ as well as outstations, worked in close co-operation, and the staff of the Bombay Research Centre played a special role in the collection and upkeep of the samples and in the analysis of the data. The names of individuals who had particular roles in the study and in the preparation of this report are given separately elsewhere.

It is a matter of gratification that this Institute could play its role in this major venture of the country's extending its reach to the horizons offshore and I would like to thank the Government of India, Ministry of Agriculture and Irrigation and the Indian Council of Agricultural Research for affording the Institute this opportunity. The co-operation extended by the Masters and Crew of MURENA and by our sister-organizations is gratefully acknowledged.

This report would, I trust, be of use to the research worker as well as the fishing trade and industry and would also be of assistance in our future planning for the development and management of the fishery resources of our Exclusive Economic Zone.

E. G. SILAS
Director
Central Marine Fisheries Research Institute
Cochin



The 69.34 m Polish fishing vessel, M.T. *Murena*

FISHERY RESOURCES OF THE EXCLUSIVE ECONOMIC ZONE OF THE NORTHWEST COAST OF INDIA

Biological follow-up studies on resources
based on cruises of M.T. MURENA

PARTICIPATION IN THE CRUISES

Cruise	I	Dr. S. V. Bapat—as Cruise Leader (8.1.77—11.2.77)
Cruise	II	Mr. C. Mukundan—as Cruise Leader (19.2.77—12.4.77)
Cruise	III	Dr. R. S. Lal Mohan—as Participant (21.4.77—21.5.77)
Cruise	IV	Mr. K. Rangarajan—as Participant (14.6.77—5.7.77) Mr. C. Muthiah—as Participant (22.7.77—22.8.77)
Cruise	V	Dr. B. Krishnamoorthi—as Cruise Leader (7.9.77—14.10.77)
Cruise	VI	Dr. M. V. Pai—as Participant (28.10.77—14.12.77)

ANALYSIS OF SAMPLES AND DATA, AND ORGANIZATION OF INSTITUTE'S PARTICIPATION

Bapat, S. V.	.. over-all charge of the Institute's participation in survey.
Bhat, G. S.	.. analysis of plankton samples.
Chakraborty, S. K.	.. analysis of catch data ; identification of fishes.
Chandrika, V.	.. analysis of zooplankton.
David Raj, I.	.. analysis of zooplankton.
Daniel Selvaraj, G. S.	.. analysis of zooplankton.
Deshmukh, V. D.	.. analysis of catch data ; identification of fishes.
Deshmukh, V. M.	.. analysis of catch data ; procurement of stores ; unloading & storage of samples.
George, M. K.	.. analysis of catch data.
Kagwade, P. V.	.. study of scales and otoliths ; length-frequency.
Kaikini, A. S.	.. identification of fishes ; procurement of stores.
Krishnamoorthi, B.	.. estimation of resources.
Kuber Vidyasagar	.. identification of fishes ; unloading and storage of samples.
Kurian, Alexander	.. estimation of resources ; unloading and storage of samples.
Mathew, K. J.	.. analysis of zooplankton.
Muthiah, C.	.. study of maturation and spawning ; identification of fishes ; unloading and storage of samples ; collection and maintenance of data.
Nandedkar, R. R.	.. identification of fishes.
Pillai, A. Ayyappan	.. analysis of zooplankton.
Pillai, P. Parameswaran	.. analysis of zooplankton.
Pillai, S. Krishna	.. analysis of plankton samples ; food and feeding habits.
Pillai, V. Kunjukrishna	.. analysis of zoopplankton.
Raghu, R.	.. analysis of zooplankton.
Ramamirtham, C. P.	.. analysis of hydrographic data.
Regunathan, A.	.. analysis of zooplankton.
Rengarajan, K.	.. analysis of zooplankton.
Somavanshi, V. S.	.. identification of fishes.
Valsala, K. K.	.. analysis of zooplankton.

PREPARATION OF THE REPORT

S. V. Bapat
V. M. Deshmukh
B. Krishnamoorthi
C. Muthiah
P. V. Kagwade
C. P. Ramamirtham
K. J. Mathew
S. Krishna Pillai
C. Mukundan

I

INTRODUCTION

For well over two decades now, trawling operations, both exploratory and commercial, have been going on along the north-western region, off the Goa, Maharashtra and Gujarat coasts (15°-24°N). A historical resume of trawling in India has been given by Jayaraman *et al.* (1959) in their account of the demersal fishery resources of the shelf waters of this area, for the period 1950 to 1955. Similar accounts on the distribution patterns of major exploited fisheries for 1961-1967 and 1968-1970, have been given by Rao (1969) and Rao *et al.* (1966, 1972) and Nair (1974). Apart from the above accounts on the fisheries in general, detailed studies on the pattern of distribution and abundance of individual species have been reported by Rao (1965—*Pseudosciaena diacanthus*), Kagwade (1973—*Polynemus heptadactylus*), Deshmukh (1973—*Pomadasys hasta*), Kaikini (1974—*Lactarius lactarius*) and Kagwade (1966—prawns), as also (Prabhu and Dhawan, 1974)—regional fisheries off Goa. The results of these studies, based on bottom-trawling operations mostly in regions less than 80 metres in depth, have given us a fair knowledge of the demersal resources potential of this region.

However, in view of the extensive shelf and slope areas available for exploitation off the NW coast; the need was felt to survey and study the demersal as well as pelagic fishery resources of areas not covered so far. The trawler M.T. MURENA was, therefore, commissioned by the Government of India under contract with the Government of Poland to conduct a year-long survey with six cruises or coverages that could make a quick appraisal of the fisheries potential of the region beyond 50 metres depth. The results of this survey, from the Central Marine Fisheries Research Institute's participation in it, are reported in the present account.

The objectives of the survey included the assessment of the nature, quality and quantity of commercially exploited fishes and other living resources in the area between 15° and 24°N latitude on the north-west coast of India, from 55 m (30 fathom) to 360 m (200 fathom) depths.

Implementing a programme of this magnitude involved considerable planning, both at the Governmental level and at the level of participating institutions. The Central Marine Fisheries Research Institute was actively involved in the survey programme along with other national institutions and worked in close collaboration with the Polish counterparts on board MURENA.

To ensure proper and uniform recording, all observations and data were logged on special forms, such as

(*a*) Demersal and Pelagic catch form;

(*b*) Data form for collecting length frequency information;

(*c*) Length frequency data form;

(*d*) Age frequency form (See Annexures A to F for the prescribed proformae).

These served as original written records for all basic data, haul by haul.

The trawler MURENA made six coverages, from January to December 1977, according to the survey programme.

The Exploratory Fisheries Project, as a co-ordinating body representing the Government of India, has brought out preliminary reports highlighting the results of each coverage (Dwivedi *et al.*, 1977a, b, c; Swaminath *et al.*, 1977 a, b; 1978). The present report is a comprehensive account based on the data collected during all the six coverages, highlighting the resource potential, its distribution in time and space, together with an account of the nature of the ground and hydrobiological conditions of the region and seasons covered. The resource-complex within the 55 m line and outside, based on earlier work and present data, has been discussed. It is hoped that all this information would be of help to private entrepreneurs, Governmental agencies and financial institutions.

II

PLAN OF THE SURVEY

The region of the continental shelf and beyond from 15° to 24°N lat. and from the 55 m depth to 360 m depth was the ground surveyed during the year. As envisaged in the Agreement between the Govts. of India and Poland, the survey programme consisted of three coverages for bottom fish survey and three for pelagic fish survey. A basic grid of 10 zones, each divided into 3 strata, was adopted (Fig. 1) for the cruise tracks, with enough flexibility as regards the number of hauls in each stratum for a practical implementation of the survey. Two types of gear, the bottom trawl and the midwater trawl, were used for the survey. The trawling stations (Fig. 2-7) in each stratum were decided by acoustic survey and stratified random sampling. The trawling speed was 3.5-4.5 knots. Thus MURENA made 247 hauls during the bottom fish coverage, and 542 hauls in the pelagic fish surveys (Tables 1, 2)

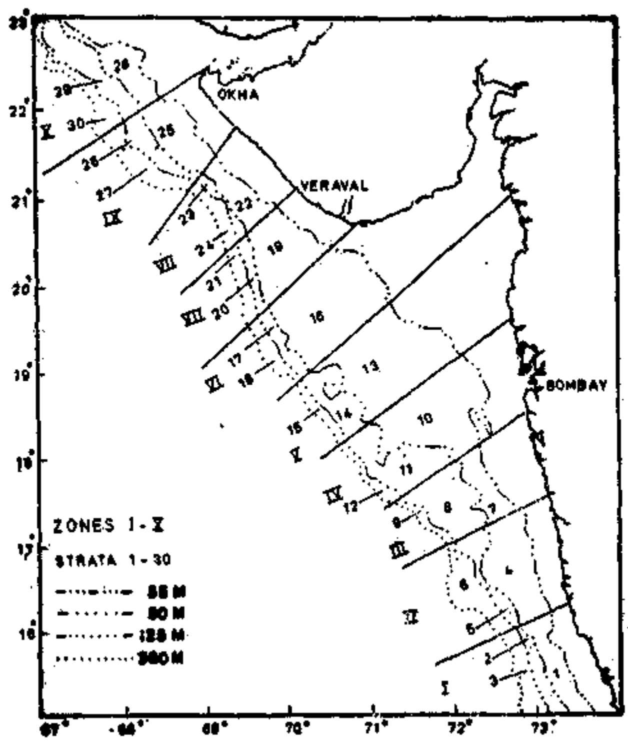


Fig. 1. The ground surveyed showing the basic grid of 10 zones and 30 strata.

TABLE 1. *Distribution of effort (number of hauls and fishing hours) in the ten zones and three depth-ranges during bottom trawling.*

Depth range	55-90 metres		91-125 metres		126-360 metres	
Strata	1,4,7,10,13,16,19,22,25,28		2,5,8,11,14,17,20,23,26,29		3,6,9,12,15,18,21,24,27,30	
Zone	No. of hauls	Fishing effort	No. of hauls	Fishing effort	No. of hauls	Fishing effort
I	12	19.75	9	15.50	9	13.50
II	15	24.22	9	15.09	5	7.50
III	12	18.83	16	26.01	4	4.84
IV	18	31.49	10	16.08	3	4.25
V	20	35.58	2	2.67	3	4.75
VI	17	29.92	5	8.50	4	5.59
VII	12	17.53	4	7.41	7	7.34
VIII	10	16.58	4	6.50	5	9.41
IX	9	13.67	6	11.50	3	3.05
X	4	6.58	8	12.33	2	1.58
Total	129	214.15	73	121.59	45	61.81

TABLE 2. *Distribution of effort (number of hauls and fishing hours) in the ten zones and three depth-ranges during pelagic trawling*

Depth range	55-90 metres		91-125 metres		126-360 metres	
Strata	1,4,7,10,13,16,19,22,25,28		2,5,8,11,14,17,20,23,26,29		3,6,9,12,15,18,21,24,27,30	
Zones	No. of hauls	Fishing effort	No. of hauls	Fishing effort	No. of hauls	Fishing effort
I	16	29.73	7	12.17	6	10.49
II	16	30.57	6	10.17	16	28.99
III	13	20.08	8	14.50	6	10.92
IV	33	65.79	15	24.95	6	10.08
V	64	148.41	11	18.58	4	7.08
VI	47	101.60	4	6.42	8	12.75
VII	29	69.00	3	5.25	6	11.41
VIII	20	41.66	14	25.08	7	10.67
IX	15	27.62	11	18.16	21	33.24
X	58	144.85	46	78.99	26	42.13
Total	311	679.31	125	214.27	106	177.76
Percentage of Total Hauls/Effort	57.38	63.41	23.06	20.00	19.56	16.59

Total No. of hauls : 542 ; Total Effort : 1071.37 hrs.

TABLE 3. *Nature of the sea bottom in the area surveyed.*

Nature of Bottom	Zone	I			II			III			IV			V			VI			VII			VIII			IX			X		
	Strata	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
SILT		**			*			** **		*	*		*	**			** ** ** *			** ** *	*		** *	**	*	**	**	*	** ** **	** ** ** *	** *
MUD		** **			** **	** ** *		** *	** **		** ** ** ** ** ** **	*		** ** ** ** ** ** ** ** *	** ** *		** ** ** ** ** ** ** ** ** **		*	** ** ** ** ** *	*	*	** ** ** ** *	**	**	** ** ** *	** **	** ** ** *	** ** ** **	** ** ** ** ** ** **	** ** ** **
SAND		** **	** ** **	** **	** **	** ** *	**	*	** ** *	** **	** ** ** ** ** *	** ** ** ** ** *	** *	** *	** ** **	** *	** ** **	** ** *	** *	** ** *	** *	** *	*	** **	** *		**	** ** ** ** ** *	** ** *	** *	** ** **
CORAL			*				** ** ** ** **		**	**		** ** ** **	*	** *	*		** ** **	*	** *			*						** ** ** *			**
ROCKY					*	*	**		**	*	** ** *	*	*		* ** **														** *	**	** ** ** *
GRAVEL					*		**									*			*							*					*

* frequency of occurrence

III

FISHING DATA

The catch and effort data pertaining to the operations of the demersal hauls and the pelagic hauls have been separately analysed (Table 4). Though the survey design provided for alternate and equal coverages for the demersal and the pelagic, often circumstances, particularly engine trouble, forced curtailment of a planned cruise's duration and the unfinished part of the work was then carried out during the subsequent cruise. Thus some pelagic fishing was done in all the six coverages during the year. The catch, effort and catch-rate values, calculated separately for each gear, cruise and depth-zone, are indicated in Fig. 8.

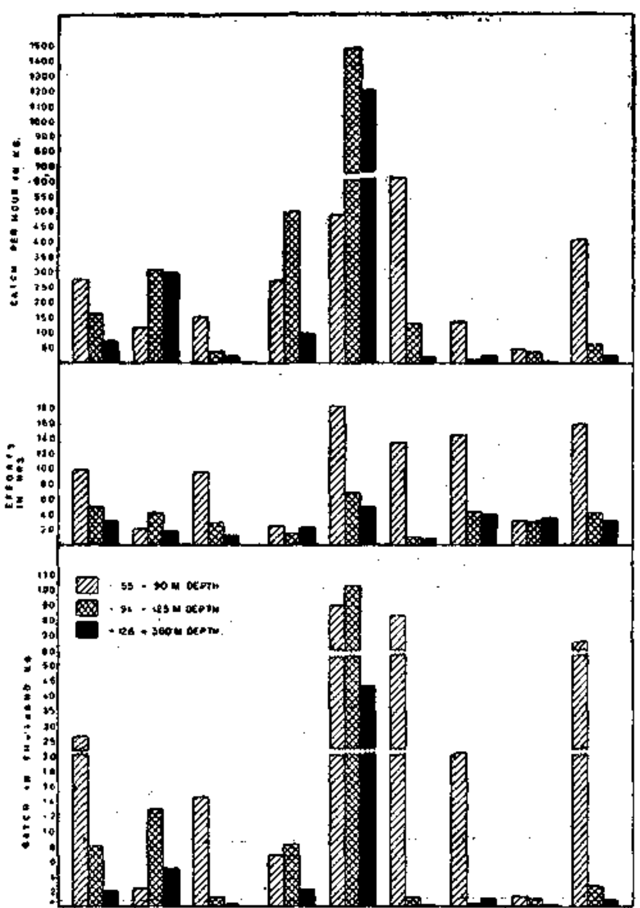


Fig. 8. Cruise-wise, year-wise and depth-wise catch, effort and catch rates.

Demersal Fishing

Nature of the Ground

Bottom samples were collected by operating a Peterson's grab, after the bottom trawls were made, during coverages I, III and V. The nature of bottom was grouped qualitatively into six categories, viz., silt & clay, mud, sand, coral, rock and gravel. The results of processed data collected during 247 hauls are presented in Table 3.

The greater part of the area sampled indicated soft ground comprising sand, mud, silt and clay, ideally suited for bottom-trawling. The deeper strata of Zones II, VI, IX and X showed hard bottom, with coral or rock. The inshore strata of Zones IV and VI and the middle strata of Zones IV and V also showed hard bottom.

Catch Analysis

During the three coverages using the bottom trawl, 129 hauls were made in the 55-90 m depth range putting in 214.15 fishing hours, 73 hauls in the 91-125 m range with 121.59 hours and 45 hauls in the 126-360 m range expending 61.81 hours in fishing.

Tables 1 and 2 give the details of the fishing effort spent in each of the strata and zones. Thus MURENA made a total of 247 bottom-trawl hauls during the period of the survey and landed 73,073 kg for an effort of 397.55 hrs, giving an average catch-rate of 184 kg/hr. (Table 5). Of the 3 depth-ranges the highest catch of 43, 207 kg, with a catch-rate of 202 kg/hr, came from the depth-range 55-90 m. The depth range 91-125 m yielded 22,159 kg, at the rate of 182 kg/hr, whereas the depth-range 126-360 m gave 7,707 kg, with a catch-rate of 125 kg/hr. Demersal fishing during the January-February (Cruise I) coverage yielded a catch-rate of 269.05 kg/hr in the 55-90 m area. The rates declined in the deeper regions. During April-May (Cruise III) the pattern was different, the higher catch-rates (305.5 kg/hr) coming from 91-125 m region, followed by 126-360 m areas. During the September-October coverage (Cruise V) the pattern was similar to that of

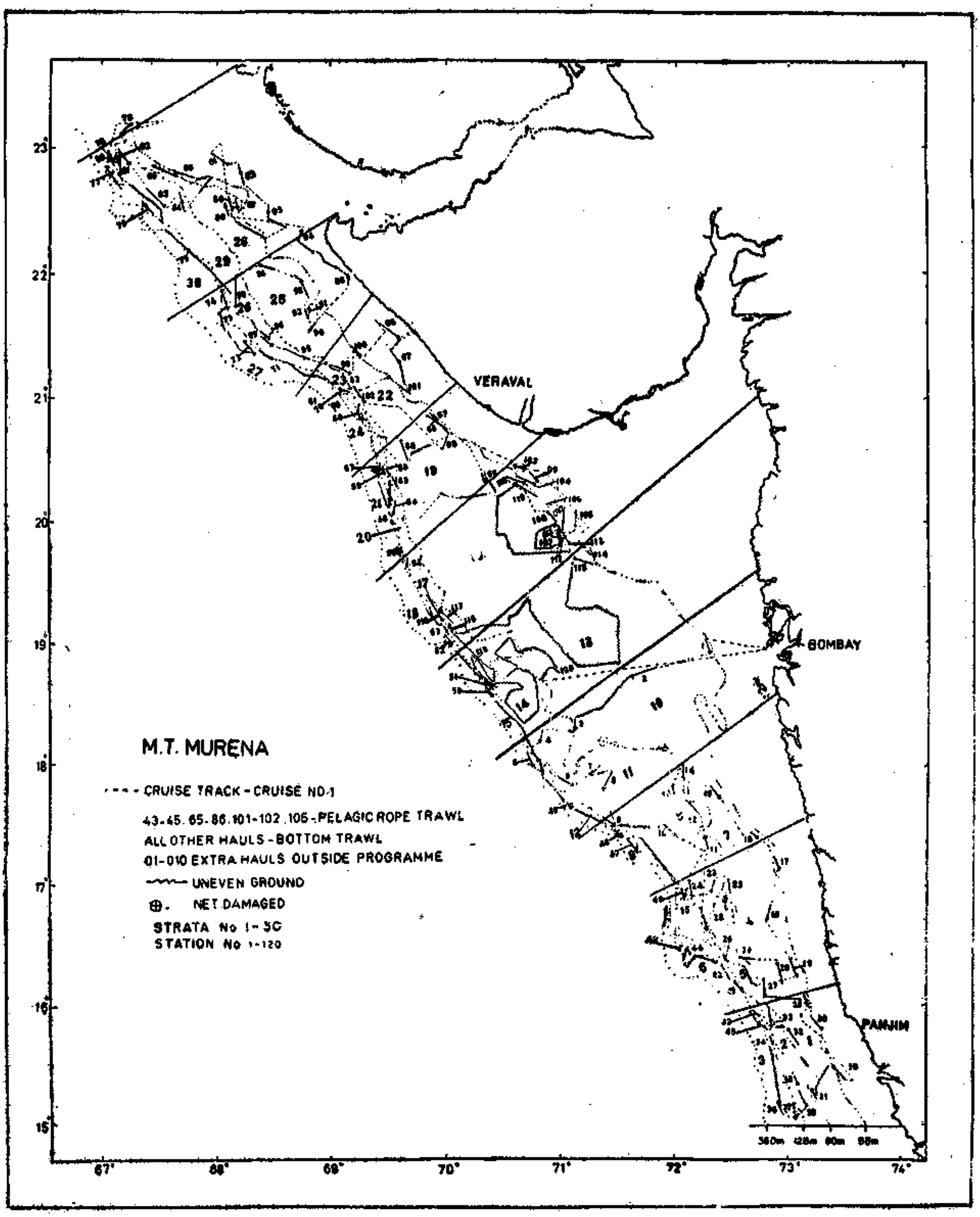


Fig. 2. Cruise I : Cruise track.

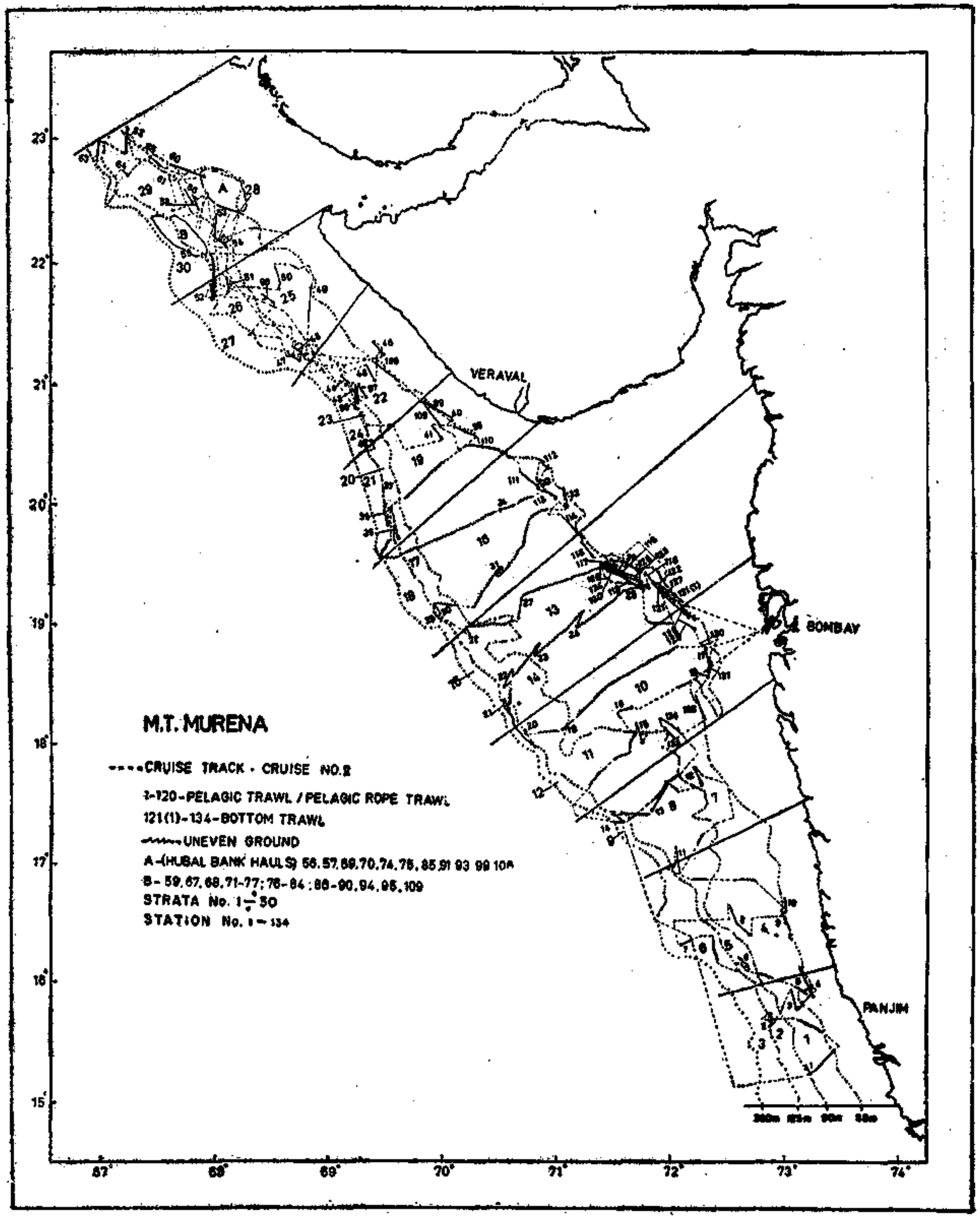


Fig. 3a. Cruise II : Cruise track.

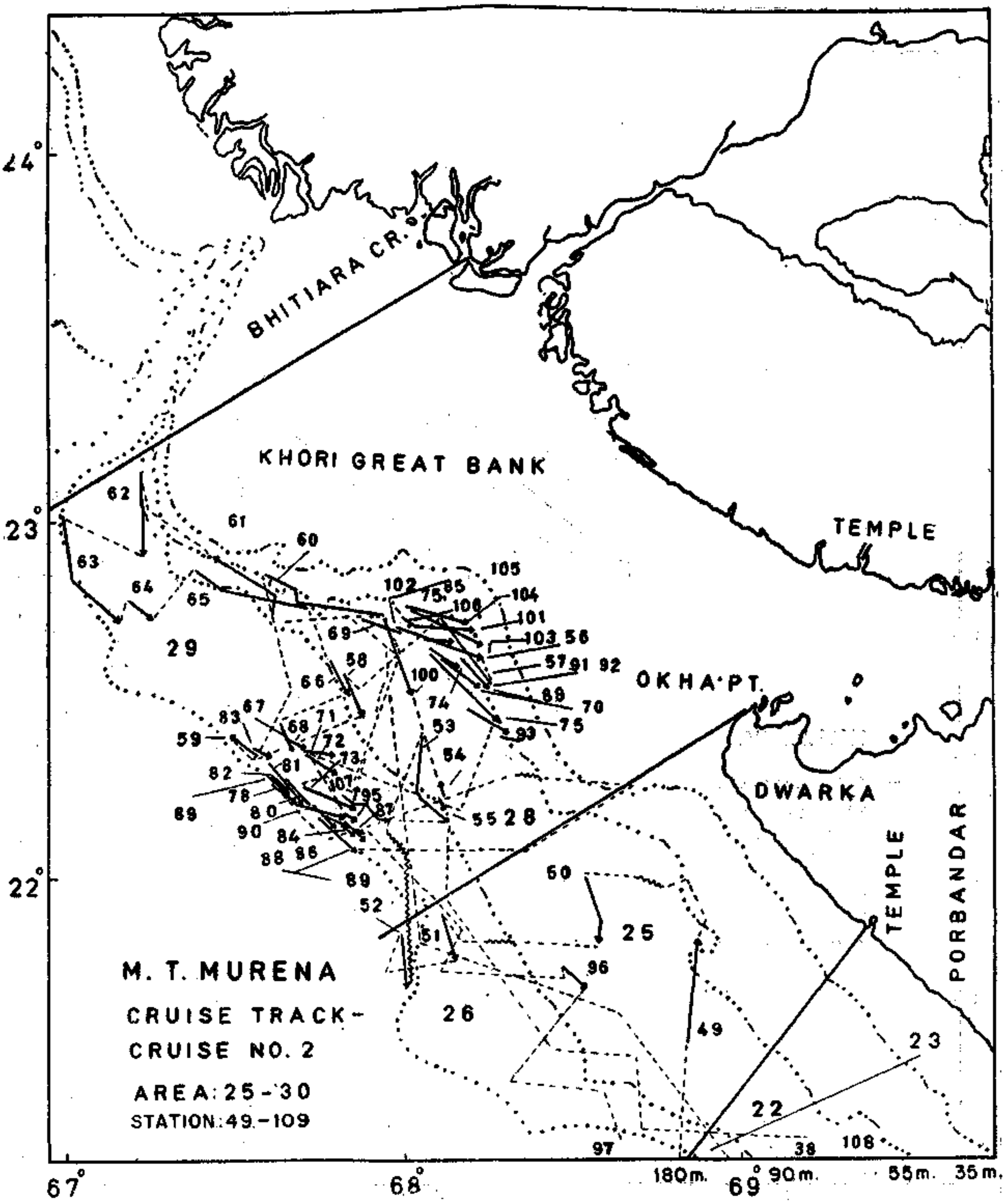


Fig. 3b. Cruise II: Cruise track in Zone 10 (showing horse-mackerel grounds in strata 28-29).

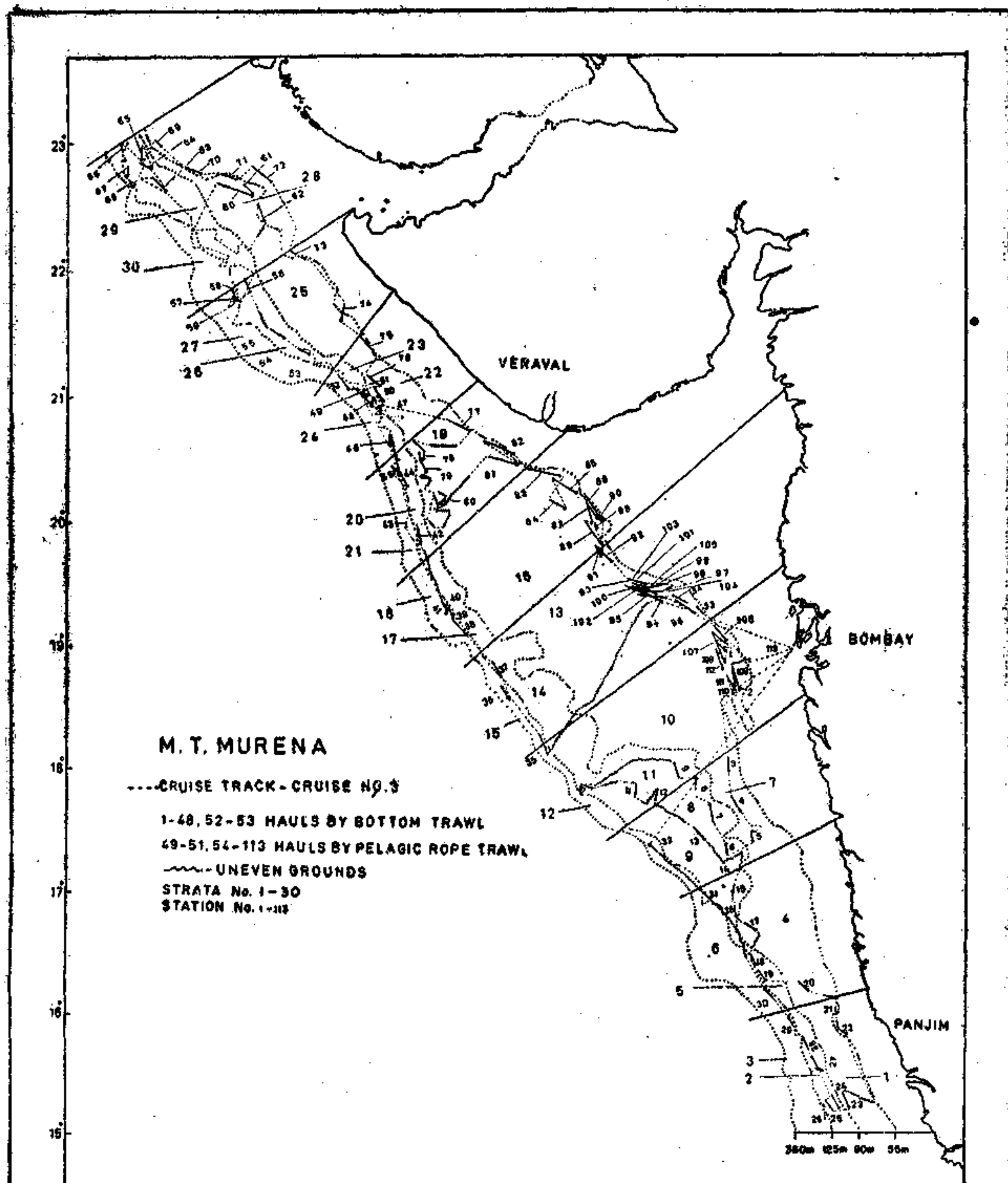


Fig. 4. Cruise III : Cruise track.

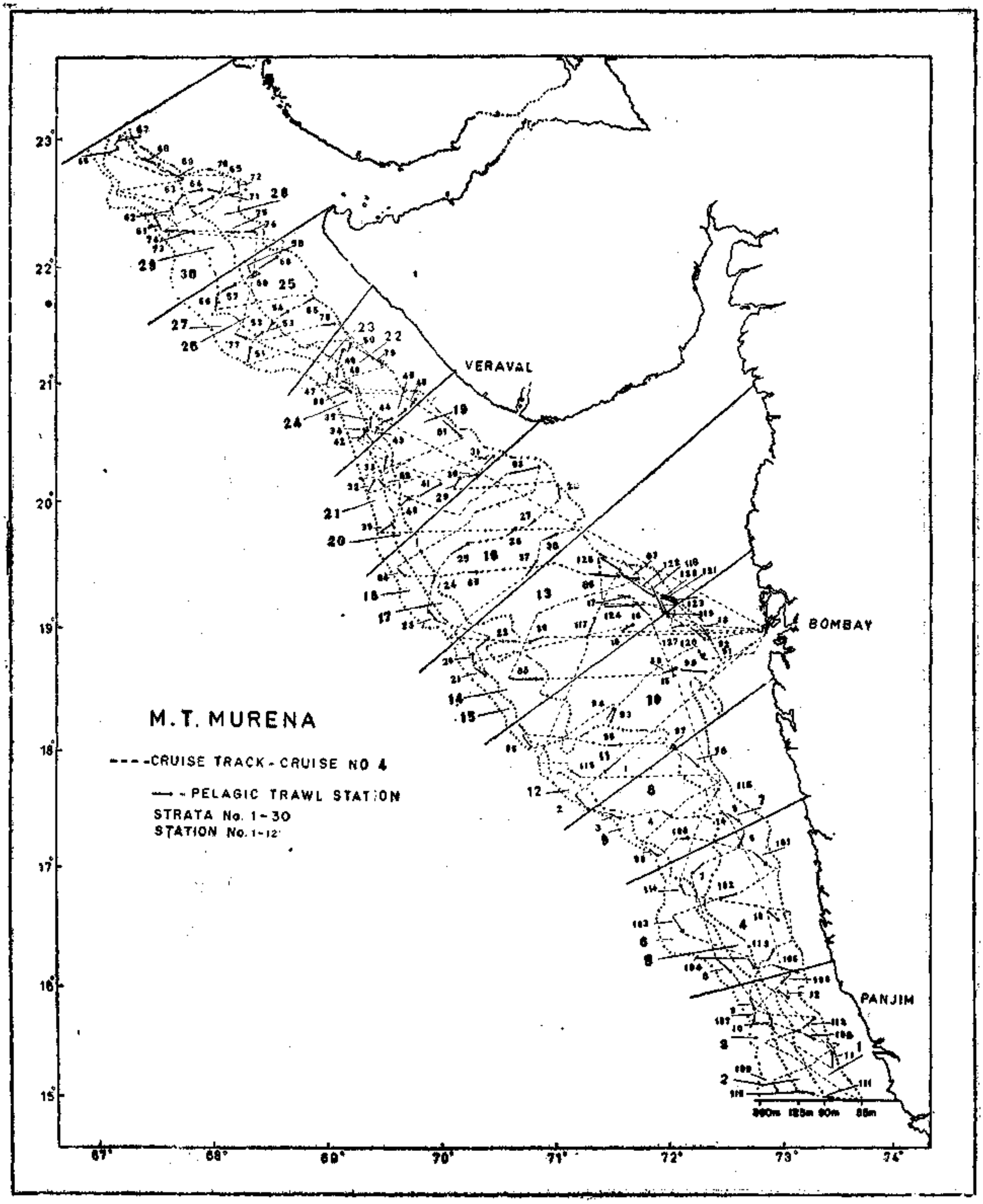


Fig. 5. Cruise IV : Cruise track.

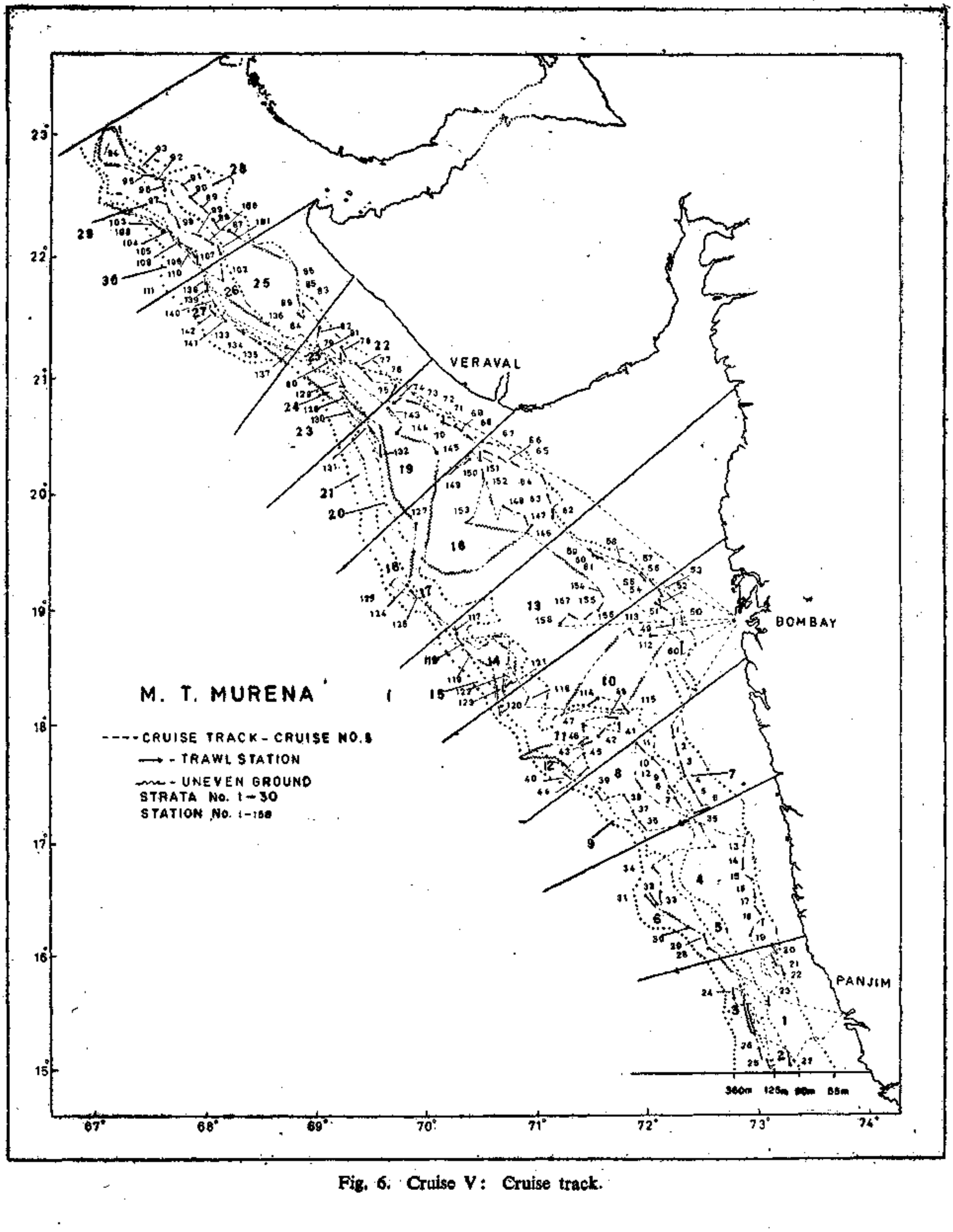


Fig. 6. Cruise V: Cruise track.

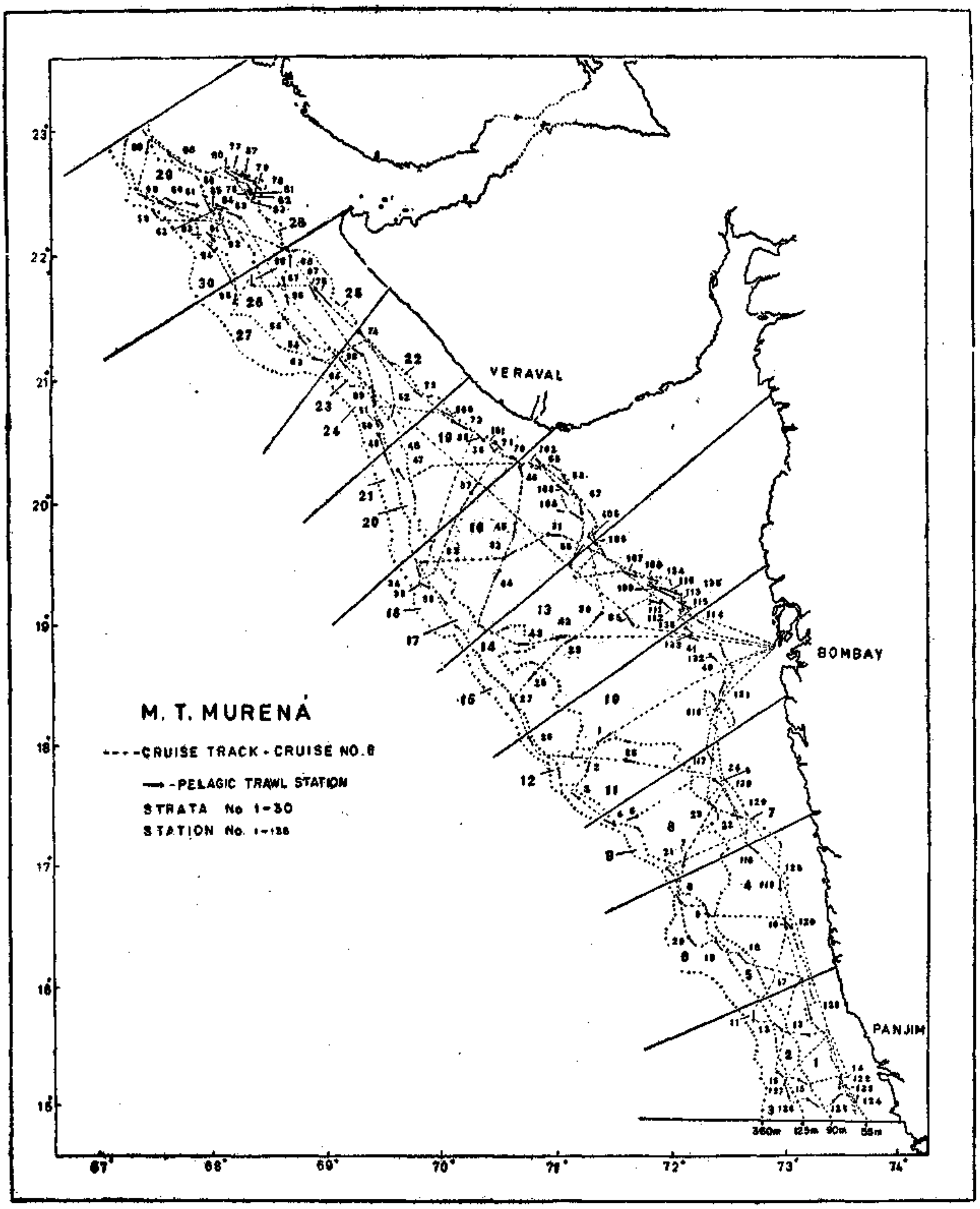


Fig. 7. Cruise VI : Cruise track.

Table - 4 : Species-wise and depth-wise total catch and catch-rates by bottom and Pelagic trawling operations.

Depth in Metres / Major Fish Groups	BOTTOM TRAWLING 55-90 Catch (C/H)	91-125 Catch (C/H)	126-360 Catch (C/H)	Total Catch (C/H)	Per cen tage	PELAGIC TRAWLING 55-90 Catch (C/H)	91-125 Catch (C/H)	126-360 Catch (C/H)	Total Catch (C/H)	Per cen tage	GRAND TOTAL FOR BOTTOM TRAWLING & PELAGIC TRAWLING Catch	Per cen tage
Sharks	1551 (7.25)	583 (4.79)	132 (2.14)	2267 (5.70)	3.10	21601 (31.80)	2604 (12.15)	1141 (6.42)	25346 (23.66)	5.88	27613	5.48
Rays	2678 (12.51)	809 (6.65)	202 (3.27)	3689 (9.28)	5.05	9012 (13.27)	368 (1.78)	112 (0.63)	9492 (8.86)	2.20	13181	2.62
Skates	1541 (7.20)	760 (6.26)	300 (4.86)	2601 (6.54)	3.56	664 (0.98)	-	-	664 (0.62)	0.15	3265	0.65
Congresox talabonoides	1368 (6.39)	-	-	1368 (3.44)	1.87	13690 (20.15)	31 (0.14)	16 (0.09)	13737 (12.82)	3.19	15105	3.00
Cat fish	3265 (15.25)	2427 (19.96)	130 (2.10)	5822 (14.64)	7.97	14456 (21.28)	378 (1.76)	22 (0.12)	14856 (13.87)	3.45	20678	4.10
Clupeids	1284 (6.00)	9 (0.07)	22 (0.36)	1315 (3.31)	1.80	3830 (5.64)	42 (0.20)	6 (0.03)	3878 (3.62)	0.90	5193	1.03
Scopelids	208 (0.97)	719 (5.91)	352 (5.69)	1279 (3.22)	1.75	333 (0.49)	1 (0.00)	2 (0.01)	336 (0.31)	0.08	1615	0.32
Pomadasys hasta	1369 (6.39)	18 (0.15)	-	1387 (3.49)	1.90	3206 (4.72)	129 (0.60)	8 (0.05)	3343 (3.12)	0.78	4730	0.94
Lutjanus spp.	323 (1.51)	559 (4.60)	117 (1.89)	999 (2.51)	1.37	2222 (3.27)	-	6 (0.03)	2228 (2.08)	0.52	3227	0.64
Mene maculata	-	-	-	-	-	623 (0.92)	28 (0.13)	4 (0.02)	655 (0.61)	0.15	655	0.13
Nemipterus japonicus	1115 (5.21)	870 (7.16)	666 (10.77)	2651 (6.67)	3.63	302 (0.44)	1 (0.00)	16 (0.09)	319 (0.30)	0.07	2970	0.59
Serranids	413 (1.93)	1616 (13.29)	377 (6.10)	2406 (6.05)	3.29	192 (0.28)	-	118 (0.66)	310 (0.29)	0.07	2716	0.54
Other perches	2193 (10.24)	330 (2.71)	87 (1.41)	2610 (6.57)	3.57	3482 (5.13)	493 (2.30)	229 (1.29)	4204 (3.92)	0.98	6814	1.35
Polynemids	1427 (6.66)	8 (0.07)	15 (0.24)	1450 (3.65)	1.98	891 (1.31)	-	-	891 (0.83)	0.21	2341	0.46
Protonibea diacanthus (Ghol)	1213 (5.66)	-	81 (1.31)	1294 (3.25)	1.77	6892 (10.15)	3 (0.01)	-	6895 (6.44)	1.60	8189	1.63
Otolithoides brunneus (Koth)	129 (0.60)	-	20 (0.32)	149 (0.37)	0.20	15 (0.02)	-	-	15 (0.01)	-	164	0.03
Lesser sciaenids (Dhoma)	7349 (34.32)	128 (1.05)	203 (3.28)	7680 (19.32)	10.51	4220 (6.21)	2 (0.01)	20 (0.11)	4242 (3.96)	0.98	11922	2.37
Trichiurus spp.	10210 (47.68)	10415 (85.66)	4247 (68.71)	24872 (62.56)	34.04	100219 (147.53)	7644 (35.67)	9521 (53.56)	117384 (109.57)	27.25	142256	28.23
Megalaspis cordyla	1009 (4.71)	623 (5.12)	460 (7.44)	2092 (5.26)	2.86	34830 (51.27)	101597 (474.15)	33497 (188.44)	169924 (158.61)	39.45	172016	34.14
Carangoides chrysophrys	114 (0.53)	170 (1.40)	42 (0.68)	326 (0.82)	0.45	28 (0.04)	188 (0.88)	20 (0.11)	236 (0.22)	0.05	562	0.11
Other carangids	1637 (7.64)	712 (5.86)	71 (1.15)	2420 (6.09)	3.31	6539 (9.63)	65 (0.30)	192 (1.08)	6796 (6.34)	1.58	9216	1.83
Pampus argenteus	1219 (5.69)	-	-	1219 (3.07)	1.67	6658 (9.80)	1406 (6.56)	160 (0.90)	8224 (7.68)	1.91	9443	1.87
Apolectus niger	549 (2.56)	33 (0.27)	-	582 (1.46)	0.80	19907 (29.30)	463 (2.16)	34 (0.19)	20404 (19.05)	4.74	20986	4.17
Scombroids	252 (1.18)	53 (0.44)	2 (0.03)	307 (0.77)	0.42	4275 (6.29)	149 (0.70)	13 (0.07)	4437 (4.14)	1.03	4744	0.94
Tunnies	1 (0.00)	-	11 (0.18)	12 (0.03)	0.02	421 (0.62)	25 (0.12)	850 (4.78)	1296 (1.21)	0.30	1308	0.26
Flat fishes	22 (0.10)	1 (0.01)	-	23 (0.06)	0.03	9 (0.01)	-	-	9 (0.01)	-	32	0.01
Other fishes	234 (1.09)	1102 (9.06)	43 (0.70)	1379 (3.47)	1.89	8304 (12.22)	345 (1.61)	1101 (6.19)	9750 (9.10)	2.26	11129	2.21
Crustaceans	75 (0.35)	4 (0.03)	34 (0.55)	113 (0.28)	0.15	630 (0.93)	4 (0.02)	1 (0.01)	635 (0.59)	0.15	748	0.15
Cephalopods	458 (2.14)	210 (1.73)	93 (1.50)	761 (1.91)	1.04	229 (0.34)	22 (0.10)	3 (0.02)	254 (0.24)	0.06	1015	0.20
TOTAL	43207 (201.76)	22159 (182.24)	7707 (124.69)	73073 (183.81)		267680 (394.08)	115988 (541.32)	47082 (264.92)	430760 (402.08)		503833	

TABLE-5. Species-wise and strata-wise catch, effort and catch-rate by the three bottom-trawl cruises. (Figures in parenthesis indicate catch rates)

Depth in metres: 55–90

Strata	1	4	7	10	13	16	19	22	25	28	Total	C/h
Efforts	19.75	24.22	18.83	31.49	35.58	29.92	17.53	16.58	13.67	6.58	214.15	
Shark	140 (7.09)	62 (2.56)	3 (6.00)	238 (7.56)	300 (8.43)	378 (12.63)	-	80 (4.83)	91 (6.66)	150 (22.80)	1552	7.25
Rays	56 (2.84)	15 (0.62)	-	497 (15.78)	661 (18.58)	659 (22.03)	-	250 (15.08)	405 (29.63)	135 (20.52)	2678	12.51
Skates	-	8 (0.33)	-	475 (15.08)	67 (1.88)	178 (5.98)	1 (0.06)	6 (0.36)	806 (58.96)	-	1541	7.20
Congresox talabonoides	-	-	22 (1.17)	245 (7.78)	977 (27.46)	122 (4.08)	-	-	-	2 (0.30)	1368	6.39
Cat fish	294 (14.89)	364 (15.03)	992 (52.68)	685 (21.75)	708 (19.90)	134 (4.48)	-	60 (3.62)	17 (1.24)	11 (1.67)	3265	15.25
Clupeids	199 (10.08)	9 (0.37)	1 (0.05)	86 (2.73)	117 (3.29)	824 (27.54)	-	-	41 (3.00)	7 (1.06)	1284	6.00
Scopelids	12 (0.61)	20 (0.83)	45 (2.39)	47 (1.49)	12 (0.34)	12 (0.40)	9 (0.51)	25 (1.51)	15 (1.10)	11 (1.67)	208	0.97
[illegible]	48 (2.43)	50 (2.06)	35 (1.86)	165 (5.24)	179 (5.03)	323 (10.80)	-	115 (6.94)	230 (16.83)	222 (33.74)	1369	6.39
Lutjanus spp.	12 (0.61)	56 (2.31)	6 (0.32)	77 (2.45)	103 (2.89)	34 (1.14)	5 (0.29)	-	30 (2.19)	-	323	1.51
Mene maculata	-	-	-	-	-	-	-	-	-	-	-	-
Nemipterus japonicus	437 (22.13)	226 (9.33)	198 (10.52)	183 (5.81)	-	1 (0.03)	-	55 (3.32)	15 (1.10)	-	1115	5.21
Serranids spp.	27 (1.37)	44 (1.82)	108 (5.74)	3 (0.10)	14 (0.39)	11 (0.37)	5 (0.29)	-	196 (14.34)	5 (0.76)	413	1.93
Other perches	97 (4.91)	24 (0.99)	5 (0.27)	498 (15.81)	114 (3.20)	100 (3.34)	171 (9.75)	45 (2.71)	809 (59.18)	330 (50.15)	2193	10.24
Polynemids	-	14 (0.58)	1 (0.05)	35 (1.11)	330 (9.27)	834 (27.87)	-	20 (1.21)	88 (6.44)	105 (15.96)	1427	6.66
Pretonibea diacanthus (Ghol)	3 (0.15)	30 (1.24)	26 (1.38)	108 (3.43)	878 (24.68)	107 (3.58)	-	20 (1.21)	25 (1.83)	16 (2.43)	1213	5.66
Otolithoides brunneus (Koth)	-	-	-	4 (0.13)	111 (3.12)	14 (0.47)	-	-	-	-	129	0.69
Lesser sciaenids (Dhoma)	4 (0.20)	16 (0.66)	26 (1.38)	155 (4.92)	3788 (106.41)	1082 (36.16)	-	30 (1.81)	420 (30.72)	1830 (278.12)	7349	34.32
Trichiurus spp.	68 (3.44)	27 (1.11)	287 (15.24)	1579 (50.14)	294 (8.26)	7422 (248.06)	411 (23.45)	7 (0.42)	30 (2.19)	85 (12.92)	10210	47.68
Megalaspis cordyla	32 (1.62)	2 (0.08)	5 (0.27)	-	-	920 (30.75)	-	-	50 (3.66)	-	1009	4.71
Carangoides chrysophrys	50 (2.53)	43 (1.78)	6 (0.32)	15 (0.48)	-	-	-	-	-	-	114	0.53
Other carangids	53 (2.68)	494 (20.40)	102 (5.42)	104 (3.30)	20 (0.56)	185 (6.18)	2 (0.11)	13 (0.78)	657 (0.48)	7 (1.06)	1637	7.64
Pampus argenteus	110 (5.57)	-	9 (0.48)	205 (6.51)	45 (1.26)	777 (25.97)	-	-	1 (0.07)	72 (10.94)	1219	5.69
Apolectus niger	58 (2.94)	30 (1.24)	15 (0.80)	240 (7.62)	-	95 (3.18)	-	-	110 (8.05)	1 (0.15)	549	2.56
Scombroids	48 (2.43)	83 (3.43)	-	80 (2.54)	-	21 (0.70)	-	-	-	20 (3.04)	252	1.18
Tunnies	-	-	-	1 (0.03)	-	-	-	-	-	-	1	0.00
Flat fishes	-	-	-	15 (0.48)	-	5 (0.17)	-	2 (0.12)	-	-	22	0.10
Other fishes	13 (0.66)	45 (1.86)	-	85 (2.70)	62 (1.74)	3 (0.10)	-	-	25 (1.83)	1 (0.15)	234	1.09
Crustaceans	9 (0.46)	-	3 (0.16)	17 (0.54)	39 (1.10)	6 (0.20)	-	-	-	2 (0.30)	75	0.35
Cephalopods	63 (3.19)	44 (1.82)	29 (1.54)	123 (3.91)	58 (1.63)	35 (1.17)	94 (5.36)	-	12 (0.88)	-	458	2.14
TOTAL :	1832 (92.76)	1706 (70.44)	2034 (108.02)	5967 (189.49)	8875 (249.43)	14282 (477.34)	698 (39.82)	728 (43.91)	4073 (297.95)	3012 (457.75)	43207	201.76

Depth in metres: 91–125

Strata	2	5	8	11	14	17	20	23	26	29	Total	C/h
Efforts	15.50	15.09	26.01	16.08	2.67	8.50	7.41	16.50	11.50	12.33	121.59	
Shark	58 (3.74)	27 (1.79)	120 (4.61)	-	-	40 (4.71)	30 (4.05)	10 (1.54)	288 (25.04)	10 (0.81)	583	4.79
Rays	52 (3.35)	110 (7.29)	15 (0.58)	100 (6.22)	-	240 (28.20)	40 (5.40)	150 (23.08)	102 (8.87)	-	809	6.65
Skates	-	609 (40.36)	-	-	-	1 (0.12)	-	-	150 (13.04)	-	760	6.25
Congresox talabonoides	-	-	-	-	-	-	-	-	-	-	-	-
Cat fish	1171 (75.55)	263 (17.43)	559 (21.49)	385 (23.94)	-	5 (0.59)	2 (0.27)	40 (6.15)	2 (0.17)	-	2427	19.96
Clupeids	-	-	6 (0.23)	-	-	3 (0.35)	-	-	-	-	9	0.07
Scopelids	45 (2.90)	57 (3.78)	91 (3.50)	13 (0.81)	5 (1.87)	338 (39.76)	36 (4.86)	118 (18.15)	16 (1.39)	-	719	5.91
[illegible]	-	-	3 (0.12)	-	-	-	-	-	15 (1.30)	-	18	0.15
Lutjanus spp.	70 (4.52)	327 (21.67)	136 (5.23)	21 (1.31)	-	-	-	5 (0.77)	-	-	559	4.60
Mene maculata	-	-	-	-	-	-	-	-	-	-	-	-
Nemipterus japonicus	59 (3.81)	39 (2.58)	656 (25.22)	1 (0.06)	-	-	-	-	115 (10.00)	-	870	7.16
Serranids spp.	5 (0.32)	447 (29.62)	1060 (40.75)	29 (1.80)	-	-	1 (0.13)	15 (2.31)	14 (1.22)	45 (3.65)	1616	13.29
Other perches	6 (0.39)	87 (5.77)	35 (1.35)	6 (0.37)	-	68 (8.00)	7 (0.94)	5 (0.77)	114 (9.91)	2 (0.16)	330	2.71
Polynemids	-	-	4 (0.15)	2 (0.12)	-	-	-	2 (0.31)	-	-	8	0.07
Pretonibea diacanthus (Ghol)	-	-	-	-	-	-	-	-	-	-	-	-
Otolithoides brunneus (Koth)	-	-	-	-	-	-	-	-	-	-	-	-
Lesser sciaenids (Dhoma)	-	-	1 (0.04)	-	-	-	5 (0.67)	-	-	122 (9.89)	128	1.05
Trichiurus spp.	3177 (204.97)	195 (12.92)	337 (12.96)	382 (23.76)	165 (61.80)	5 (0.59)	3003 (405.26)	3100 (186.92)	51 (4.43)	-	10475	85.66
Megalaspis cordyla	-	-	-	-	-	-	-	620 (36.38)	3 (0.26)	-	623	5.12
Carangoides chrysophrys	66 (4.26)	94 (6.23)	-	-	-	-	-	-	10 (0.87)	-	170	1.40
Other carangids	22 (1.42)	48 (3.18)	300 (11.53)	151 (9.39)	25 (9.36)	40 (4.71)	23 (3.10)	6 (0.92)	95 (8.26)	2 (0.16)	712	5.86
Pampus argenteus	-	-	-	-	-	-	-	-	-	-	-	-
Apolectus niger	-	-	26 (1.00)	-	-	-	-	-	7 (0.61)	-	33	0.27
Scombroids	21 (1.35)	2 (0.13)	21 (0.81)	-	-	-	-	-	9 (0.78)	-	53	0.44
Tunnies	-	-	-	-	-	-	-	-	-	-	-	-
Flat fishes	-	-	-	1 (0.06)	-	-	-	-	-	-	1	0.01
Other fishes	2 (0.13)	1034 (68.52)	20 (0.77)	12 (0.75)	-	8 (0.94)	15 (2.02)	2 (0.31)	8 (0.70)	1 (0.08)	1102	9.06
Crustaceans	-	2 (0.13)	-	-	-	2 (0.24)	-	-	-	-	4	0.03
Cephalopods	175 (11.29)	5 (0.33)	3 (0.12)	5 (0.31)	-	-	1 (0.13)	2 (0.31)	12 (1.04)	7 (0.57)	210	1.73
TOTAL :	4929 (318.00)	3346 (221.74)	3393 (130.45)	1108 (68.91)	195 (73.03)	750 (88.24)	3163 (426.86)	4075 (626.92)	1011 (87.91)	189 (15.33)	22159	182.24

Depth in metres: 126–360 and Grand Total

Strata	3	6	9	12	15	18	21	24	27	30	Total	C/h	Grand Total	C/h
Efforts	13.50	7.50	4.84	4.25	4.75	5.59	7.34	9.41	3.05	1.58	61.81		387.55	
Shark	5 (0.37)	15 (2.00)	-	-	-	17 (3.04)	30 (4.09)	65 (6.91)	-	-	132	2.14	2267	5.70
Rays	-	70 (9.33)	-	-	-	-	22 (3.00)	110 (11.69)	-	-	202	3.27	3689	9.28
Skates	-	-	-	-	-	-	-	300 (31.88)	-	-	300	4.85	2601	6.54
Congresox talabonoides	-	-	-	-	-	-	-	-	-	-	-	-	1368	3.44
Cat fish	-	65 (8.67)	-	-	-	-	-	65 (6.91)	-	-	130	2.10	5822	14.64
Clupeids	22 (1.63)	-	-	-	-	-	-	-	-	-	22	0.36	1315	3.31
Scopelids	12 (0.89)	43 (5.73)	-	1 (0.24)	78 (16.42)	112 (20.04)	38 (5.18)	68 (7.23)	-	-	352	5.69	1279	3.22
[illegible]	-	-	-	-	-	-	-	-	-	-	-	-	1387	3.49
Lutjanus spp.	64 (4.74)	45 (6.00)	8 (1.65)	-	-	-	-	-	-	-	117	1.89	999	2.51
Mene maculata	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nemipterus japonicus	462 (34.22)	-	1 (0.21)	2 (0.47)	55 (11.58)	43 (7.69)	3 (0.41)	100 (10.63)	-	-	666	10.77	2651	6.67
Serranids spp.	70 (5.19)	63 (8.40)	21 (4.34)	-	4 (0.84)	133 (23.79)	1 (0.14)	14 (1.49)	71 (23.28)	-	377	6.10	2406	6.05
Other perches	34 (2.52)	2 (0.27)	-	22 (5.18)	9 (1.89)	-	-	6 (0.64)	14 (4.59)	-	87	1.41	2610	6.57
Polynemids	-	-	-	-	-	-	-	15 (1.59)	-	-	15	0.24	1450	3.65
Pretonibea diacanthus (Ghol)	-	-	-	-	-	-	17 (2.32)	-	64 (20.98)	-	81	1.31	1294	3.25
Otolithoides brunneus (Koth)	-	-	-	-	-	20 (3.58)	-	-	-	-	20	0.32	149	0.37
Lesser sciaenids (Dhoma)	-	-	-	-	1 (0.21)	-	1 (0.14)	196 (20.83)	5 (1.64)	-	203	3.28	7680	19.32
Trichiurus spp.	20 (1.48)	123 (16.40)	-	5 (1.18)	4 (0.84)	5 (0.89)	300 (40.87)	3790 (402.76)	-	-	4247	68.71	24872	62.56
Megalaspis cordyla	-	-	-	-	-	-	-	460 (48.88)	-	-	460	7.44	2092	5.26
Carangoides chrysophrys	2 (0.15)	27 (3.60)	-	-	-	-	-	13 (1.38)	-	-	42	0.68	326	0.82
Other carangids	-	2 (0.27)	-	-	-	1 (0.18)	5 (0.68)	63 (6.70)	-	-	71	1.15	2420	6.09
Pampus argenteus	-	-	-	-	-	-	-	-	-	-	-	-	1219	3.07
Apolectus niger	-	-	-	-	-	-	-	-	-	-	-	-	582	1.46
Scombroids	-	2 (0.27)	-	-	-	-	-	-	-	-	2	0.03	307	0.77
Tunnies	-	3 (0.40)	-	-	5 (1.05)	2 (0.36)	-	1 (0.11)	-	-	11	0.18	12	0.08
Flat fishes	-	-	-	-	-	-	-	-	-	-	-	-	23	0.06
Other fishes	29 (2.15)	-	-	-	1 (0.21)	-	3 (0.41)	10 (1.06)	-	-	43	0.70	1379	3.47
Crustaceans	30 (2.22)	-	3 (0.62)	-	-	1 (0.18)	-	-	-	-	34	0.55	113	0.29
Cephalopods	50 (3.70)	15 (2.00)	-	-	-	-	-	26 (2.76)	2 (0.66)	-	93	1.50	761	1.97
TOTAL :	800 (59.26)	475 (69.33)	33 (6.82)	30 (7.06)	157 (33.05)	334 (59.75)	420 (57.22)	5302 (563.44)	156 (51.15)	-	7707	124.69	73073	193.81

TABLE - 6. Species-wise and strata-wise catch, effort and catch-rate by bottom trawling during Cruise-I.
(Figures in parenthesis indicate catch rates)

DEPTH IN METRES	55 — 90											
STRATA	1	4	7	10	13	16	19	22	25	28	TOTAL	C/h
EFFORTS	8.92	10.17	4.25	18.32	21.91	18.00	-	3.75	7.50	4.75	97.57	
MAJOR FISH GROUPS Sharks	22 (2.47)	40 (3.93)	8 (1.88)	106 (5.79)	67 (3.06)	292 (16.22)	-	60 (16.00)	87 (11.60)	150 (31.58)	832	8.52
Rays	14 (1.57)	-	-	425 (23.20)	608 (27.75)	656 (36.44)	-	250 (66.67)	405 (54.00)	135 (28.42)	2493	25.55
Skates	-	8 (0.79)	-	165 (9.01)	27 (1.23)	178 (9.89)	-	6 (1.60)	806 (107.47)	-	1190	12.19
Congresox talabonoides	-	-	16 (3.76)	245 (13.37)	977 (44.59)	122 (6.78)	-	-	-	2 (0.42)	1362	13.95
Cat fish	270 (30.2[illegible])	364 (35.79)	912 (214.59)	542 (29.59)	341 (15.56)	119 (6.61)	-	60 (16.00)	17 (2.27)	11 (2.32)	2636	27.01
Clupeids	199 (22.3[illegible])	9 (0.88)	-	81 (4.42)	95 (4.34)	812 (45.11)	-	-	41 (5.47)	7 (1.47)	1244	12.74
Scopelids	9 (1.01)	12 (1.18)	-	30 (1.64)	12 (0.55)	10 (0.56)	-	25 (6.67)	11 (1.47)	11 (2.32)	120	1.22
Pomadasys hasta	48 (5.3[illegible])	50 (4.92)	14 (3.2[illegible])	95 (5.19)	148 (6.75)	323 (17.94)	-	115 (30.67)	230 (30.67)	222 (46.74)	1245	12.76
Lutjanus spp.	-	6 (0.59)	4 (0.94)	70 (3.82)	9 (0.41)	12 (0.67)	-	-	30 (4.00)	-	131	1.34
Mene maculata	-	-	-	-	-	-	-	-	-	-	-	-
Nemipterus japonicus	37 (4.15)	150 (14.75)	8 (1.88)	96 (5.24)	-	1 (0.06)	-	55 (14.67)	15 (2.00)	-	362	3.71
Serranids	26 (2.9[illegible])	43 (4.23)	-	3 (0.16)	14 (0.64)	10 (0.56)	-	-	50 (6.67)	5 (1.05)	151	1.54
Other perches	89 (9.9[illegible])	15 (1.47)	-	127 (6.93)	17 (0.78)	79 (4.39)	-	45 (12.00)	257 (34.27)	330 (69.47)	959	9.82
Polynemids	-	-	-	25 (1.36)	157 (7.17)	825 (45.83)	-	20 (5.33)	88 (11.73)	105 (22.11)	1220	12.50
Protonibea diacanthus (Ghol)	-	30 (2.95)	8 (1.88)	106 (5.79)	870 (39.71)	107 (5.94)	-	20 (5.33)	7 (0.93)	16 (3.37)	1164	11.92
Otolithoides brunneus (Koth)	-	-	-	4 (0.22)	111 (5.07)	14 (0.78)	-	-	-	-	129	1.32
Lesser sciaenids (Dhoma)	-	16 (1.37)	26 (6.12)	50 (2.73)	121 (5.52)	1080 (60.00)	-	30 (8.00)	100 (13.33)	1830 (385.26)	3253	33.34
Trichiurus spp.	53 (5.94)	6 (0.59)	192 (45.18)	853 (46.56)	173 (7.90)	2312 (128.44)	-	7 (1.87)	30 (4.00)	85 (17.89)	3711	38.03
Megalaspis cordyla	30 (3.3[illegible])	-	-	-	-	920 (51.11)	-	-	50 (6.67)	-	1000	10.24
Carangoides chrysophrys	50 (5.6[illegible])	43 (4.23)	6 (1.41)	15 (0.82)	-	-	-	-	-	-	114	1.16
Other carangids	51 (5.7[illegible])	231 (22.71)	98 (23.06)	17 (0.93)	10 (0.46)	176 (9.78)	-	11 (2.93)	646 (86.13)	7 (1.47)	1247	12.78
Pampus argenteus	-	-	8 (1.88)	200 (10.92)	31 (1.41)	477 (26.50)	-	-	1 (0.13)	72 (15.16)	789	8.08
Apolectus niger	58 (6.5[illegible])	20 (1.97)	-	39 (2.13)	-	45 (2.50)	-	-	110 (14.67)	1 (0.21)	273	2.79
Scombroids	41 (4.6[illegible])	53 (5.21)	-	60 (3.28)	-	21 (1.17)	-	-	-	20 (4.21)	195	1.99
Tunnies	-	-	-	1 (0.05)	-	-	-	-	-	-	1	0.01
Flat fishes	-	-	-	8 (0.44)	-	-	-	2 (0.53)	-	-	10	0.10
Other fishes	11 (1.23)	43 (4.23)	-	34 (1.86)	62 (2.83)	3 (0.17)	-	-	25 (3.33)	1 (0.21)	179	1.83
Crustaceans	-	-	-	17 (0.93)	25 (1.14)	6 (0.33)	-	-	-	2 (0.42)	50	0.51
Cephalopods	59 (6.6[illegible])	42 (4.13)	-	54 (2.95)	2 (0.09)	35 (1.95)	-	-	-	-	192	1.96
TOTAL :	10[illegible] (119.4[illegible])	1181 (116.13)	1300 (305.88)	3468 (189.30)	3877 (176.95)	8635 (479.72)	-	706 (188.27)	3006 (400.80)	3012 (634.11)	26252	269.0[illegible]

DEPTH IN METRES	91 — 125											
STRATA	2	5	8	11	14	17	20	23	26	29	TOTAL	C/h
EFFORTS	7.23	8.67	8.82	7.83	1.17	4.50	3.58	-	8.75	-	50.67	
MAJOR FISH GROUPS Sharks	28 (3.86)	25 (2.88)	-	-	-	-	-	-	288 (32.91)	-	341	6.72
Rays	-	-	-	-	-	40 (8.89)	-	-	102 (11.66)	-	142	2.80
Skates	-	609 (70.24)	-	-	-	1 (0.22)	-	-	150 (17.14)	-	760	14.99
Congresox talabonoides	-	-	-	-	-	-	-	-	-	-	-	-
Cat fish	1158 (159.72)	241 (27.80)	444 (49.78)	55 (7.02)	-	5 (1.11)	2 (0.56)	-	2 (0.23)	-	1907	37.63
Clupeids	-	-	-	-	-	-	-	-	-	-	-	-
Scopelids	9 (1.24)	14 (1.61)	63 (7.06)	7 (0.89)	5 (4.27)	126 (28.00)	14 (3.91)	-	16 (1.83)	-	254	5.01
Pomadasys hasta	-	-	-	-	-	-	-	-	15 (1.71)	-	15	0.29
Lutjanus spp.	70 (9.66)	117 (13.49)	31 (3.48)	21 (2.68)	-	-	-	-	-	-	239	4.71
Mene maculata	-	-	-	-	-	-	-	-	-	-	-	-
Nemipterus japonicus	54 (7.45)	30 (3.46)	341 (38.23)	-	-	-	-	-	115 (13.14)	-	540	10.65
Serranids	5 (0.69)	72 (8.30)	509 (57.06)	13 (1.66)	-	-	1 (0.28)	-	13 (1.49)	-	613	12.09
Other perches	-	80 (9.23)	-	-	-	30 (6.67)	2 (0.56)	-	114 (13.03)	-	226	4.46
Polynemids	-	-	-	-	-	-	-	-	-	-	-	-
Protonibea diacanthus (Ghol)	-	-	-	-	-	-	-	-	-	-	-	-
Otolithoides brunneus (Koth)	-	-	-	-	-	-	-	-	-	-	-	-
Lesser sciaenids (Dhoma)	-	-	1 (0.11)	-	-	-	5 (1.40)	-	-	-	6	0.11
Trichiurus spp.	133 (18.34)	125 (14.42)	230 (25.78)	377 (48.15)	165 (141.03)	3 (0.67)	3 (0.84)	-	51 (5.83)	-	1087	21.45
Megalaspis cordyla	-	-	-	-	-	-	-	-	3 (0.34)	-	3	0.05
Carangoides chrysophrys	66 (9.10)	94 (10.84)	-	-	-	-	-	-	10 (1.14)	-	170	3.35
Other carangids	22 (3.03)	8 (0.92)	219 (24.55)	145 (18.52)	25 (21.37)	11 (2.44)	-	-	67 (7.66)	-	497	9.80
Pampus argenteus	-	-	-	-	-	-	-	-	-	-	-	-
Apolectus niger	-	-	11 (1.23)	-	-	-	-	-	7 (0.80)	-	18	0.35
Scombroids	-	2 (0.23)	6 (0.67)	-	-	-	-	-	9 (1.03)	-	17	0.33
Tunnies	-	-	-	-	-	-	-	-	-	-	-	-
Flat fishes	-	-	-	-	-	-	-	-	-	-	-	-
Other fishes	-	1023 (117.99)	12 (1.35)	-	-	7 (1.56)	-	-	8 (0.91)	-	1050	20.72
Crustaceans	-	-	-	-	-	-	-	-	-	-	-	-
Cephalopods	170 (23.45)	-	-	-	-	-	-	-	10 (1.14)	-	180	3.55
TOTAL :	1710 (236.5[illegible])	2440 (281.43)	1867 (209.30)	618 (78.93)	195 (166.67)	223 (49.56)	27 (7.54)	-	990 (112.00)	-	8055	159.16

DEPTH IN METRES	126 — 360											
STRATA	3	6	9	12	15	18	21	24	27	30	TOTAL	C/h
EFFORTS	5.75	4.50	3.17	1.42	3.25	3.92	5.67	4.08	-	-	31.76	
MAJOR FISH GROUPS Sharks	-	-	-	-	-	12 (3.06)	-	25 (6.13)	-	-	37	1.16
Rays	-	-	-	-	-	-	-	-	-	-	-	-
Skates	-	-	-	-	-	-	-	300 (73.53)	-	-	300	9.44
Congresox talabonoides	-	-	-	-	-	-	-	-	-	-	-	-
Cat fish	-	65 (14.44)	-	-	-	-	-	20 (4.90)	-	-	85	2.67
Clupeids	-	-	-	-	-	-	-	-	-	-	-	-
Scopelids	11 (1.91)	3 (0.67)	-	1 (0.70)	78 (24.00)	82 (20.92)	18 (3.17)	48 (11.76)	-	-	241	7.58
Pomadasys hasta	-	-	-	-	-	-	-	-	-	-	-	-
Lutjanus spp.	64 (11.13)	45 (10.00)	8 (2.52)	-	-	-	-	-	-	-	117	3.68
Mene maculata	-	-	-	-	-	-	-	-	-	-	-	-
Nemipterus japonicus	160 (27.83)	-	1 (0.32)	2 (1.41)	55 (16.92)	43 (10.97)	3 (0.53)	100 (24.56)	-	-	364	11.46
Serranids	70 (12.17)	11 (2.44)	6 (1.89)	-	4 (1.23)	133 (33.93)	1 (0.18)	14 (3.43)	-	-	239	7.52
Other perches	-	-	-	22 (15.49)	9 (2.77)	-	-	2 (0.49)	-	-	33	1.03
Polynemids	-	-	-	-	-	-	-	-	-	-	-	-
Protonibea diacanthus (Ghol)	-	-	-	-	-	-	17 (3.00)	-	-	-	17	0.53
Otolithoides brunneus (Koth)	-	-	-	-	-	20 (5.10)	-	-	-	-	20	0.62
Lesser sciaenids (Dhoma)	-	-	-	-	1 (0.31)	-	1 (0.18)	196 (48.04)	-	-	198	6.23
Trichiurus spp.	-	3 (0.67)	-	5 (3.52)	4 (1.23)	5 (1.28)	-	390 (95.59)	-	-	407	12.81
Megalaspis cordyla	-	-	-	-	-	-	-	160 (39.22)	-	-	160	5.03
Carangoides chrysophrys	2 (0.35)	27 (6.00)	-	-	-	-	-	13 (3.19)	-	-	42	1.32
Other carangids	-	2 (0.44)	-	-	-	1 (0.26)	-	2 (0.49)	-	-	5	0.15
Pampus argenteus	-	-	-	-	-	-	-	-	-	-	-	-
Apolectus niger	-	-	-	-	-	-	-	-	-	-	-	-
Scombroids	-	2 (0.44)	-	-	-	-	-	-	-	-	2	0.06
Tunnies	-	3 (0.67)	-	-	5 (1.54)	2 (0.51)	-	-	-	-	10	0.30
Flat fishes	-	-	-	-	-	-	-	-	-	-	-	-
Other fishes	-	-	-	-	1 (0.31)	-	-	-	-	-	1	0.03
Crustaceans	30 (5.22)	-	3 (0.95)	-	-	-	-	-	-	-	33	1.03
Cephalopods	-	15 (3.33)	-	-	-	-	-	23 (5.64)	-	-	38	1.19
TOTAL :	337 (58.61)	176 (39.11)	18 (5.68)	30 (21.13)	157 (48.31)	298 (76.02)	40 (7.05)	1293 (316.91)	-	-	2349	73.96

TABLE-7. Species-wise and strata-wise catch, effort and catch-rate by bottom trawl during cruise III (Figures in parenthesis indicate catch rates)

DEPTH IN METRES	55 — 90												91 — 125												125 — 360											
STRATA	1	4	7	10	13	16	19	22	25	28	TOTAL	C/h	2	5	8	11	14	17	20	23	26	29	TOTAL	C/h	3	6	9	12	15	18	21	24	27	30	TOTAL	C/h
MAJOR FISH GROUPS / EFFORTS	5.83	3.50	5.33	3.67	3.17	-	-	-	-	-	21.50		6.67	6.42	7.92	6.75	1.50	4.00	3.83	3.50	1.17	-	41.76		3.00	3.00	0.17	1.33	1.50	1.67	1.67	5.33	-	-	17.67	
Sharks	118 (20.24)	22 (6.29)	93 (17.45)	100 (27.25)	14 (4.42)	-	-	-	-	-	347	16.14	30 (4.50)	2 (0.31)	120 (15.15)	-	-	40 (10.00)	30 (7.83)	10 (2.86)	-	-	232	5.56	-	15 (5.00)	-	-	-	5 (2.99)	30 (17.96)	40 (7.50)	-	-	90	5.09
Rays	42 (7.20)	15 (4.29)	-	70 (19.07)	51 (16.09)	-	-	-	-	-	178	8.28	52 (7.80)	110 (17.13)	15 (1.89)	100 (14.81)	-	200 (50.00)	40 (10.44)	150 (42.86)	-	-	667	15.97	-	70 (23.33)	-	-	-	-	22 (13.17)	110 (20.64)	-	-	202	11.43
Skates	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Congresox talabonoides	-	-	6 (1.13)	-	-	-	-	-	-	-	6	0.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cat fish	24 (4.12)	-	80 (15.01)	5 (1.36)	10 (3.15)	-	-	-	-	-	119	5.53	13 (1.95)	22 (3.43)	115 (14.52)	330 (48.89)	-	-	-	40 (11.43)	-	-	520	12.45	-	-	-	-	-	-	-	45 (8.44)	-	-	45	2.55
Clupeids	-	-	1 (0.19)	1 (0.27)	1 (0.32)	-	-	-	-	-	3	0.14	-	-	6 (0.76)	-	-	3 (0.75)	-	-	-	-	9	0.22	22 (7.33)	-	-	-	-	-	-	-	-	-	22	1.25
Scopelids	3 (0.51)	8 (2.29)	42 (7.88)	6 (1.63)	-	-	-	-	-	-	59	2.74	36 (5.40)	43 (6.70)	28 (3.54)	6 (0.89)	-	212 (53.00)	22 (5.74)	115 (32.86)	-	-	462	11.06	-	40 (13.33)	-	-	-	30 (17.96)	20 (11.98)	20 (3.75)	-	-	110	6.23
Pomadasys hasta	-	-	21 (3.94)	66 (17.98)	4 (1.26)	-	-	-	-	-	91	4.23	-	-	3 (0.38)	-	-	-	-	-	-	-	3	0.07	-	-	-	-	-	-	-	-	-	-	-	-
Lutjanus spp.	12 (2.06)	50 (14.29)	-	7 (1.91)	30 (9.46)	-	-	-	-	-	99	4.60	-	210 (32.71)	105 (13.26)	-	-	-	-	-	-	-	315	7.54	-	-	-	-	-	-	-	-	-	-	-	-
Mene maculata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nemipterus japonicus	400 (68.61)	76 (21.71)	190 (35.65)	5 (1.36)	-	-	-	-	-	-	671	31.21	5 (0.75)	9 (1.40)	315 (39.77)	1 (0.15)	-	-	-	-	-	-	330	7.90	300 (100.00)	-	-	-	-	-	-	-	-	-	300	16.98
Serranids	1 (0.17)	1 (0.29)	-	-	-	-	-	-	-	-	2	0.09	-	375 (58.41)	550 (69.44)	16 (2.37)	-	-	-	10 (2.86)	-	-	951	22.77	-	52 (17.33)	15 (88.24)	-	-	-	-	-	-	-	67	3.79
Other perches	8 (1.37)	9 (2.57)	2 (0.38)	15 (4.09)	33 (10.41)	-	-	-	-	-	67	3.12	6 (0.90)	7 (1.09)	35 (4.42)	6 (0.89)	-	38 (9.50)	5 (1.31)	5 (1.43)	-	-	102	2.44	-	2 (0.67)	-	-	-	-	-	4 (0.75)	-	-	6	0.34
Polynemids	-	14 (4.00)	1 (0.19)	-	-	-	-	-	-	-	15	0.70	-	-	4 (0.51)	2 (0.30)	-	-	-	2 (0.57)	-	-	8	0.19	-	-	-	-	-	-	-	15 (2.81)	-	-	15	0.85
Protonibea diacanthus (Shet)	3 (0.51)	-	-	2 (0.54)	-	-	-	-	-	-	5	0.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Otolithoides brunneus (Day)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lesser Sciaenids	4 (0.69)	-	-	-	6 (1.89)	-	-	-	-	-	10	0.47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichiurus spp.	15 (2.57)	21 (6.00)	13 (2.44)	-	1 (0.32)	-	-	-	-	-	50	2.33	3044 (456.37)	70 (10.90)	107 (13.51)	5 (0.74)	-	2 (0.50)	3000 (783.29)	2000 (571.43)	-	-	8228	197.03	20 (6.67)	120 (40.00)	-	-	-	-	300 (179.64)	3400 (637.90)	-	-	3840	217.32
Megalaspis cordyla	2 (0.34)	2 (0.57)	3 (0.94)	-	-	-	-	-	-	-	9	0.42	-	-	-	-	-	-	-	620 (177.14)	-	-	620	14.85	-	-	-	-	-	-	-	300 (56.29)	-	-	300	16.98
Carangoides chrysophrys	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other carangids	2 (0.34)	263 (75.14)	4 (0.75)	11 (3.00)	-	-	-	-	-	-	280	13.02	-	40 (6.23)	81 (10.23)	6 (0.89)	-	29 (7.25)	23 (6.01)	6 (1.71)	-	-	185	4.43	-	-	-	-	-	-	5 (2.99)	61 (11.44)	-	-	66	3.74
Pampus argenteus	110 (18.87)	-	1 (0.19)	-	2 (0.63)	-	-	-	-	-	113	5.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apolectus niger	-	10 (2.86)	15 (2.81)	196 (53.41)	-	-	-	-	-	-	221	10.28	-	-	15 (1.89)	-	-	-	-	-	-	-	15	0.36	-	-	-	-	-	-	-	-	-	-	-	-
Scombroids	7 (1.20)	30 (8.57)	-	15 (4.09)	-	-	-	-	-	-	52	2.42	21 (3.15)	-	15 (1.89)	-	-	-	-	-	-	-	36	0.86	-	-	-	-	-	-	-	-	-	-	-	-
Tunnies	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 (0.19)	-	-	1	0.06
Flat fishes	-	-	-	6 (1.63)	-	-	-	-	-	-	6	0.28	-	-	-	1 (0.15)	-	-	-	-	-	-	1	0.02	-	-	-	-	-	-	-	-	-	-	-	-
Other fishes	2 (0.34)	2 (0.57)	-	6 (1.63)	-	-	-	-	-	-	10	0.47	2 (0.30)	11 (1.71)	8 (1.01)	12 (1.78)	-	1 (0.25)	15 (3.92)	2 (0.57)	-	-	51	1.22	2 (0.67)	-	-	-	-	-	3 (1.80)	10 (1.88)	-	-	15	0.85
Crustaceans	8 (1.37)	-	3 (0.56)	-	2 (0.63)	-	-	-	-	-	13	0.60	-	2 (0.31)	-	-	-	2 (0.50)	-	-	-	-	4	0.10	-	-	-	-	-	1 (0.60)	-	-	-	-	1	0.06
Cephalopods	4 (0.69)	2 (0.57)	-	1 (0.27)	-	-	-	-	-	-	7	0.33	5 (0.75)	5 (0.78)	3 (0.38)	5 (0.74)	-	-	1 (0.26)	-	-	-	19	0.45	-	-	-	-	-	-	-	3 (0.56)	-	-	3	0.17
TOTAL	765 (131.22)	525 (150.00)	477 (89.49)	512 (139.51)	154 (48.58)	-	-	-	-	-	2433	113.16	3214 (481.86)	906 (141.12)	1525 (192.55)	490 (72.59)	-	527 (131.75)	3136 (818.80)	2960 (845.71)	-	-	12758	305.55	344 (114.67)	299 (99.67)	15 (88.24)	-	-	36 (21.56)	380 (227.54)	4009 (752.16)	-	-	5083	287.66

TABLE – 8. Species-wise and strata-wise catch, effort and catch-rate by bottom trawl during cruise V (Figures in parenthesis indicate catch rates)

DEPTH IN METRES	55 — 90											
STRATA	1	4	7	10	13	16	19	22	25	28	TOTAL	C/h
EFFORT	5.00	10.55	9.25	9.50	10.50	11.92	17.53	12.83	6.17	1.83	95.08	
MAJOR FISH GROUPS												
Shark	–	–	12 (1.30)	32 (3.37)	219 (20.86)	86 (7.21)	–	20 (1.56)	4 (0.65)	–	373	3.92
Rays	–	–	–	2 (0.21)	2 (0.19)	3 (0.25)	–	–	–	–	7	0.07
Skates	–	–	–	310 (32.63)	40 (3.81)	–	1 (0.06)	–	–	–	351	3.69
Congresox talabonoides	–	–	–	–	–	–	–	–	–	–	–	–
Cat fish	–	–	–	138 (14.53)	357 (34.00)	15 (1.26)	–	–	–	–	510	5.36
Clupeids	–	–	–	4 (0.42)	21 (2.00)	12 (1.01)	–	–	–	–	37	0.39
Scopelids	–	–	3 (0.32)	11 (1.16)	–	2 (0.17)	9 (0.51)	–	4 (0.65)	–	29	0.31
Pomadasys hasta	–	–	–	6 (0.63)	27 (2.57)	–	–	–	–	–	33	0.35
Lutianus spp.	–	–	2 (0.22)	–	64 (6.10)	22 (1.85)	5 (0.29)	–	–	–	93	0.98
Mene maculata	–	–	–	–	–	–	–	–	–	–	–	–
Nemipterus japonicus	–	–	–	82 (8.63)	–	–	–	–	–	–	82	0.86
Epinephalus spp.	–	–	108 (11.68)	–	–	1 (0.08)	5 (0.29)	–	146 (23.74)	–	260	2.73
Other perches	–	–	3 (0.32)	356 (37.47)	64 (6.10)	21 (1.76)	171 (9.75)	–	552 (90.34)	–	1167	12.27
Polynemids	–	–	–	10 (1.05)	173 (16.48)	9 (0.76)	–	–	–	–	192	2.02
Protonibea diacanthus (Ghol)	–	–	18 (1.95)	–	8 (0.76)	–	–	–	18 (2.95)	–	44	0.46
Otolithoides brunneus (Koth)	–	–	–	–	–	–	–	–	–	–	–	–
Lesser sciaenids	–	–	–	105 (11.05)	3659 (348.48)	2 (0.17)	–	–	320 (52.37)	–	4086	42.97
Trichiurus spp.	–	–	82 (8.86)	726 (76.42)	120 (11.43)	5110 (428.69)	411 (23.45)	–	–	–	6449	67.83
Megalaspis cordyla	–	–	–	–	–	–	–	–	–	–	–	–
Carangoides crysophrys	–	–	–	–	–	–	–	–	–	–	–	–
Other Carangids	–	–	–	76 (8.00)	10 (0.95)	9 (0.76)	2 (0.11)	2 (0.16)	11 (1.80)	–	110	1.16
Pampus argenteus	–	–	–	5 (0.53)	12 (1.14)	300 (25.17)	–	–	–	–	317	3.33
Apolectus niger	–	–	–	5 (0.53)	–	50 (4.19)	–	–	–	–	55	0.58
Scombroids	–	–	–	5 (0.53)	–	–	–	–	–	–	5	0.05
Tunnies	–	–	–	–	–	–	–	–	–	–	–	–
Flat fishes	–	–	–	1 (0.11)	–	5 (0.42)	–	–	–	–	6	0.06
Other fishes	–	–	–	45 (4.74)	–	–	–	–	–	–	45	0.47
Crustaceans	–	–	–	–	12 (1.14)	–	–	–	–	–	12	0.13
Cephalopods	–	–	29 (3.14)	68 (7.16)	56 (5.33)	–	94 (5.36)	–	12 (1.96)	–	259	2.72
TOTAL	–	–	257 (27.78)	1987 (209.16)	4844 (461.33)	5647 (473.74)	698 (39.82)	22 (1.71)	1067 (174.63)	–	14522	152.73

DEPTH IN METRES	91 — 125											
STRATA	2	5	8	11	14	17	20	23	26	29	TOTAL	C/h
EFFORT	1.58	–	9.17	1.50	–	–	–	3.00	1.58	12.33	29.16	
Shark	–	–	–	–	–	–	–	–	–	10 (0.81)	10	0.34
Rays	–	–	–	–	–	–	–	–	–	–	–	–
Skates	–	–	–	–	–	–	–	–	–	–	–	–
Congresox talabonoides	–	–	–	–	–	–	–	–	–	–	–	–
Cat fish	–	–	–	–	–	–	–	–	–	–	–	–
Clupeids	–	–	–	–	–	–	–	–	–	–	–	–
Scopelids	–	–	–	–	–	–	–	3 (1.00)	–	–	3	0.10
Pomadasys hasta	–	–	–	–	–	–	–	–	–	–	–	–
Lutianus spp.	–	–	–	–	–	–	–	5 (1.67)	–	–	5	0.17
Mene maculata	–	–	–	–	–	–	–	–	–	–	–	–
Nemipterus japonicus	–	–	–	–	–	–	–	–	–	–	–	–
Epinephalus spp.	–	–	1 (0.11)	–	–	–	–	5 (1.67)	1 (0.63)	45 (3.65)	52	1.78
Other perches	–	–	–	–	–	–	–	–	–	2 (0.16)	2	0.07
Polynemids	–	–	–	–	–	–	–	–	–	–	–	–
Protonibea diacanthus (Ghol)	–	–	–	–	–	–	–	–	–	–	–	–
Otolithoides brunneus (Koth)	–	–	–	–	–	–	–	–	–	–	–	–
Lesser sciaenids	–	–	–	–	–	–	–	–	–	122 (9.89)	122	4.18
Trichiurus spp.	–	–	–	–	–	–	–	1100 (366.67)	–	–	1100	37.72
Megalaspis cordyla	–	–	–	–	–	–	–	–	–	–	–	–
Carangoides crysophrys	–	–	–	–	–	–	–	–	–	–	–	–
Other Carangids	–	–	–	–	–	–	–	–	28 (17.72)	2 (0.16)	30	1.03
Pampus argenteus	–	–	–	–	–	–	–	–	–	–	–	–
Apolectus niger	–	–	–	–	–	–	–	–	–	–	–	–
Scombroids	–	–	–	–	–	–	–	–	–	–	–	–
Tunnies	–	–	–	–	–	–	–	–	–	–	–	–
Flat fishes	–	–	–	–	–	–	–	–	–	–	–	–
Other fishes	–	–	–	–	–	–	–	–	–	1 (0.08)	1	0.03
Crustaceans	–	–	–	–	–	–	–	–	–	–	–	–
Cephalopods	–	–	–	–	–	–	–	2 (0.67)	2 (1.27)	7 (0.57)	11	0.38
TOTAL	–	–	1 (0.11)	–	–	–	–	1115 (371.67)	31 (19.62)	189 (15.33)	1336	45.82

DEPTH IN METRES	126 — 360											
STRATA	3	6	9	12	15	18	21	24	27	30	TOTAL	C/h
EFFORT	4.75	–	1.50	1.50	–	–	–	–	3.05	1.58	12.38	
Shark	5 (1.05)	–	–	–	–	–	–	–	–	–	5	0.40
Rays	–	–	–	–	–	–	–	–	–	–	–	–
Skates	–	–	–	–	–	–	–	–	–	–	–	–
Congresox talabonoides	–	–	–	–	–	–	–	–	–	–	–	–
Cat fish	–	–	–	–	–	–	–	–	–	–	–	–
Clupeids	–	–	–	–	–	–	–	–	–	–	–	–
Scopelids	1 (0.21)	–	–	–	–	–	–	–	–	–	1	0.08
Pomadasys hasta	–	–	–	–	–	–	–	–	–	–	–	–
Lutianus spp.	–	–	–	–	–	–	–	–	–	–	–	–
Mene maculata	–	–	–	–	–	–	–	–	–	–	–	–
Nemipterus japonicus	2 (0.42)	–	–	–	–	–	–	–	–	–	2	0.16
Epinephalus spp.	–	–	–	–	–	–	–	–	71 (23.28)	–	71	5.74
Other perches	34 (7.16)	–	–	–	–	–	–	–	14 (4.59)	–	48	3.88
Polynemids	–	–	–	–	–	–	–	–	–	–	–	–
Protonibea diacanthus (Ghol)	–	–	–	–	–	–	–	–	64 (20.98)	–	64	5.17
Otolithoides brunneus (Koth)	–	–	–	–	–	–	–	–	–	–	–	–
Lesser sciaenids	–	–	–	–	–	–	–	–	5 (1.64)	–	5	0.40
Trichiurus spp.	–	–	–	–	–	–	–	–	–	–	–	–
Megalaspis cordyla	–	–	–	–	–	–	–	–	–	–	–	–
Carangoides crysophrys	–	–	–	–	–	–	–	–	–	–	–	–
Other Carangids	–	–	–	–	–	–	–	–	–	–	–	–
Pampus argenteus	–	–	–	–	–	–	–	–	–	–	–	–
Apolectus niger	–	–	–	–	–	–	–	–	–	–	–	–
Scombroids	–	–	–	–	–	–	–	–	–	–	–	–
Tunnies	–	–	–	–	–	–	–	–	–	–	–	–
Flat fishes	–	–	–	–	–	–	–	–	–	–	–	–
Other fishes	27 (5.68)	–	–	–	–	–	–	–	–	–	27	2.18
Crustaceans	–	–	–	–	–	–	–	–	–	–	–	–
Cephalopods	50 (10.53)	–	–	–	–	–	–	–	2 (0.66)	–	52	4.20
TOTAL	119 (25.05)	–	–	–	–	–	–	–	156 (51.15)	–	275	22.21

TABLE - 9. Species-wise and strata-wise catch, effort and catch-rate by pelagic trawl for all [illegible] (Figures in parenthesis indicate catch-rates)

Depth 55 — 90 metres

DEPTH IN METRES / STRATA	1	4	7	10	13	16	19	22	25	28	TOTAL	C/h
MAJOR FISH GROUPS/EFFORT	29.73	30.57	20.08	65.79	148.41	101.60	69.00	41.66	27.62	144.85	679.31	
Sharks	323 (10.86)	444 (14.52)	381 (18.97)	756 (11.49)	6496 (43.77)	2410 (23.72)	1489 (21.29)	371 (8.91)	298 (10.79)	8653 (59.74)	21601	31.80
Rays	12 (0.40)	66 (2.16)	7 (0.35)	140 (2.13)	1706 (11.50)	2320 (22.83)	2345 (33.99)	140 (3.36)	123 (4.45)	2153 (14.86)	9012	13.27
Skates	—	—	—	—	116 (0.78)	—	353 (5.12)	35 (0.84)	70 (2.53)	90 (0.62)	664	0.98
Congresox talabonoides	5 (0.17)	—	—	122 (1.85)	11219 (75.59)	1519 (14.95)	292 (4.23)	20 (0.48)	15 (0.54)	498 (3.44)	13690	20.15
Cat fish	3217 (108.21)	202 (6.61)	11 (0.55)	368 (5.59)	6146 (41.41)	831 (8.18)	1042 (15.10)	199 (4.78)	75 (2.72)	2365 (16.33)	14456	21.28
Clupeids	11 (0.37)	58 (1.90)	1 (0.05)	37 (0.56)	877 (5.91)	1051 (10.34)	345 (5.00)	44 (1.06)	79 (2.86)	1327 (9.16)	3830	5.64
Scopelids	—	1 (0.03)	—	6 (0.09)	255 (1.72)	60 (0.59)	9 (0.13)	1 (0.02)	—	1 (0.01)	333	0.49
Pomadasys hasta	12 (0.40)	5 (0.16)	2 (0.10)	123 (1.87)	843 (5.68)	416 (4.09)	156 (2.26)	21 (0.50)	82 (2.97)	1546 (10.67)	3206	4.72
Lutjanus spp.	—	—	—	47 (0.71)	821 (5.53)	378 (3.72)	286 (4.14)	3 (0.07)	58 (2.10)	629 (4.34)	2222	3.27
Mene maculata	—	—	180 (8.96)	—	401 (2.70)	2 (0.02)	1 (0.01)	36 (0.86)	1 (0.04)	2 (0.01)	623	0.92
Nemipterus japonicus	—	2 (0.07)	—	1 (0.02)	120 (0.81)	14 (1.14)	107 (1.55)	—	25 (0.91)	33 (0.23)	302	0.44
Serranids	—	—	—	—	1 (0.01)	44 (0.43)	140 (2.03)	1 (0.02)	5 (0.18)	1 (0.01)	192	0.28
Other perches	36 (1.21)	11 (0.36)	2 (0.10)	16 (0.24)	215 (1.45)	332 (3.27)	394 (5.71)	185 (4.44)	55 (1.99)	2236 (15.44)	3482	5.13
Polynemids	—	—	—	—	214 (1.44)	274 (2.70)	318 (4.61)	—	—	85 (0.59)	891	1.31
Protonibea diacanthus (Ghol)	—	—	—	60 (0.91)	2610 (17.59)	2743 (27.00)	674 (9.77)	11 (0.26)	18 (0.65)	776 (5.36)	6892	10.15
Otolithoides brunneus (Koth)	—	—	3 (0.15)	—	9 (0.06)	3 (0.03)	—	—	—	—	15	0.02
Lesser sciaenids (Dhoma)	—	—	—	10 (0.15)	1327 (8.94)	1124 (11.06)	1211 (17.55)	17 (0.41)	—	531 (3.67)	4220	6.21
Trichiurus spp.	1490 (50.12)	795 (26.01)	389 (19.37)	1074 (16.32)	34351 (231.46)	21609 (212.69)	9507 (137.78)	667 (16.01)	530 (19.19)	29807 (205.78)	100219	147.53
Megalaspis cordyla	8 (0.27)	316 (10.34)	1331 (66.28)	7655 (116.36)	1277 (8.60)	353 (3.47)	7266 (105.30)	1667 (40.01)	233 (8.44)	14724 (101.65)	34830	51.27
Carangoides crysophrys	—	—	—	11 (0.17)	—	—	12 (0.17)	5 (0.12)	—	—	28	0.04
Other carangids	3 (0.10)	91 (2.98)	98 (4.88)	2746 (41.74)	508 (3.42)	928 (9.13)	732 (10.61)	44 (1.06)	200 (7.24)	1189 (8.21)	6539	9.63
Pampus argenteus	46 (1.55)	45 (1.47)	62 (3.09)	161 (2.45)	3134 (21.12)	1159 (11.41)	275 (3.99)	16 (0.38)	15 (0.54)	1745 (12.05)	6658	9.80
Apolectus niger	322 (10.83)	22 (0.72)	614 (30.58)	238 (3.62)	219 (1.48)	165 (1.62)	61 (0.88)	172 (4.13)	153 (5.54)	17941 (123.86)	19907	29.30
Scombroids	157 (5.62)	17 (0.56)	103 (5.13)	117 (1.78)	840 (5.66)	743 (7.31)	378 (5.48)	171 (4.10)	89 (3.22)	1650 (11.39)	4275	6.29
Tunnies	1 (0.03)	—	23 (1.15)	20 (0.30)	39 (0.26)	10 (0.10)	7 (0.10)	3 (0.07)	29 (1.05)	289 (2.00)	421	0.62
Flat fishes	—	—	—	—	—	2 (0.02)	2 (0.03)	3 (0.07)	1 (0.04)	1 (0.01)	9	0.01
Other fishes	52 (1.75)	90 (2.94)	4 (0.20)	7045 (107.08)	603 (4.06)	138 (1.36)	241 (3.49)	44 (1.06)	3 (0.11)	84 (0.58)	8304	12.22
Crustaceans	—	—	—	3 (0.05)	400 (2.70)	70 (0.69)	105 (1.52)	—	3 (0.11)	49 (0.34)	630	0.93
Cephalopods	7 (0.24)	3 (0.10)	1 (0.05)	17 (0.26)	16 (0.11)	23 (0.23)	65 (0.94)	—	—	97 (0.67)	229	0.34
TOTAL	5712 (192.13)	2168 (70.92)	3212 (159.96)	20773 (315.75)	74763 (503.76)	38721 (381.11)	27793 (402.80)	3876 (93.04)	2160 (78.20)	88502 (610.99)	267680	394.05

Depth 91 — 125 metres

DEPTH IN METRES / STRATA	2	5	8	11	14	17	20	23	26	29	TOTAL	C/h
MAJOR FISH GROUPS/EFFORT	12.17	10.17	14.50	24.9[illegible]	[illegible].58	6.42	5.25	25.08	18.16	78.99	214.27	
Sharks	[illegible]	[illegible]	40 (2.76)	18 (0.72)	220 (11.84)	3 (0.47)	10 (1.90)	180 (7.18)	47 (2.59)	2086 (26.41)	2604	12.15
Rays	[illegible]	—	—	—	[illegible]	—	—	—	—	368 (4.66)	368	1.78
Skates	[illegible]	[illegible]	—	—	[illegible]	—	—	—	—	—	—	—
Congresox talabonoides	[illegible]	—	—	—	[illegible]	—	—	—	—	31 (0.39)	31	0.14
Cat fish	[illegible]	270 ([illegible])	60 (4.14)	8 (0.32)	[illegible]	—	2 (0.38)	5 (0.20)	10 (0.53)	23 (0.29)	378	1.76
Clupeids	[illegible]	—	—	—	[illegible]	—	—	8 (0.32)	—	34 (0.43)	42	0.20
Scopelids	[illegible]	—	—	—	[illegible]	1 (0.16)	—	—	—	—	1	0.00
Pomadasys hasta	[illegible]	—	—	—	[illegible]	—	—	—	—	129 (1.63)	129	0.60
Lutjanus spp.	[illegible]	—	—	—	[illegible]	—	—	—	—	—	—	—
Mene maculata	—	11 (1.08)	4 (0.28)	—	[illegible]	—	10 (1.90)	2 (0.08)	—	1 (0.01)	28	0.13
Nemipterus japonicus	—	—	—	—	[illegible]	—	—	—	—	1 (0.01)	1	0.00
Serranids	—	—	—	—	[illegible]	—	—	—	—	—	—	—
Other perches	4 (0.33)	3 (0.29)	—	40 (1.60)	5 (0.27)	370 (57.63)	3 (0.57)	1 (0.04)	13 (0.72)	54 (0.68)	493	2.30
Polynemids	—	—	—	—	[illegible]	—	—	—	—	—	—	—
Protonibea diacanthus (Ghol)	—	—	—	—	[illegible]	—	—	—	—	3 (0.04)	3	0.01
Otolithoides brunneus (Koth)	—	—	—	—	[illegible]	—	—	—	—	—	—	—
Lesser sciaenids (Dhoma)	—	—	—	—	[illegible]	—	—	—	—	2 (0.03)	2	0.01
Trichiurus spp.	39 (3.20)	203 (19.96)	130 (8.97)	168 (6.73)	134 (7.27)	42 (6.54)	270 (51.43)	3693 (147.25)	70 (3.85)	2895 (36.65)	7644	35.67
Megalaspis cordyla	—	—	—	—	[illegible]	—	—	2730 (108.85)	10 (0.55)	98857 (1251.51)	101597	474.15
Carangoides crysophrys	130 (10.68)	—	8 (0.55)	—	25 (1.35)	10 (1.56)	—	13 (0.52)	—	2 (0.03)	188	0.88
Other carangids	4 (0.33)	—	—	13 (0.52)	—	—	2 (0.38)	9 (0.36)	22 (1.21)	15 (0.19)	65	0.30
Pampus argenteus	—	10 (0.98)	—	—	—	—	—	2 (0.08)	—	1394 (17.65)	1406	6.56
Apolectus niger	—	—	—	—	—	—	—	—	5 (0.28)	458 (5.80)	463	2.16
Scombroids	—	—	—	—	—	—	—	7 (0.28)	2 (0.11)	140 (1.77)	149	0.70
Tunnies	—	3 (0.29)	2 (0.14)	—	9 (0.48)	—	—	4 (0.16)	6 (0.33)	1 (0.01)	25	0.12
Flat fishes	[illegible]	—	—	—	—	—	—	—	—	—	—	—
Other fishes	16 (1.31)	20 (1.97)	16 (1.10)	9 (0.36)	1 (0.05)	—	2 (0.38)	40 (1.59)	4 (0.22)	237 (3.00)	345	1.61
Crustaceans	[illegible]	—	—	1 (0.04)	1 (0.05)	—	—	—	1 (0.06)	1 (0.01)	4	0.02
Cephalopods	—	—	—	—	1 (0.05)	—	—	21 (0.84)	—	—	22	0.10
TOTAL	193 (15.86)	520 (51.13)	260 (17.93)	257 (10.30)	394 ([illegible].46)	426 (66.36)	299 (56.95)	6715 (267.74)	190 (10.46)	106732 (1351.21)	115988	541.32

Depth 126 — 360 metres and grand total

DEPTH IN METRES / STRATA	3	6	9	12	15	18	21	24	27	30	TOTAL	C/h	GRAND TOTAL	C/h
MAJOR FISH GROUPS/EFFORT	10.49	28.99	10.92	10.08	7.08	12.75	11.41	10.67	33.24	42.13	177.?6		1071.34	
Sharks	14 (1.33)	240 (8.28)	35 (3.21)	38 (3.77)	100 (14.12)	49 (3.84)	105 (9.20)	64 (6.00)	[illegible]	228 (5.41)	1141	6.42	25346	23.68
Rays	—	50 (1.72)	—	—	60 (8.47)	—	—	—	[illegible]	—	112	0.63	9492	8.86
Skates	—	—	—	—	—	—	—	—	—	—	—	—	664	0.62
Congresox talabonoides	—	—	—	—	—	—	—	—	[illegible]	4 (0.09)	16	0.09	13737	12.82
Cat fish	—	—	8 (0.73)	—	—	—	—	—	[illegible]	14 (0.33)	22	0.12	14856	13.87
Clupeids	—	—	—	—	—	—	—	—	[illegible]	3 (0.07)	6	0.03	3878	3.62
Scopelids	—	—	1 (0.09)	—	—	1 (0.08)	—	—	[illegible]	[illegible] (0.07)	2	0.01	336	0.31
Pomadasys hasta	—	—	—	—	—	—	—	—	—	8 (0.19)	8	0.05	3343	3.12
Lutjanus spp.	—	1 (0.03)	—	3 (0.30)	—	—	—	—	—	2 (0.04)	6	0.03	2228	2.08
Mene maculata	—	1 (0.03)	—	—	—	—	3 (0.26)	—	—	—	4	0.02	655	0.61
Nemipterus japonicus	—	—	5 (0.46)	—	—	10 (0.75)	—	—	—	1 (0.02)	16	0.09	319	0.30
Serranids	—	—	4 (0.31)	—	—	87 (6.82)	—	—	[illegible]	4 (0.09)	118	0.66	310	0.29
Other perches	—	37 (1.28)	4 (0.37)	3 (0.30)	1 (0.14)	2 (0.16)	4 (0.35)	42 (3.94)	[illegible] (3.70)	13 (0.31)	229	1.29	4204	3.92
Polynemids	—	—	—	—	—	—	—	—	—	—	—	—	891	0.83
Protonibea diacanthus (Ghol)	—	—	—	—	—	—	—	—	—	—	—	—	6895	6.44
Otolithoides brunneus (Koth)	—	—	—	—	—	—	—	—	—	—	—	—	15	0.01
Lesser sciaenids (Dhoma)	—	—	—	—	—	—	—	—	—	20 (0.47)	20	0.11	4242	3.96
Trichiurus spp.	30 (2.76)	5 (0.17)	120 ([illegible])	17 ([illegible])	40 (5.65)	340 ([illegible])	6503 (569.94)	76 (7.12)	874 (26.30)	416 (9.87)	9521	53.56	117384	109.57
Megalaspis cordyla	—	—	—	—	—	—	2350 (205.96)	80 (7.50)	30 (0.90)	31037 (736.70)	33497	188.44	169924	158.61
Carangoides crysophrys	—	17 (0.59)	3 (0.27)	—	—	—	—	—	—	—	20	0.11	236	0.22
Other carangids	1 (0.10)	84 (2.90)	—	—	—	—	2 (0.18)	32 (3.00)	[illegible]	71 (1.69)	192	1.08	6796	6.34
Pampus argenteus	—	—	—	—	—	—	—	—	—	160 (3.80)	160	0.90	8224	7.68
Apolectus niger	—	—	—	—	—	—	—	—	14 (0.48)	18 (0.43)	34	0.19	20404	19.05
Scombroids	—	—	—	3 (0.30)	—	—	—	2 (0.19)	—	8 (0.19)	13	0.07	4437	4.14
Tunnies	—	12 (0.41)	21 (1.92)	2 (0.20)	8 (1.13)	530 (41.57)	8 (0.70)	6 (0.56)	245 (7.37)	—	850	4.78	1296	1.21
Flat fishes	—	—	—	—	—	—	—	—	—	—	—	—	9	0.01
Other fishes	8 (0.76)	172 (5.93)	14 (1.28)	6 (0.60)	188 (26.55)	321 (25.18)	41 (3.59)	6 (0.56)	11 (0.33)	334 (7.93)	1101	6.19	9750	9.10
Crustaceans	—	—	—	—	—	—	—	—	—	1 (0.02)	1	0.01	635	0.59
Cephalopods	—	—	1 (0.09)	—	—	—	—	1 (0.09)	1 (0.03)	—	3	0.02	254	0.24
TOTAL	53 (5.05)	619 (21.35)	216 (19.78)	72 (7.14)	397 (56.07)	2340 (183.53)	9016 (790.18)	309 (28.96)	1728 (51.[illegible])	32342 (767.67)	47092	264.92	430760	402.08

TABLE - 10. Species-wise and strata-wise catch, effort and catch-rate by pelagic trawl during cruise I (Figures in parenthesis indicate catch rates)

DEPTH IN METRES	55 — 90											
STRATA	1	4	7	10	13	16	19	22	25	28	TOTAL	C/h
EFFORT	-	-	-	-	-	6.40	9.15	5.00	-	4.55	25.10	
MAJOR FISH GROUPS												
Sharks	-	-	-	-	-	285 (44.53)	245 (26.78)	93 (18.60)	-	1060 (232.97)	1683	67.05
Rays	-	-	-	-	-	140 (21.88)	635 (69.40)	70 (14.00)	-	165 (36.26)	1010	40.24
Skates	-	-	-	-	-	-	3 (0.33)	-	-	20 (4.40)	23	0.92
Congresox talabonoides	-	-	-	-	-	24 (3.75)	88 (9.62)	8 (1.60)	-	-	120	4.78
Cat fish	-	-	-	-	-	135 (21.09)	118 (12.90)	30 (6.00)	-	-	283	11.27
Clupeids	-	-	-	-	-	90 (14.06)	13 (1.42)	5 (1.00)	-	65 (14.29)	173	6.89
Scopelids	-	-	-	-	-	-	8 (0.87)	-	-	-	8	0.32
Pomadasys hasta	-	-	-	-	-	173 (27.03)	104 (11.37)	5 (1.00)	-	40 (8.79)	322	12.83
Lutjanus spp.	-	-	-	-	-	-	-	-	-	-	-	-
Mene maculata	-	-	-	-	-	-	-	-	-	-	-	-
Nemipterus japonicus	-	-	-	-	-	2 (0.31)	92 (10.05)	-	-	-	94	3.75
Serranids	-	-	-	-	-	-	-	-	-	-	-	-
Other perches	-	-	-	-	-	20 (3.13)	2 (0.22)	15 (3.00)	-	8 (1.76)	45	1.79
Polynemids	-	-	-	-	-	7 (1.09)	18 (1.97)	-	-	-	25	1.00
Protonibea diacanthus (Ghol)	-	-	-	-	-	15 (2.34)	-	-	-	-	15	0.60
Otolithoides brunneus (Koth)	-	-	-	-	-	3 (0.47)	-	-	-	-	3	0.12
Lesser sciaenids	-	-	-	-	-	230 (35.94)	477 (52.13)	5 (1.00)	-	-	712	28.37
Trichiurus spp.	-	-	-	-	-	250 (39.06)	404 (44.15)	170 (34.00)	-	120 (26.37)	944	37.61
Megalaspis cordyla	-	-	-	-	-	2 (0.31)	25 (2.73)	5 (1.00)	-	-	32	1.27
Carangoides crysophrys	-	-	-	-	-	-	11 (1.20)	5 (1.00)	-	-	16	0.64
Other carangids	-	-	-	-	-	60 (9.38)	8 (0.87)	6 (1.20)	-	11 (2.42)	85	3.39
Pampus argenteus	-	-	-	-	-	270 (42.19)	30 (3.28)	4 (0.80)	-	30 (6.59)	334	13.31
Apolectus niger	-	-	-	-	-	17 (2.66)	-	25 (5.00)	-	122 (26.81)	164	6.53
Scombroids	-	-	-	-	-	168 (26.65)	71 (7.76)	55 (11.00)	-	56 (12.31)	350	13.94
Tunnies	-	-	-	-	-	-	2 (0.22)	-	-	-	2	0.08
Flat fishes	-	-	-	-	-	-	-	-	-	-	-	-
Other fishes	-	-	-	-	-	30 (4.69)	179 (19.56)	-	-	-	209	8.33
Crustaceans	-	-	-	-	-	-	99 (10.82)	-	-	-	99	3.94
Cephalopods	-	-	-	-	-	15 (2.34)	27 (2.95)	-	-	-	42	1.67
TOTAL	-	-	-	-	-	1936 (302.50)	2659 (290.60)	501 (100.20)	-	1697 (372.97)	6793	270.64

DEPTH IN METRES	91 — 125											
STRATA	2	5	8	11	14	17	20	23	26	29	TOTAL	C/h
EFFORT	-	-	-	-	-	-	-	3.00	-	13.33	16.33	
MAJOR FISH GROUPS												
Sharks	-	-	-	-	-	-	-	15 (5.00)	-	1272 (95.42)	1287	78.81
Rays	-	-	-	-	-	-	-	-	-	14 (1.05)	14	0.86
Skates	-	-	-	-	-	-	-	-	-	-	-	-
Congresox talabonoides	-	-	-	-	-	-	-	-	-	29 (2.18)	29	1.78
Cat fish	-	-	-	-	-	-	-	-	-	23 (1.73)	23	1.41
Clupeids	-	-	-	-	-	-	-	1 (0.33)	-	10 (0.75)	11	0.67
Scopelids	-	-	-	-	-	-	-	-	-	-	-	-
Pomadasys hasta	-	-	-	-	-	-	-	-	-	80 (6.00)	80	4.90
Lutjanus spp.	-	-	-	-	-	-	-	-	-	-	-	-
Mene maculata	-	-	-	-	-	-	-	-	-	1 (0.08)	1	0.06
Nemipterus japonicus	-	-	-	-	-	-	-	-	-	1 (0.08)	1	0.06
Serranids	-	-	-	-	-	-	-	-	-	-	-	-
Other perches	-	-	-	-	-	-	-	-	-	33 (2.48)	33	2.02
Polynemids	-	-	-	-	-	-	-	-	-	-	-	-
Protonibea diacanthus (Ghol)	-	-	-	-	-	-	-	-	-	-	-	-
Otolithoides brunneus (Koth)	-	-	-	-	-	-	-	-	-	-	-	-
Lesser sciaenids	-	-	-	-	-	-	-	-	-	2 (0.15)	2	0.12
Trichiurus spp.	-	-	-	-	-	-	-	2370 (790.00)	-	270 (20.26)	2640	161.67
Megalaspis cordyla	-	-	-	-	-	-	-	2130 (710.00)	-	80 (6.00)	2210	135.33
Carangoides crysophrys	-	-	-	-	-	-	-	8 (2.67)	-	2 (0.15)	10	0.61
Other carangids	-	-	-	-	-	-	-	-	-	4 (0.30)	4	0.24
Pampus argenteus	-	-	-	-	-	-	-	-	-	1380 (103.53)	1380	84.51
Apolectus niger	-	-	-	-	-	-	-	-	-	275 (20.63)	275	16.84
Scombroids	-	-	-	-	-	-	-	-	-	59 (4.43)	59	3.61
Tunnies	-	-	-	-	-	-	-	2 (0.67)	-	-	2	0.12
Flat fishes	-	-	-	-	-	-	-	-	-	-	-	-
Other fishes	-	-	-	-	-	-	-	-	-	101 (7.58)	101	6.18
Crustaceans	-	-	-	-	-	-	-	-	-	-	-	-
Cephalopods	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	-	-	-	-	-	-	-	4526 (1508.67)	-	3636 (272.77)	8162	499.82

DEPTH IN METRES	126 — 360											
STRATA	3	6	9	12	15	18	21	24	27	30	TOTAL	C/h
EFFORT	-	7.75	-	-	-	-	-	-	8.17	7.08	23.00	
MAJOR FISH GROUPS												
Sharks	-	200 (25.81)	-	-	-	-	-	-	194 (23.75)	145 (20.48)	539	23.43
Rays	-	45 (5.81)	-	-	-	-	-	-	2 (0.24)	-	47	2.04
Skates	-	-	-	-	-	-	-	-	-	-	-	-
Congresox talabonoides	-	-	-	-	-	-	-	-	12 (1.47)	4 (0.56)	16	0.70
Cat fish	-	-	-	-	-	-	-	-	-	14 (1.98)	14	0.61
Clupeids	-	-	-	-	-	-	-	-	-	3 (0.42)	3	0.13
Scopelids	-	-	-	-	-	-	-	-	-	-	-	-
Pomadasys hasta	-	-	-	-	-	-	-	-	-	6 (0.85)	6	0.26
Lutjanus spp.	-	-	-	-	-	-	-	-	-	-	-	-
Mene maculata	-	-	-	-	-	-	-	-	-	-	-	-
Nemipterus japonicus	-	-	-	-	-	-	-	-	-	1 (0.14)	1	0.04
Serranids	-	-	-	-	-	-	-	-	23 (2.82)	2 (0.28)	25	1.09
Other perches	-	29 (3.74)	-	-	-	-	-	-	122 (14.93)	10 (1.41)	161	7.00
Polynemids	-	-	-	-	-	-	-	-	-	-	-	-
Protonibea diacanthus (Ghol)	-	-	-	-	-	-	-	-	-	-	-	-
Otolithoides brunneus (Koth)	-	-	-	-	-	-	-	-	-	-	-	-
Lesser sciaenids	-	-	-	-	-	-	-	-	-	20 (2.82)	20	0.87
Trichiurus spp.	-	5 (0.65)	-	-	-	-	-	-	513 (62.79)	345 (48.73)	863	37.52
Megalaspis cordyla	-	-	-	-	-	-	-	-	20 (2.45)	-	20	0.87
Carangoides crysophrys	-	7 (0.90)	-	-	-	-	-	-	-	-	7	0.30
Other carangids	-	7 (0.90)	-	-	-	-	-	-	1 (0.02)	2 (0.28)	10	0.43
Pampus argenteus	-	-	-	-	-	-	-	-	-	160 (22.60)	160	6.96
Apolectus niger	-	-	-	-	-	-	-	-	16 (1.96)	18 (2.54)	34	1.48
Scombroids	-	-	-	-	-	-	-	-	-	8 (1.13)	8	0.35
Tunnies	-	12 (1.55)	-	-	-	-	-	-	-	-	12	0.52
Flat fishes	-	-	-	-	-	-	-	-	-	-	-	-
Other fishes	-	167 (21.55)	-	-	-	-	-	-	5 (0.61)	81 (11.44)	253	11.00
Crustaceans	-	-	-	-	-	-	-	-	-	-	-	-
Cephalopods	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	-	472 (60.90)	-	-	-	-	-	-	908 (111.14)	819 (115.68)	2199	95.61

TABLE 11. Species-wise and stratum-wise catch, effort and catch-rate by pelagic trawl during Cruise II (figures in parenthesis indicate catch rates)

Depth in metres: 55 — 90

STRATA	1	4	7	10	13	16	19	22	25	28	TOTAL	C/h
MAJOR FISH GROUPS/EFFORT	4.58	8.00	2.50	7.92	34.33	20.00	17.75	7.00	7.42	73.50	183.00	
Sharks	165 (36.03)	85 (10.63)	48 (19.20)	48 (6.06)	1450 (42.24)	783 (39.15)	280 (15.77)	60 (8.57)	45 (6.06)	5290 (71.97)	8254	45.10
Rays	–	65 (8.13)	4 (1.60)	16 (2.02)	170 (4.95)	80 (4.00)	335 (18.87)	14 (2.00)	2 (0.27)	1226 (16.68)	1912	10.45
Skates	–	–	–	–	70 (2.04)	–	–	–	–	30 (0.41)	100	0.55
Congresox talabonoides	5 (1.09)	–	–	–	4050 (117.97)	1044 (52.20)	130 (7.32)	–	–	226 (3.07)	5459	29.83
Cat fish	3120 (681.22)	100 (12.50)	–	60 (7.58)	702 (20.45)	83 (4.15)	430 (24.23)	3 (1.43)	25 (3.37)	2010 (27.35)	6533	35.70
Clupeids	6 (1.31)	4 (0.50)	–	4 (0.51)	136 (3.96)	143 (7.15)	99 (5.58)	25 (3.57)	2 (0.27)	492 (6.69)	911	4.98
Scopelids	–	–	–	–	–	–	–	–	–	–	–	–
Pomadasys hasta	6 (1.31)	5 (0.63)	–	35 (4.42)	175 (5.10)	67 (3.35)	52 (2.93)	6 (0.86)	22 (2.96)	447 (6.08)	815	4.45
Lutjanus spp.	–	–	–	–	30 (0.87)	134 (6.70)	66 (3.72)	–	48 (6.47)	368 (5.01)	646	3.53
Mene maculata	–	–	180 (72.00)	–	400 (11.65)	–	–	–	–	–	580	3.17
Nemipterus japonicus	–	–	–	1 (0.13)	–	–	15 (0.85)	–	–	–	16	0.09
Serranids	–	–	–	–	–	–	–	–	5 (0.67)	–	5	0.03
Other perches	5 (1.09)	7 (0.88)	–	–	5 (0.15)	27 (1.35)	21 (1.18)	3 (0.43)	13 (1.75)	569 (7.74)	650	3.55
Polynemids	–	–	–	–	100 (2.91)	77 (3.85)	208 (11.72)	–	–	39 (0.53)	424	2.32
Protonibea diacanthus (Ghol)	–	–	–	–	144 (4.19)	342 (17.10)	360 (20.28)	8 (1.14)	–	257 (3.50)	1111	6.07
Otolithoides brunneus (Koth)	–	–	–	–	2 (0.06)	–	–	–	–	–	2	0.01
Lesser sciaenids (Dhoma)	–	–	–	–	20 (0.58)	15 (0.75)	340 (19.15)	–	–	20 (0.27)	395	2.16
Trichiurus spp.	24 (5.24)	200 (25.00)	7 (2.80)	167 (21.09)	1675 (48.79)	3560 (178.00)	4870 (274.37)	265 (37.86)	55 (7.41)	19900 (270.75)	30723	167.89
Megalaspis cordyla	–	158 (19.75)	–	–	–	120 (6.00)	2 (0.11)	–	100 (13.48)	9836 (133.82)	10216	55.83
Carangoides chrysophrys	–	–	–	10 (1.26)	–	–	1 (0.06)	–	–	–	11	0.06
Other carangids	25 (5.46)	45 (5.63)	3 (1.20)	–	388 (11.30)	145 (7.30)	120 (6.76)	11 (1.57)	–	930 (12.65)	1667	9.11
Pampus argenteus	–	10 (1.25)	–	21 (2.65)	19 (0.55)	135 (6.75)	42 (2.37)	1 (0.14)	118 (15.90)	660 (8.98)	1006	5.50
Apolectus niger	60 (13.10)	20 (2.50)	25 (10.00)	130 (16.41)	10 (0.29)	60 (3.00)	30 (1.69)	32 (4.57)	7 (0.94)	15950 (217.01)	16324	89.20
Scombroids	35 (7.64)	11 (1.38)	–	36 (4.55)	67 (1.95)	71 (3.55)	55 (3.10)	29 (4.14)	65 (8.76)	1070 (14.56)	1439	7.86
Tunnies	–	–	–	5 (0.63)	2 (0.06)	–	4 (0.23)	–	–	–	11	0.06
Flat fishes	–	–	–	–	–	–	–	–	–	–	–	–
Other fishes	–	33 (4.13)	–	–	50 (1.46)	1 (0.05)	60 (3.38)	–	–	56 (0.76)	200	1.09
Crustaceans	–	–	–	1 (0.13)	71 (2.07)	20 (1.00)	2 (0.11)	–	–	25 (0.34)	119	0.65
Cephalopods	–	–	–	5 (0.63)	–	3 (0.15)	–	–	–	42 (0.57)	50	0.27
TOTAL	3451 (753.49)	743 (92.88)	267 (106.80)	539 (68.06)	9740 (283.72)	6910 (345.50)	7522 (423.77)	457 (65.29)	507 (68.33)	59443 (808.75)	89579	489.50

Depth in metres: 91 — 125

STRATA	2	5	8	11	14	17	20	23	26*	29	TOTAL	C/h
MAJOR FISH GROUPS/EFFORT	3.17	3.92	3.83	3.00	2.00	[illegible].67	2.08	7.58	3.83	38.16	69.24	
Sharks	–	–	40 (10.44)	3 (1.00)	80 (40.00)	[illegible] ([illegible]80)	–	155 (20.45)	20 (5.22)	420 (11.01)	721	10.41
Rays	–	–	–	–	–	[illegible]	–	–	–	200 (5.24)	200	2.89
Skates	–	–	–	–	–	[illegible]	–	–	–	–	–	–
Congresox talabonoides	–	–	–	–	–	[illegible]	–	–	–	–	–	–
Cat fish	–	270 (68.88)	60 (15.67)	8 (2.67)	–	[illegible]	2 (0.96)	5 (0.66)	–	–	345	4.98
Clupeids	–	–	–	–	–	[illegible]	–	2 (0.26)	–	10 (0.26)	12	0.17
Scopelids	–	–	–	–	–	[illegible]	–	–	–	–	1	0.01
Pomadasys hasta	–	–	–	–	–	[illegible]	–	–	–	10 (0.26)	10	0.14
Lutjanus spp.	–	–	–	–	–	[illegible]	–	–	–	–	–	–
Mene maculata	–	–	4 (1.04)	–	–	[illegible]	–	–	–	–	4	0.06
Nemipterus japonicus	–	–	–	–	–	[illegible]	–	–	–	–	–	–
Serranids	–	–	–	–	–	[illegible]	–	–	–	–	–	–
Other perches	4 (1.26)	1 (0.26)	–	–	5 (2.50)	368 ([illegible].36)	1 (0.48)	1 (0.13)	10 (2.61)	10 (0.26)	400	5.78
Polynemids	–	–	–	–	–	[illegible]	–	–	–	–	–	–
Protonibea diacanthus (Ghol)	–	–	–	–	–	[illegible]	–	–	–	–	–	–
Otolithoides brunneus (Koth)	–	–	–	–	–	[illegible]	–	–	–	–	–	–
Lesser sciaenids (Dhoma)	–	–	–	–	–	[illegible]	–	–	–	–	–	–
Trichiurus spp.	34 (10.73)	60 (15.31)	130 (33.94)	10 (3.33)	7 (3.50)	40 (23.95)	20 (9.62)	375 (49.47)	40 (10.44)	1170 (30.66)	1886	27.24
Megalaspis cordyla	–	–	–	–	–	–	–	600 (79.16)	–	97830 (2563.68)	98430	1421.58
Carangoides chrysophrys	130 (41.01)	–	8 (2.09)	–	25 (12.50)	10 (5.99)	–	5 (0.66)	–	–	178	2.57
Other carangids	–	10 (2.55)	–	–	–	–	–	2 (0.26)	–	9 (0.24)	21	0.30
Pampus argenteus	4 (1.26)	–	–	5 (1.67)	–	–	–	–	14 (3.66)	4 (0.10)	27	0.39
Apolectus niger	–	–	–	–	–	–	–	–	–	24 (0.63)	24	0.35
Scombroids	–	–	–	–	–	–	–	7 (0.92)	2 (0.52)	44 (1.15)	53	0.77
Tunnies	–	3 (0.77)	–	–	–	–	–	–	–	–	3	0.04
Flat fishes	–	–	–	–	–	–	–	–	–	–	–	–
Other fishes	5 (1.58)	15 (3.83)	3 (0.78)	–	–	–	–	3 (0.40)	1 (0.26)	135 (3.54)	162	2.34
Crustaceans	–	–	–	–	1 (0.50)	–	–	–	–	–	1	0.01
Cephalopods	–	–	–	–	–	–	–	–	–	–	–	–
TOTAL	177 (55.84)	359 (91.58)	245 (63.97)	26 (8.67)	118 (59.00)	422 (252.69)	23 (11.06)	1155 (152.37)	87 (22.72)	99866 (2617.03)	102478	1480.04

Depth in metres: 126 — 360

STRATA	3	6	9	12	15	18	21	24	27	30	TOTAL	C/h
MAJOR FISH GROUPS/EFFORT	1.83	1.50	2.42	2.00	1.83	2.00	4.83	2.67	3.75	12.58	35.41	
Sharks	–	–	35 (14.46)	–	–	3 (1.50)	65 (13.46)	15 (5.62)	10 (2.67)	–	128	3.61
Rays	–	–	–	–	60 (32.79)	–	–	–	–	–	60	1.69
Skates	–	–	–	–	–	–	–	–	–	–	–	–
Congresox talabonoides	–	–	–	–	–	–	–	–	–	–	–	–
Cat fish	–	–	8 (3.31)	–	–	–	–	–	–	–	8	0.23
Clupeids	–	–	–	–	–	–	–	–	3 (0.80)	–	3	0.08
Scopelids	–	–	–	–	–	1 (0.50)	–	–	–	–	1	0.03
Pomadasys hasta	–	–	–	–	–	–	–	–	–	–	–	–
Lutjanus spp.	–	1 (0.67)	–	3 (1.50)	–	–	–	–	–	–	4	0.11
Mene maculata	–	–	–	–	–	–	–	–	–	–	–	–
Nemipterus japonicus	–	–	–	–	–	10 (5.00)	–	–	–	–	10	0.28
Serranids	–	–	4 (1.65)	–	–	87 (43.50)	–	–	–	–	91	2.57
Other perches	–	4 (2.67)	–	–	1 (0.55)	2 (1.00)	4 (0.83)	40 (14.98)	1 (0.27)	–	52	1.47
Polynemids	–	–	–	–	–	–	–	–	–	–	–	–
Protonibea diacanthus (Ghol)	–	–	–	–	–	–	–	–	–	–	–	–
Otolithoides brunneus (Koth)	–	–	–	–	–	–	–	–	–	–	–	–
Lesser sciaenids (Dhoma)	–	–	–	–	–	–	–	–	–	–	–	–
Trichiurus spp.	30 (16.39)	–	30 (12.40)	16 (8.00)	40 (21.86)	1300 (650.00)	6500 (1345.76)	76 (28.46)	35 (9.33)	10 (0.79)	8037	226.97
Megalaspis cordyla	–	–	–	–	–	–	2350 (486.54)	80 (29.96)	–	31010 (2465.00)	33440	944.37
Carangoides chrysophrys	–	8 (5.33)	3 (1.24)	–	–	–	–	–	–	–	11	0.31
Other carangids	–	–	–	–	–	–	–	–	–	–	–	–
Pampus argenteus	1 (0.55)	–	–	–	–	–	2 (0.41)	32 (11.99)	1 (0.27)	4 (0.32)	40	1.13
Apolectus niger	–	–	–	–	–	–	–	–	–	–	–	–
Scombroids	–	–	–	–	–	–	–	–	–	–	–	–
Tunnies	–	–	–	–	3 (1.64)	70 (35.00)	7 (1.45)	–	–	–	80	2.26
Flat fishes	–	–	–	–	–	–	–	–	–	–	–	–
Other fishes	2 (1.09)	–	1 (0.41)	1 (0.50)	142 (77.60)	320 (160.00)	40 (2.28)	–	1 (0.27)	252 (20.03)	759	21.43
Crustaceans	–	–	–	–	–	–	–	–	–	–	–	–
Cephalopods	–	–	–	–	–	–	–	–	1 (0.27)	–	1	0.03
TOTAL	33 (18.03)	13 (8.67)	81 (33.47)	20 (10.00)	246 (134.43)	1793 (896.50)	8968 (1856.73)	243 (91.01)	52 (13.87)	31276 (2486.17)	42725	1206.58

TABLE 12. Species-wise and strata-wise catch, effort and catch rate by pelagic trawl during Cruise 111 (Figures in parenthesis indicate catch rates)

DEPTH IN METRES: 55 — 90

STRATA	1	4	7	10	13	16	19	22	25	28	TOTAL	C/h
MAJOR FISH GROUPS/EFFORT	-	-	-	21.67	39.83	25.50	16.33	12.83	3.83	15.33	135.32	
Sharks	-	-	-	350 (16.15)	1724 (43.28)	590 (23.14)	415 (25.41)	165 (12.86)	-	690 (45.01)	3934	29.07
Rays	-	-	-	30 (1.38)	240 (6.03)	470 (18.43)	210 (12.86)	2 (0.16)	50 (13.05)	370 (24.14)	1372	10.14
Skates	-	-	-	-	-	-	-	-	70 (18.28)	-	70	0.52
...ngrasox talabanoides	-	-	-	110 (5.08)	5585 (140.22)	440 (17.25)	70 (4.29)	-	15 (3.92)	120 (7.83)	6340	46.85
Cat fish	-	-	-	200 (9.23)	1780 (44.69)	249 (9.76)	5 (0.31)	15 (1.17)	50 (13.05)	137 (8.94)	2436	18.00
Clupeids	-	-	-	8 (0.37)	556 (13.96)	689 (27.02)	61 (3.74)	6 (0.47)	20 (5.22)	424 (27.66)	1764	13.03
...copelids	-	-	-	-	60 (1.51)	60 (2.35)	-	-	-	-	120	0.89
...umedamrs kaata	-	-	-	45 (2.08)	406 (10.19)	149 (5.84)	-	10 (0.78)	60 (15.67)	386 (25.18)	1056	7.80
Leiognathus spp.	-	-	-	16 (0.74)	129 (3.24)	175 (6.86)	40 (2.45)	-	10 (2.61)	258 (16.83)	628	4.64
Mene maculata	-	-	-	-	-	-	-	-	-	-	-	-
Nemipterus japonicus	-	-	-	-	-	-	-	-	25 (6.53)	-	25	0.18
Serranids	-	-	-	-	-	-	-	1 (0.08)	-	-	1	0.01
Other perches	-	-	-	-	30 (0.75)	5 (0.20)	15 (0.92)	155 (12.08)	25 (6.53)	1006 (65.62)	1236	9.13
Polynemids	-	-	-	-	14 (0.35)	170 (6.67)	80 (4.90)	-	-	44 (2.87)	308	2.28
Protonibea diacanthus(...ll)	-	-	-	-	30 (0.75)	1917 (77.[illegible])	18 (1.10)	-	18 (4.70)	287 (18.72)	2323	17.17
Otolithoides brunneus(Koth)	-	-	-	-	-	-	-	-	-	-	-	-
...ssar aclamidis(Ohuma)	-	-	-	-	475 (11.93)	172 (6.75)	200 (12.25)	10 (0.78)	-	300 (19.57)	1157	8.55
Trichiurus spp.	-	-	-	255 (11.77)	23225 (583.10)	10310 (404.31)	1550 (94.92)	200 (15.59)	300 (78.33)	6750 (440.31)	42590	314.71
Megalaspis cordyla	-	-	-	7380 (340.56)	208 (5.22)	25 (0.98)	7200 (440.91)	1661 (129.46)	2 (0.52)	234 (15.26)	16710	123.48
Carangoides chrysophrys	-	-	-	-	-	-	-	-	-	-	-	-
Other carangids	-	-	-	-	36 (0.90)	111 (4.35)	-	16 (1.25)	10 (2.61)	-	173	1.28
Pampus argenteus	-	-	-	12 (0.55)	337 (8.46)	381 (14.94)	83 (5.08)	-	2 (0.52)	303 (19.77)	1118	8.26
Apolectus niger	-	-	-	25 (1.15)	52 (1.31)	64 (2.51)	28 (1.71)	108 (8.42)	-	5 (0.33)	282	2.08
Scombroids	-	-	-	19 (0.88)	33 (0.83)	141 (5.53)	37 (2.27)	69 (5.38)	1 (0.26)	20 (1.[illegible])	320	2.36
Tunnies	-	-	-	-	-	-	-	-	13 (3.39)	107 (6.98)	120	0.89
Flat fishes	-	-	-	-	-	-	2 (0.12)	3 (0.23)	-	-	5	0.04
Other fishes	-	-	-	22 (1.02)	541 (13.58)	-	-	-	-	23 (1.50)	586	4.33
Crustaceans	-	-	-	-	199 (5.00)	41 (1.61)	-	-	3 (0.78)	-	243	1.80
Cephalopods	-	-	-	2 (0.09)	5 (0.13)	2 (0.08)	5 (0.31)	-	-	-	14	0.10
TOTAL	-	-	-	8474 (391.05)	35665 (895.43)	16214 (635.84)	10019 (613.53)	2421 (188.70)	674 (175.98)	11464 (747.81)	84931	627.58

DEPTH IN METRES: 91 — 125

STRATA	2	5	8	11	14	17	20	23	26	29	TOTAL	C/h
MAJOR FISH GROUPS/EFFORT	-	-	-	-	-	-	-	-	5.00	5.17	10.17	
Sharks	-	-	-	-	-	-	-	-	9 (1.80)	150 (29.01)	159	15.63
Rays	-	-	-	-	-	-	-	-	-	150 (29.01)	150	14.75
Skates	-	-	-	-	-	-	-	-	-	-	-	-
...ngrasox talabanoides	-	-	-	-	-	-	-	-	-	2 (0.39)	2	0.20
Cat fish	-	-	-	-	-	-	-	-	10 (2.00)	-	10	0.98
Clupeids	-	-	-	-	-	-	-	-	-	11 (2.13)	11	1.08
...copelids	-	-	-	-	-	-	-	-	-	-	-	-
...umedamrs kaata	-	-	-	-	-	-	-	-	-	38 (7.35)	38	3.74
Leiognathus spp.	-	-	-	-	-	-	-	-	-	-	-	-
Mene maculata	-	-	-	-	-	-	-	-	-	-	-	-
Nemipterus japonicus	-	-	-	-	-	-	-	-	-	-	-	-
Serranids	-	-	-	-	-	-	-	-	-	-	-	-
Other perches	-	-	-	-	-	-	-	-	-	8 (1.55)	8	0.79
Polynemids	-	-	-	-	-	-	-	-	-	-	-	-
Protonibea diacanthus(...ll)	-	-	-	-	-	-	-	-	-	-	-	-
Otolithoides brunneus(Koth)	-	-	-	-	-	-	-	-	-	-	-	-
...ssar aclamidis(Ohuma)	-	-	-	-	-	-	-	-	-	-	-	-
Trichiurus spp.	-	-	-	-	-	-	-	-	30 (6.00)	752 (145.45)	782	76.89
Megalaspis cordyla	-	-	-	-	-	-	-	-	10 (2.00)	100 (19.34)	110	10.82
Carangoides chrysophrys	-	-	-	-	-	-	-	-	-	-	-	-
Other carangids	-	-	-	-	-	-	-	-	8 (1.60)	-	8	0.79
Pampus argenteus	-	-	-	-	-	-	-	-	-	-	-	-
Apolectus niger	-	-	-	-	-	-	-	-	5 (1.00)	-	5	0.49
Scombroids	-	-	-	-	-	-	-	-	-	7 (1.35)	7	0.69
Tunnies	-	-	-	-	-	-	-	-	6 (1.20)	-	6	0.59
Flat fishes	-	-	-	-	-	-	-	-	-	-	-	-
Other fishes	-	-	-	-	-	-	-	-	-	-	-	-
Crustaceans	-	-	-	-	-	-	-	-	1 (0.20)	-	1	0.10
Cephalopods	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	-	-	-	-	-	-	-	-	79 (15.80)	1218 (235.59)	1297	127.53

DEPTH IN METRES: 126 — 360

STRATA	3	6	9	12	15	18	21	24	27	30	TOTAL	C/h
MAJOR FISH GROUPS/EFFORT	-	-	-	-	-	-	-	-	3.83	4.50	8.33	
Sharks	-	-	-	-	-	-	-	-	36 (9.40)	23 (5.11)	59	7.09
Rays	-	-	-	-	-	-	-	-	-	-	-	-
Skates	-	-	-	-	-	-	-	-	-	-	-	-
...ngrasox talabanoides	-	-	-	-	-	-	-	-	-	-	-	-
Cat fish	-	-	-	-	-	-	-	-	-	-	-	-
Clupeids	-	-	-	-	-	-	-	-	-	-	-	-
...copelids	-	-	-	-	-	-	-	-	-	-	-	-
...umedamrs kaata	-	-	-	-	-	-	-	-	-	2 (0.44)	2	0.24
Leiognathus spp.	-	-	-	-	-	-	-	-	-	-	-	-
Mene maculata	-	-	-	-	-	-	-	-	-	-	-	-
Nemipterus japonicus	-	-	-	-	-	-	-	-	-	-	-	-
Serranids	-	-	-	-	-	-	-	-	-	2 (0.44)	2	0.24
Other perches	-	-	-	-	-	-	-	-	-	3 (0.67)	3	0.3[illegible]
Polynemids	-	-	-	-	-	-	-	-	-	-	-	-
Protonibea diacanthus(...ll)	-	-	-	-	-	-	-	-	-	-	-	-
Otolithoides brunneus(Koth)	-	-	-	-	-	-	-	-	-	-	-	-
...ssar aclamidis(Ohuma)	-	-	-	-	-	-	-	-	-	-	-	-
Trichiurus spp.	-	-	-	-	-	-	-	-	25 (6.53)	13 (2.89)	38	4.56
Megalaspis cordyla	-	-	-	-	-	-	-	-	10 (2.61)	-	10	1.20
Carangoides chrysophrys	-	-	-	-	-	-	-	-	-	-	-	-
Other carangids	-	-	-	-	-	-	-	-	-	65 (14.44)	65	7.80
Pampus argenteus	-	-	-	-	-	-	-	-	-	-	-	-
Apolectus niger	-	-	-	-	-	-	-	-	-	-	-	-
Scombroids	-	-	-	-	-	-	-	-	-	-	-	-
Tunnies	-	-	-	-	-	-	-	-	1 (0.26)	-	1	0.[illegible]
Flat fishes	-	-	-	-	-	-	-	-	-	-		
Other fishes	-	-	-	-	-	-	-	-	-	1 (0.22)	1	[illegible]
Crustaceans	-	-	-	-	-	-	-	-	-	1 (0.22)	1	[illegible]
Cephalopods	-	-	-	-	-	-	-	-	-	-	-	
TOTAL	-	-	-	-	-	-	-	-	72 (18.80)	110 (24.44)	182	[illegible]

TABLE-13. Species-wise and strata-wise catch, effort and catch rate by pelagic trawl during cruise IV (Figures in parenthesis indicate catch rates)

DEPTH IN METRES	55 — 90											
STRATA	1	4	7	10	13	16	19	22	25	28	TOTAL	C/h
MAJOR FISH GROUPS/ EFFORT	12.17	11.4[illegible]	6.83	19.12	35.42	16.08	11.30	10.58	8.45	12.83	144.23	
Sharks	35 (2.88)	200 (17.47)	–	43 (2.25)	1104 (31.17)	3 (0.19)	58 (5.13)	11 (1.04)	110 (13.02)	294 (22.92)	1858	12.88
Rays	–	–	–	40 (2.09)	141 (3.98)	260 (16.17)	50 (4.42)	54 (5.10)	70 (8.28)	11 (0.86)	626	4.34
Skates	–	–	–	–	37 (1.04)	–	–	–	–	–	37	0.26
Congresox talabonoides	–	–	–	–	22 (0.62)	10 (0.62)	–	–	–	–	32	0.22
Cat fish	10 (0.82)	–	9 (1.32)	6 (0.31)	346 (9.77)	54 (3.36)	28 (2.48)	11 (1.04)	–	4 (0.31)	468	3.24
Clupeids	–	–	–	4 (0.21)	43 (1.21)	29 (1.80)	–	–	–	4 (0.31)	80	0.55
Scopelids	–	1 (0.09)	–	5 (0.26)	58 (1.64)	–	–	1 (0.09)	–	–	65	0.45
Pomadasys hasta	–	–	–	2 (0.10)	–	1 (0.06)	–	–	–	1 (0.08)	4	0.03
Lutianus sp.	–	–	–	27 (1.41)	373 (10.53)	–	37 (3.27)	–	–	–	437	3.09
Mene maculata	–	–	–	–	1 (0.03)	1 (0.06)	1 (0.09)	36 (3.40)	1 (0.12)	–	40	0.28
Nemipterus japonicus	–	1 (0.09)	–	–	–	–	–	–	–	–	1	0.01
Serranids	–	–	–	–	–	–	–	–	–	–	–	–
Other perches	3 (0.25)	1 (0.09)	2 (0.29)	16 (0.84)	70 (1.98)	3 (0.19)	13 (1.15)	6 (0.57)	9 (1.07)	20 (1.56)	143	0.99
Polynemids	–	–	–	–	12 (0.34)	7 (0.44)	–	–	–	–	19	0.13
Protonibea diacanthus (Ghol)	–	–	–	–	361 (10.19)	16 (1.00)	69 (6.11)	–	–	–	446	3.09
Otolithoides brunneus (Koch)	–	–	–	–	–	–	–	–	–	–	–	–
Lesser sciaenids (Others)	–	–	–	8 (0.42)	421 (11.89)	–	100 (8.85)	–	7	4 (0.31)	583	3.70
Trichiurus sp.	15 (1.23)	–	–	162 (8.47)	370 (10.45)	654 (40.67)	688 (60.89)	3 (0.28)	15 (1.78)	629 (49.03)	2536	17.38
Megalaspis cordyla	2 (0.16)	1 (0.09)	65 (9.52)	271 (14.17)	1069 (30.18)	120 (7.46)	19 (1.68)	–	–	–	1547	10.73
Carangoides chrysophrys	–	–	–	1 (0.05)	–	–	–	–	–	–	1	0.01
Other carangids	–	–	–	2711 (141.79)	82 (2.32)	15 (0.93)	48 (4.25)	–	3 (0.36)	30 (2.34)	2889	20.03
Pampus argenteus	–	–	–	2 (0.10)	790 (22.30)	67 (4.17)	9 (0.80)	–	1 (0.12)	12 (0.94)	881	6.11
Apolectus niger	–	–	–	11 (0.58)	71 (2.00)	8 (0.50)	–	–	–	–	90	0.62
Scombroids	–	–	6 (0.88)	52 (2.72)	62 (1.75)	97 (6.03)	11 (0.97)	8 (0.76)	9 (1.07)	–	245	1.70
Tunnies	1 (0.08)	–		14 (0.73)	4 (0.11)	–	1 (0.09)	2 (0.19)	13 (1.54)	182 (14.19)	217	1.50
Flat fishes	–	–	–	–	–	–	–	–	–	–	–	–
Other fishes	43 (3.53)	51 (4.[illegible])	4 (0.59)	7005 (366.37)	2 (0.06)	55 (3.42)	–	43 (4.06)	2 (0.24)	3 (0.23)	7211	50.00
Crustaceans	–	–	–	2 (0.10)	74 (2.09)	–	–	–	–	12 (0.94)	88	0.61
Cephalopods	3 (0.25)	2 (0.[illegible])	1 (0.15)	–	9 (0.25)	–	–	–	–	40 (3.12)	55	0.38
TOTAL	112 (9.20)	260 (22.[illegible])	87 (12.74)	10382 (542.99)	5522 (155.90)	1400 (87.06)	1132 (100.18)	175 (16.54)	234 (27.69)	1246 (97.12)	20550	142.48

DEPTH IN METRES	91 — 125											
STRATA	2	5	8	11	14	17	20	23	26	29	TOTAL	C/h
MAJOR FISH GROUPS/ EFFORT	4.50	3.17	3.25	6.75	4.50	1.67	1.67	4.42	6.17	9.67	45.77	
Sharks	–	–	–	10 (1.48)	140 (31.11)	–	–	–	–	–	150	3.28
Rays	–	–	–	–	–	–	–	–	–	–	–	–
Skates	–	–	–	–	–	–	–	–	–	–	–	–
Congresox talabonoides	–	–	–	–	–	–	–	–	–	–	–	–
Cat fish	–	–	–	–	–	–	–	–	–	–	–	–
Clupeids	–	–	–	–	–	–	–	–	–	–	–	–
Scopelids	–	–	–	–	–	–	–	–	–	–	–	–
Pomadasys hasta	–	–	–	–	–	–	–	–	–	–	–	–
Lutianus sp.	–	–	–	–	–	–	–	–	–	–	–	–
Mene maculata	–	1 (0.32)	–	–	–	–	10 (5.99)	2 (0.45)	–	–	13	0.28
Nemipterus japonicus	–	–	–	–	–	–	–	–	–	–	–	–
Serranids	–	–	–	–	–	–	–	–	–	–	–	–
Other perches	–	2 (0.63)	–	–	–	2 (1.20)	–	–	–	–	4	0.09
Polynemids	–	–	–	–	–	–	–	–	–	–	–	–
Protonibea diacanthus (Ghol)	–	–	–	–	–	–	–	–	–	–	–	–
Otolithoides brunneus (Koch)	–	–	–	–	–	–	–	–	–	–	–	–
Lesser sciaenids (Others)	–	–	–	–	–	–	–	–	–	–	–	–
Trichiurus sp.	–	3 (0.95)	–	8 (1.19)	–	2 (1.20)	–	–	–	–	13	0.28
Megalaspis cordyla	–	–	–	–	–	–	–	–	–	–	–	–
Carangoides chrysophrys	–	–	–	–	–	–	–	–	–	–	–	–
Other carangids	–	–	–	8 (1.19)	–	–	–	–	–	–	8	0.17
Pampus argenteus	–	–	–	–	–	–	–	–	–	–	–	–
Apolectus niger	–	–	–	–	–	–	–	–	–	–	–	–
Scombroids	–	–	–	–	–	–	–	–	–	–	–	–
Tunnies	–	–	–	–	–	–	–	–	–	1 (0.10)	1	0.02
Flat fishes	–	–	–	–	–	–	–	–	–	–	–	–
Other fishes	6 (1.33)	4 (1.26)	10 (3.08)	8 (1.19)	–	–	1 (0.60)	30 (6.79)	–	–	59	1.29
Crustaceans	–	–	–	–	–	–	–	–	–	1 (0.10)	1	0.02
Cephalopods	–	–	–	–	–	–	–	–	–	–	–	–
TOTAL	5 (1.33)	10 (3.15)	10 (3.08)	34 (5.04)	140 (31.11)	4 (2.40)	11 (6.59)	32 (7.24)	–	2 (0.21)	249	5.44

DEPTH IN METRES	126 — 360											
STRATA	3	6	9	12	15	18	21	24	27	30	TOTAL	C/h
MAJOR FISH GROUPS/ EFFORT	3.08	4.83	4.00	3.42	3.75	3.25	5.00	6.50	5.00	3.00	41.83	
Sharks	–	–	–	–	60 (16.00)	28 (8.66)	40 (8.00)	49 (7.54)	–	–	177	4.23
Rays	–	5 (1.04)	–	–	–	–	–	–	–	–	5	0.12
Skates	–	–	–	–	–	–	–	–	–	–	–	–
Congresox talabonoides	–	–	–	–	–	–	–	–	–	–	–	–
Cat fish	–	–	–	–	–	–	–	–	–	–	–	–
Clupeids	–	–	–	–	–	–	–	–	–	–	–	–
Scopelids	–	–	–	–	–	–	–	–	–	–	–	–
Pomadasys hasta	–	–	–	–	–	–	–	–	–	–	–	–
Lutianus sp.	–	–	–	–	–	–	–	–	–	2 (0.67)	2	0.05
Mene maculata	–	1 (0.21)	–	–	–	–	3 (0.60)	–	–	–	4	0.10
Nemipterus japonicus	–	–	–	–	–	–	–	–	–	–	–	–
Serranids	–	–	–	–	–	–	–	–	–	–	–	–
Other perches	–	4 (0.83)	1 (0.25)	3 (0.88)	–	–	–	2 (0.31)	–	–	10	0.24
Polynemids	–	–	–	–	–	–	–	–	–	–	–	–
Protonibea diacanthus (Ghol)	–	–	–	–	–	–	–	–	–	–	–	–
Otolithoides brunneus (Koch)	–	–	–	–	–	–	–	–	–	–	–	–
Lesser sciaenids (Others)	–	–	–	–	–	–	–	–	–	–	–	–
Trichiurus sp.	–	–	30 (7.50)	1 (0.29)	–	–	3 (0.60)	–	1 (0.20)	–	35	0.84
Megalaspis cordyla	–	–	–	–	–	–	–	–	–	–	–	–
Carangoides chrysophrys	–	2 (0.41)	–	–	–	–	–	–	–	–	2	0.05
Other carangids	–	–	–	–	–	–	–	–	–	–	–	–
Pampus argenteus	–	–	–	–	–	–	–	–	–	–	–	–
Apolectus niger	–	–	–	–	–	–	–	–	–	–	–	–
Scombroids	–	–	–	3 (0.88)	–	–	–	2 (0.31)	–	–	5	0.12
Tunnies	–	–	1 (0.25)	1 (0.29)	5 (1.33)	455 (140.00)	1 (0.20)	6 (0.92)	262 (52.40)	–	731	17.48
Flat fishes	–	–	–	–	–	–	–	–	–	–	–	–
Other fishes	–	5 (1.04)	1 (0.25)	3 (0.88)	45 (12.00)	–	1 (0.20)	6 (0.92)	5 (1.00)	–	66	1.58
Crustaceans	–	–	–	–	–	–	–	–	–	–	–	–
Cephalopods	–	–	–	–	–	–	–	1 (0.15)	–	–	1	0.02
TOTAL	–	17 (3.52)	33 (8.25)	11 (3.22)	110 (29.33)	483 (148.62)	48 (9.60)	66 (10.15)	268 (53.60)	2 (0.67)	1038	24.81

TABLE 14. Species-wise and strata-wise catch, effort and catch-rate during cruise V (Figures in parenthesis indicate catch rates)

DEPTH IN METRES: 55 — 90

STRATA	1	4	7	10	13	16	19	22	25	28	TOTAL	C/h
EFFORTS	–	1·50	–	6·08	7·50	10·50	–	–	–	6·00	31·58	
MAJOR FISH GROUPS												
Sharks	–	–	–	–	–	45 (4·29)	–	–	–	–	45	1·42
Rays	–	–	–	–	1000 (133·33)	–	–	–	–	–	1000	31·67
Skates	–	–	–	–	–	–	–	–	–	–	–	–
Congresox telabonoides	–	–	–	–	–	–	–	–	–	–	–	–
Cat fish	–	–	–	–	–	–	–	–	–	–	–	–
Clupeids	–	–	–	–	–	1 (0·10)	–	–	–	–	1	0·03
Scopelids	–	–	–	–	–	–	–	–	–	–	–	–
Pomadasys hasta	–	–	–	–	–	–	–	–	–	–	–	–
Lutianus spp.	–	–	–	–	–	3 (0·29)	–	–	–	–	3	0·09
Mene maculata	–	–	–	–	–	–	–	–	–	–	–	–
Nemipterus japonicus	–	–	–	–	–	–	–	–	–	–	–	–
Serranids	–	–	–	–	–	–	–	–	–	–	–	–
Other perches	–	–	–	–	–	8 (0·76)	–	–	–	–	8	0·25
Polynemids	–	–	–	–	–	–	–	–	–	–	–	–
Protonibea diacanthus (Ghol)	–	–	–	–	–	–	–	–	–	–	–	–
Otolithoides brunneus (Koth)	–	–	–	–	–	–	–	–	–	–	–	–
Lesser sciaenids	–	–	–	–	–	–	–	–	–	–	–	–
Trichiurus spp.	–	–	–	–	–	13 (1·24)	–	–	–	–	13	0·41
Megalaspis cordyla	–	–	–	–	–	5 (0·48)	–	–	–	–	5	0·16
Carangoides crysophrys	–	–	–	–	–	–	–	–	–	–	–	–
Other carangids	–	–	–	–	–	290 (27·62)	–	–	–	–	290	9·18
Pampus argenteus	–	–	–	–	–	–	–	–	–	–	–	–
Apolectus niger	–	–	–	–	–	–	–	–	–	–	–	–
Scombroids	–	–	–	–	–	–	–	–	–	–	–	–
Tunnies	–	–	–	–	–	1 (0·10)	–	–	–	–	1	0·03
Flat fishes	–	–	–	–	–	–	–	–	–	–	–	–
Other fishes	–	–	–	–	–	3 (0·29)	–	–	–	–	3	0·09
Crustaceans	–	–	–	–	2 (0·27)	–	–	–	–	–	2	0·06
Cephalopods	–	–	–	–	–	1 (0·10)	–	–	–	–	1	0·03
TOTAL	–	–	–	–	1002 (133·60)	370 (35·24)	–	–	–	–	1372	43·45

DEPTH IN METRES: 91 — 125

STRATA	2	5	8	11	14	17	20	23	26	29	TOTAL	C/h
EFFORTS	–	–	4·42	12·20	9·08	–	–	1·50	–	3·00	30·20	
MAJOR FISH GROUPS												
Sharks	–	–	–	5 (0·41)	–	–	–	–	–	–	5	0·17
Rays	–	–	–	–	–	–	–	–	–	–	–	–
Skates	–	–	–	–	–	–	–	–	–	–	–	–
Congresox telabonoides	–	–	–	–	–	–	–	–	–	–	–	–
Cat fish	–	–	–	–	–	–	–	–	–	–	–	–
Clupeids	–	–	–	–	–	–	–	–	–	–	–	–
Scopelids	–	–	–	–	–	–	–	–	–	–	–	–
Pomadasys hasta	–	–	–	–	–	–	–	–	–	–	–	–
Lutianus spp.	–	–	–	–	–	–	–	–	–	–	–	–
Mene maculata	–	–	–	–	–	–	–	–	–	–	–	–
Nemipterus japonicus	–	–	–	–	–	–	–	–	–	–	–	–
Serranids	–	–	–	–	–	–	–	–	–	–	–	–
Other perches	–	–	–	40 (3·28)	–	–	–	–	–	–	40	1·32
Polynemids	–	–	–	–	–	–	–	–	–	–	–	–
Protonibea diacanthus (Ghol)	–	–	–	–	–	–	–	–	–	–	–	–
Otolithoides brunneus (Koth)	–	–	–	–	–	–	–	–	–	–	–	–
Lesser sciaenids	–	–	–	–	–	–	–	–	–	–	–	–
Trichiurus spp.	–	–	–	145 (11·89)	115 (12·67)	–	–	770 (513·33)	–	–	1030	34·11
Megalaspis cordyla	–	–	–	–	–	–	–	–	–	–	–	–
Carangoides crysophrys	–	–	–	–	–	–	–	–	–	–	–	–
Other carangids	–	–	–	–	–	–	–	–	–	–	–	–
Pampus argenteus	–	–	–	–	–	–	–	–	–	–	–	–
Apolectus niger	–	–	–	–	–	–	–	–	–	–	–	–
Scombroids	–	–	–	–	–	–	–	–	–	–	–	–
Tunnies	–	–	–	–	–	–	–	–	–	–	–	–
Flat fishes	–	–	–	–	–	–	–	–	–	–	–	–
Other fishes	–	–	–	1 (0·08)	–	–	–	–	–	–	1	0·03
Crustaceans	–	–	–	1 (0·08)	–	–	–	–	–	–	1	0·03
Cephalopods	–	–	–	–	–	–	–	20 (13·33)	–	–	20	0·66
TOTAL	–	–	–	192 (15·74)	115 (12·67)	–	–	790 (526·67)	–	–	1097	36·32

DEPTH IN METRES: 126 — 360

STRATA	3	6	9	12	15	18	21	24	[illegible]	30	TOTAL	
EFFORTS	–	11·93	–	1·50	–	4·50	–	–	9·33	10·83	37·[illegible]	
MAJOR FISH GROUPS												
Sharks	–	40 (3·38)	–	–	–	–	–	–	–	50 (4·62)	90	[illegible]
Rays	–	–	–	–	–	–	–	–	–	–		
Skates	–	–	–	–	–	–	–	–	–	–		
Congresox telabonoides	–	–	–	–	–	–	–	–	–	–		
Cat fish	–	–	–	–	–	–	–	–	–	–		
Clupeids	–	–	–	–	–	–	–	–	–	–	–	
Scopelids	–	–	–	–	–	–	–	–	–	–	–	
Pomadasys hasta	–	–	–	–	–	–	–	–	–	–	–	
Lutianus spp.	–	–	–	–	–	–	–	–	–	–	–	
Mene maculata	–	–	–	–	–	–	–	–	–	–	–	
Nemipterus japonicus	–	–	–	–	–	–	–	–	–	–	–	
Serranids	–	–	–	–	–	–	–	–	–	–	–	
Other perches	–	–	–	–	–	–	–	–	–	–	–	
Polynemids	–	–	–	–	–	–	–	–	–	–	–	–
Protonibea diacanthus (Ghol)	–	–	–	–	–	–	–	–	–	–	–	–
Otolithoides brunneus (Koth)	–	–	–	–	–	–	–	–	–	–	–	–
Lesser sciaenids	–	–	–	–	–	–	–	–	–	–	–	–
Trichiurus spp.	–	–	–	–	–	–	–	–	–	–	–	–
Megalaspis cordyla	–	–	–	–	–	–	–	–	–	–	–	–
Carangoides crysophrys	–	–	–	–	–	–	–	–	–	–	–	–
Other carangids	–	77 (6·51)	–	–	–	–	–	–	–	–	77	2·03
Pampus argenteus	–	–	–	–	–	–	–	–	–	–	–	–
Apolectus niger	–	–	–	–	–	–	–	–	–	–	–	–
Scombroids	–	–	–	–	–	–	–	–	–	–	–	–
Tunnies	–	–	–	–	–	–	–	–	–	–	–	–
Flat fishes	–	–	–	–	–	–	–	–	–	–	–	–
Other fishes	–	–	–	–	–	–	–	–	–	–	–	
Crustaceans	–	–	–	–	–	–	–	–	–	–	–	
Cephalopods	–	–	–	–	–	–	–	–	–	–		
TOTAL	–	117 (9·89)	–	–	–	–	–	–	–	50 (4·62)	16[illegible]	

TABLE - 15. Species-wise and strata-wise catch, effort and catch-rate by pelagic trawl during Cruise VI (Figures in parenthesis indicate catch-rates).

Depth in metres: 55 — 90

DEPTH IN METRES / STRATA	1	4	7	10	13	16	19	22	25	28	TOTAL	C/h
MAJOR FISH GROUPS/EFFORT	12.98	9.62	10.75	11.00	31.33	22.85	14.37	6.25	7.92	32.27	159.34	
Sharks	123 (9.48)	159 (16.53)	333 (30.98)	315 (28.64)	2218 (70.79)	704 (30.81)	471 (32.78)	42 (6.72)	143 (18.06)	1319 (40.87)	5827	36.57
Rays	12 (0.92)	1 (0.10)	3 (0.28)	54 (4.91)	155 (4.95)	1370 (59.96)	1115 (77.59)	–	1 (0.13)	381 (11.81)	3092	19.41
Skates	–	–	–	–	9 (0.29)	–	350 (24.36)	35 (5.60)	–	40 (1.24)	434	2.72
Congresox talabonoides	–	–	–	12 (1.09)	1558 (49.73)	1 (0.04)	4 (0.28)	12 (1.92)	–	152 (4.71)	1739	10.91
Cat fish	87 (6.70)	102 (10.60)	2 (0.19)	102 (9.27)	3318 (105.90)	310 (13.57)	461 (32.08)	140 (22.40)	–	214 (6.63)	4736	29.72
Clupeids	5 (0.39)	54 (5.61)	1 (0.09)	21 (1.91)	142 (4.53)	99 (4.33)	172 (11.97)	8 (1.28)	57 (7.20)	342 (10.60)	901	5.65
Scopelids	–	–	–	1 (0.09)	137 (4.37)	–	1 (0.07)	–	–	1 (0.03)	140	0.88
Pomadasys hasta	6 (0.46)	–	2 (0.19)	41 (3.73)	262 (8.36)	26 (1.14)	–	–	–	672 (20.82)	1009	6.33
Lutjanus spp.	–	–	–	4 (0.36)	289 (9.22)	66 (2.89)	143 (9.95)	3 (0.48)	–	3 (0.09)	508	3.19
Mene maculata	–	–	–	–	–	1 (0.04)	–	–	–	2 (0.06)	3	0.02
Nemipterus japonicus	–	1 (0.10)	–	–	120 (3.83)	12 (0.53)	–	–	–	33 (1.02)	166	1.04
Serranids	–	–	–	–	1 (0.03)	44 (1.93)	140 (9.74)	–	–	1 (0.03)	186	1.17
Other perches	28 (2.16)	3 (0.31)	–	–	110 (3.51)	269 (11.77)	343 (23.87)	6 (0.96)	8 (1.01)	633 (19.62)	1400	8.79
Polynemids	–	–	–	–	88 (2.81)	13 (0.57)	12 (0.84)	–	–	2 (0.06)	115	0.72
Protonibea diacanthus (Ghol)	–	–	–	60 (5.45)	2075 (66.23)	400 (17.51)	227 (15.80)	3 (0.48)	–	232 (7.19)	2997	18.81
Otolithoides brunneus (Koth)	–	–	3 (0.28)	–	7 (0.22)	–	–	–	–	–	10	0.06
Lesser sciaenids	–	–	–	2 (0.18)	411 (13.12)	707 (30.94)	94 (6.54)	2 (0.32)	–	207 (6.41)	1423	8.93
Trichiurus spp.	1451 (111.79)	595 (61.85)	382 (35.53)	490 (44.55)	9081 (289.85)	6822 (298.56)	1995 (138.83)	29 (4.64)	160 (20.20)	2408 (74.62)	23413	146.94
Megalaspis cordyla	6 (0.46)	157 (16.32)	1266 (117.77)	4 (0.36)	–	81 (3.54)	20 (1.39)	1 (0.16)	131 (16.54)	4654 (144.22)	6320	39.66
Carangoides crysophrys	–	–	–	–	–	–	–	–	–	–	–	–
Other carangids	3 (0.23)	81 (8.42)	98 (9.12)	14 (1.27)	371 (11.84)	317 (13.87)	634 (44.12)	21 (3.36)	69 (8.71)	488 (15.12)	2096	13.15
Pampus argenteus	21 (1.62)	–	59 (5.49)	147 (13.36)	1619 (51.68)	296 (12.95)	33 (2.30)	1 (0.16)	12 (1.52)	470 (14.56)	2658	16.68
Apolectus niger	262 (20.18)	2 (0.21)	589 (54.79)	72 (6.55)	86 (2.74)	16 (0.70)	3 (0.21)	7 (1.12)	146 (18.43)	1864 (57.76)	3047	19.12
Scombroids	132 (10.17)	6 (0.62)	97 (9.02)	10 (0.91)	678 (21.64)	266 (11.64)	204 (14.20)	10 (1.60)	14 (1.77)	504 (15.62)	1921	12.06
Tunnies	–	–	23 (2.14)	1 (0.09)	33 (1.05)	9 (0.39)	–	1 (0.16)	3 (0.38)	–	70	0.44
Flat fishes	–	–	–	–	–	2 (0.09)	–	–	–	1 (0.03)	3	0.02
Other fishes	9 (0.69)	3 (0.31)	–	18 (1.64)	10 (0.32)	49 (2.14)	2 (0.14)	1 (0.16)	1 (0.13)	2 (0.06)	95	0.60
Crustaceans	–	–	–	–	54 (1.72)	9 (0.39)	4 (0.28)	–	–	12 (0.37)	79	0.50
Cephalopods	4 (0.31)	1 (0.10)	–	10 (0.91)	2 (0.06)	2 (0.09)	33 (2.30)	–	–	15 (0.46)	67	0.42
TOTAL	2149 (165.56)	1165 (121.10)	2858 (265.86)	1378 (125.27)	22834 (728.82)	11891 (520.39)	6461 (449.62)	322 (51.52)	745 (94.07)	14652 (454.04)	64455	404.51

Depth in metres: 91 — 125

DEPTH IN METRES / STRATA	2	5	8	11	14	17	20	23	26	29	TOTAL	C/h
MAJOR FISH GROUPS/EFFORT	4.50	3.08	3.00	3.00	3.00	3.08	1.50	8.58	3.16	9.66	42.56	
Sharks	–	–	–	–	–	–	10 (6.67)	10 (1.17)	18 (5.70)	244 (25.26)	282	6.63
Rays	–	–	–	–	–	–	–	–	–	4 (0.41)	4	0.09
Skates	–	–	–	–	–	–	–	–	–	–	–	–
Congresox talabonoides	–	–	–	–	–	–	–	–	–	–	–	–
Cat fish	–	–	–	–	–	–	–	–	–	–	–	–
Clupeids	–	–	–	–	–	–	–	5 (0.58)	–	3 (0.31)	8	0.19
Scopelids	–	–	–	–	–	–	–	–	–	–	–	–
Pomadasys hasta	–	–	–	–	–	–	–	–	–	1 (0.10)	1	0.02
Lutjanus spp.	–	–	–	–	–	–	–	–	–	–	–	–
Mene maculata	–	10 (3.25)	–	–	–	–	–	–	–	–	10	0.23
Nemipterus japonicus	–	–	–	–	–	–	–	–	–	–	–	–
Serranids	–	–	–	–	–	–	–	–	–	–	–	–
Other perches	–	–	–	–	–	–	2 (1.33)	–	3 (0.95)	3 (0.31)	8	0.19
Polynemids	–	–	–	–	–	–	–	–	–	–	–	–
Protonibea diacanthus (Ghol)	–	–	–	–	–	–	–	–	–	3 (0.31)	3	0.07
Otolithoides brunneus (Koth)	–	–	–	–	–	–	–	–	–	–	–	–
Lesser sciaenids	–	–	–	–	–	–	–	–	–	–	–	–
Trichiurus spp.	5 (1.11)	140 (45.45)	–	5 (1.67)	12 (4.00)	–	250 (166.67)	178 (20.75)	–	703 (72.77)	1293	30.38
Megalaspis cordyla	–	–	–	–	–	–	–	–	–	847 (87.68)	847	19.90
Carangoides crysophrys	–	–	–	–	–	–	–	–	–	–	–	–
Other carangids	–	–	–	–	–	–	2 (1.33)	9 (1.05)	–	7 (0.72)	18	0.42
Pampus argenteus	–	–	–	–	–	–	–	–	–	5 (0.52)	5	0.12
Apolectus niger	–	–	–	–	–	–	–	–	–	159 (16.46)	159	3.74
Scombroids	–	–	–	–	–	–	–	–	–	30 (3.11)	30	0.70
Tunnies	–	–	2 (0.67)	–	9 (3.00)	–	–	2 (0.23)	–	–	13	0.31
Flat fishes	–	–	–	–	–	–	–	–	–	–	–	–
Other fishes	5 (1.11)	1 (0.32)	3 (1.00)	–	1 (0.33)	–	1 (0.67)	7 (0.82)	3 (0.95)	1 (0.10)	22	0.52
Crustaceans	–	–	–	–	–	–	–	–	–	–	–	–
Cephalopods	–	–	–	–	1 (0.33)	–	–	1 (0.12)	–	–	2	0.05
TOTAL	10 (2.22)	151 (49.03)	5 (1.67)	5 (1.67)	23 (7.67)	–	265 (176.67)	212 (24.71)	24 (7.59)	2010 (208.07)	2705	63.56

Depth in metres: 126 — 360

DEPTH IN METRES / STRATA	3	6	9	12	15	18	21	24	27	30	TOTAL	C/h
MAJOR FISH GROUPS/EFFORT	5.58	3.08	4.50	3.16	1.50	3.00	1.58	1.58	3.16	4.14	31.20	
Sharks	14 (2.51)	–	–	38 (12.03)	40 (26.67)	18 (6.00)	–	–	28 (8.86)	10 (2.42)	148	4.74
Rays	–	–	–	–	–	–	–	–	–	–	–	–
Skates	–	–	–	–	–	–	–	–	–	–	–	–
Congresox talabonoides	–	–	–	–	–	–	–	–	–	–	–	–
Cat fish	–	–	–	–	–	–	–	–	–	–	–	–
Clupeids	–	–	–	–	–	–	–	–	–	–	–	–
Scopelids	–	–	1 (0.22)	–	–	–	–	–	–	–	1	0.03
Pomadasys hasta	–	–	–	–	–	–	–	–	–	–	–	–
Lutjanus spp.	–	–	–	–	–	–	–	–	–	–	–	–
Mene maculata	–	–	–	–	–	–	–	–	–	–	–	–
Nemipterus japonicus	–	–	5 (1.11)	–	–	–	–	–	–	–	5	0.16
Serranids	–	–	–	–	–	–	–	–	–	–	–	–
Other perches	–	–	3 (0.67)	–	–	–	–	–	–	–	3	0.10
Polynemids	–	–	–	–	–	–	–	–	–	–	–	–
Protonibea diacanthus (Ghol)	–	–	–	–	–	–	–	–	–	–	–	–
Otolithoides brunneus (Koth)	–	–	–	–	–	–	–	–	–	–	–	–
Lesser sciaenids	–	–	–	–	–	–	–	–	–	–	–	–
Trichiurus spp.	–	–	60 (13.33)	–	–	40 (13.33)	–	–	400 (126.58)	48 (11.59)	548	17.56
Megalaspis cordyla	–	–	–	–	–	–	–	–	–	27 (6.52)	27	0.87
Carangoides crysophrys	–	–	–	–	–	–	–	–	–	–	–	–
Other carangids	–	–	–	–	–	–	–	–	–	–	–	–
Pampus argenteus	–	–	–	–	–	–	–	–	–	–	–	–
Apolectus niger	–	–	–	–	–	–	–	–	–	–	–	–
Scombroids	–	–	–	–	–	–	–	–	–	–	–	–
Tunnies	–	–	20 (4.44)	1 (0.32)	–	5 (1.67)	–	–	–	–	26	0.83
Flat fishes	–	–	–	–	–	–	–	–	–	–	–	–
Other fishes	6 (1.08)	–	12 (2.67)	2 (0.63)	1 (0.67)	1 (0.33)	–	–	–	–	22	0.71
Crustaceans	–	–	–	–	–	–	–	–	–	–	–	–
Cephalopods	–	–	1 (0.22)	–	–	–	–	–	–	–	1	0.03
TOTAL	20 (3.58)	–	102 (22.67)	41 (12.97)	41 (27.33)	64 (21.33)	–	–	428 (135.44)	85 (20.53)	781	25.03

TABLE-16 Strata-wise and cruise-wise occurrence of the different species (Number indicates the cruise number)

STRATA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Stegostoma fasciatum																			6						3,4,5					
Alopias vulpinus															4			4					4							5
Carcharias hemiodon																												2		
Eulamia melanoptera										3			3	4					4					4					6	
Galeocerdo cuvieri																						1				1			1	
Myrmillo manazo																												2		
Carcharias limbatus										3			3			1														
Scoliodon palasorrah							5			3				4					1	6			1	1	4		1	3,4		
Scoliodon sorrakowah													2,4			2,6		6	4,6	6	4		6		1,4,6	2		4		
Scoliodon walbeehmi																												2		
Carcharinus macloti													4												4					
Eulamia spallanzani																												2		
Rhina ancylostoma																6			6									6		
Sphyrna blochii	2,6		5	2			2,6			2,6			2,6			1,2			4			2	2	1	1,2,6	1	1	1,2,6	1,2,6	1
Sphyrna zygaena	4,6		6	6			5					6	4			4,6						4	6		4,6		6	6	6	
Rhynchobatus djiddensis										2,5			2,4,5						1,5					1						
Rhinobatus annulatus			1	1									4,6			1						6			1					
Pristis cuspidatus										5			6			4			6									6		
Amphotistius zugei	1									2,3															1					
Gymnura micrura										3			3									2	3							
Aetobatus narinari							6			6			3			4			2,4			2			2			2,6		
Narke dipterygia																4														
Aetomylaeus nichofii	3			1												4														
Narcine timlei													4			1												4		
Mobula diabolus						1,4				4,6			4			4,6			1,4,6			1			4			1,2,6		
Megalops cyprinoides	3			1				3																						
Euplatygaster indica	4			1						3			4															2		
Ilisha elongata										4			4			4,6					2,6							4		
Ilisha filligera	1,6									3,5,6			1,2,3,4,6			1,2,3,4,6			2,3,6		2	2,6	2,6		3,4,6			1,2,3,4,6	1,2	1
Tenualosa sinensis	2									3	1					4									6			6		
Sardinella sirm																													6	
Anodontostoma chacunda	1																													
Dussumieria hasseltii	1,3,6			1,6						2,4			2,4			2,4,5			2,4,6			2,6	3	3	4,6	1	2	6	3	
Spratelloide japonicus						1																								
Stolephorus commersonii	2																		1								2	2		1
Coilia dussumieri										1,2,3			1,2,3,4,6			1,2,3												6		
Thryssa dussumieri	1,2															2						2							1,2	
Thryssa mystax										5			2,3,4,5						4									1,2,4		
Thryssa hamiltonii													4																	
Chirocentrus dorab	1,2,6			1,2,3			3,6	3		2,3,4,6			2,3,4,6			1,2,3,4,6			1,2,3,6			2,3	1		1,2,6			1,2,3,4,6	1,3	
Chirocentrus nudus										2			4			4												2,4	2	
Pellona ditchela	4									2,5															4					
Saurida gracilis			5	4																										

TABLE 16 (Contd.)

STRATA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Saurida tumbil	1,2,3,4	1,2,3	1,3,5	1,2,3,6	1	1,3	3,5	1,3,5,6	6	2,3,4,5	1,3	1,2,4	1,2,5	1	1	1,5	1,2,3	1,2,3	1,5,6	1,3	1,2,3	1,4,5,6	3,5	1,4	1,2,5	1,2	2,5	1,4,6		
Saurida undosquamis				4						4												4						4		
Synodus indicus	4				3																									
Diaphus splendidus	4								4,6			4	4			2,6			2,4					4			4	4		
Harpodon nehereus									5	4.6			2,3,4,6			2,3												4		
Plotosus anguillaris	1	1		1																										
Tachysurus dussumieri					3								1,6																	
Arius leiotetocephalus													2,4,6						2,4											
Tachysurus maculatus				6																								2		
Arius polystaphylodon													3																	
Tachysurus thalassinus	3,4			6			4	3		3,4,5	1,2,3		4,5			2						2,4	3	3				4	4	
Tachysurus venosus		1				1		1					4																	
Osteogeneiosus militaris																1														
Gymnothorax boschi													2																	
Gymnothorax favagineus																							3							
Muraenesox cinereus							3						2			1,6														1
Congresox talabonoides	2						1,3			1,2,3,6			1,2,3,4,6			1,2,3,4,6			1,2,3,6			1,6			3		1	1,2,3,6	1,3	1
Ariosoma anago																												4		
Uroconger lepturus																							3							
Pisodonophis cancrivorus																			2											
Ablennes hians		2																										2		
Cypselurus comatus						1																								
Fistularia petimba							3	3			5					6	3													
Fistularia villosa	1	1,3			5		5	1								6	3			3								1		
Sphyraena accutipinnis						1				2																2	2			3
Sphyraena jello	4			2,6		2	5	3	2,6	5	3		4			2,4	1		2,4			3,6		2	1,2,4,6	1	2	1,2,4	1	1
Sphyraena langsar									4	4			4									2			5			4		
Sphyraena obtusata	3,4			6						4,5			4						6			2			4,5			6		
Sphyraena picuda	3				4								4																	
Eleutheronema tetradactylum							3			2			2,3,6			2,3,6			2			1						2		
Polynemus heptadactylus				3						2			1,2,4,5,6			1,2,3,6			2,6			1			1			1,2,3,4,6		
Polynemus sextarius																			1									4		
Polynemus indicus				3			3	3			3		2 3 4			1 3 4							3	3		3		2		
Polynemus plebeius				3	1			3								3			3					3				3		
Epinephelus areolatus													1																	
Epinephelus diacanthus	3				3	3	5	1,3		1,3	1,3		6			1,6		2	2			3,5		1,3	5	5	1,5	2,4		
Epinephelus fuscoguttatus				3		3			3														3							
Epinephelus bleekeri																									2					
Epinephelus fasciatus	1	1		1	1	1		1	1		1	1	1,2		1	1,5		1	5	1	1	5	5	1	1,5	1	1	1.5		1
Epinephelus malabaricus										1																			5	
Promicrops lanceolatus											1																			
Serranus gramicus	1		1	3	3			1,3	1,3														3		1					
Serranus corrallicola												1			1															

TABLE 16 (Contd.)

STRATA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Therapon theraps					1		1	3					4										3							
Therapon jarbua	2			1,2,6	2					2,4			2			5			6			1								
Cookeclus boops		6	5	1				3	6		1,5	1		6	1									1				1	5	
Priacanthus cruentatus																														
Priacanthus hamrur	1	6		3,6		3		1,3	4,6	6		1,4,6	6	6	1,4	6	3			3			3	1	6		5		5,6	6
Priacanthus tayenus									6																					
Acanthocepola limbata															1				5											
Apogon aureus			3																											
Apogon taeniatus																5,6														
Apogon quadrifasciatus													4,5															4		
Synagrops japonicus													4															4		
Acropoma japonicus										5						2,6						4		1				4		
Lactarius lactarius	2,3,6		5	2		1	1			2,5			2			1,2			2,4,6			1,2,3			1,2,3	1		1,2,3,4,6	1	1
Howella sherborni	2																													
Alectis indicus			1	6		1	1			1,2			4			4							1		1,3			1		
Atropus atropus	4			2,4				3		2,5	4	4	4			4			4									4		
Carangoides chrysophrys		1		1		1		1		1,4	1			2					1			1				1,2		1		
Alepes djedaba				1															2			3	1					2		
Carangoides malabaricus				1,3	1		1,6	1,3		5		6	1,6			1,6			6			1		1,3	1	1,2	1	1,3,4	6	1
Carangoides oblongus								3								6						3		3	1					
Caranx carangus						1																								
Carangoides ferdau	3				2																									
Caranx melampygus				3																										
Caranx sanson				3																				1		1,3				
Caranx sexfasciatus										1			4						4						1,4					
Caranx stellatus																	3			3			3	3						
Selaroides leptolepis																5														
Scomberoides lysan	6	2	2	1		1	3			2,3	2		2,6			1,2,3,4,6			2,4,6			3,6			2,3			2,3,6	2	
Scomberoides tala	1			1			4				1								1			1			1			1,2	1	
Scomberoides tol					1		4									1			4						4					
Decapterus russelli	4			2,3,4,6			1,3	1,3		2,3,4,5,6	2,3,4	6	2,4,6			2,5,6			4,5,6	6		2,6	6	2,3	2,4,6	2	2	2,6		1,6
Megalaspis cordyla	1,3,4,6			2,3,4,6			3,4,5,6	6		4,6			3,4			1,2,3,4,5,6			1,2,3,4,6		2	1,3,6	1,2,3	1,3	1,2,5,6	1,3	1,3	2,3,4,6	1,2,3,6	1,2
Selar crumenophthalmus				6						1																				
Selar kalla				2																				2					4	
Alepes mate				3	3	5	5	3		3,5,6	3		5,6	1,5		1,5	1		6						1,4	1		2,6	5	
Selar malam	4										4																			
Elagatis bipinnulata						1																								
Seriola bonariensis			6												2	2														
Trachinotus blochi						5							4						4						1			2		
Trachinotus ovatus													4																	
Seriolina nigrofasciata				3				3		3	3					2	3													
Rachycentron canadus	1,6	3,6	6	3,6	1,3,6		3,6	3	6	2,3			1,2,4	2	1	1,2,4,6	1,2,3,4		1	3,6		1,3		3	1	1,6		3,6		6
Trachurus trachurus	1	1		1 2	1	1	1	1		2			1												1	1		1	1	

TABLE 16 (Contd.)

STRATA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Mene maculata	4	1		4	4,6	4	2,6	2	2	2,3,4			2,4			2,6			1,2,4,6	4	4	2,4	4,6		2,3,4		6	1,2,4,6	1	
Coryphaena hippurus													1													6		6	2	2
Emmelichthys nitidus															2															
Lutianus argentimaculatus							1			1,2,6			6			6			6			1			1	1				
Lutianus johni				3		1,3	5	3		3			2,3,4	1		1,2,3			2,3,4						2,3			2	3	
Lutianus lutianus		1,2				1,2			1			2													1			1		
Lutianus malabaricus																1						3								
Lutianus sanguineus							4						4			1														
Lutianus vaigiensis																									1					
Pristipomoides typus				3																							1			
Caesio caerulaureus						1												1												
Nemipterus bleekeri																		2												
Nemipterus furcosus																												2		
Nemipterus japonicus	1,2,3,4,6	1,3	1,3,5	1,3,4,6	1,3		1,3,5	1,3	1,6	1,2,3,5	3	1	6		1	1,6		1,2	1,2,5		1	1,5		1	1,3,5	1	1,5	2,4,6	1	1
Gazza minuta	2,3			1						2	2					2												1,2,4		
Leiognathus bindus							1												6			4						1,4	1	
Leiognathus splendens																									6					
Secutor insidiator				4						2			4			2,6			2,4,6			2,4,6			2,4	2	2	2,4,6		
Pomadasys hasta	1,2,6			1,2			1,3,6	3		1,2,3,4,5,6			1,2,3,4,5,6			1,2,3,4,5,6			1,2			1,2,3			1,2,3	1		1,2,3,6	1,2,3,6	1,3
Pomadasys maculatus	1						1																			1	1	4,6		
Atrobucca alba			5										5						6			4	4					4		
Protonibea diacanthus	3		1	1			1,5,6	3,5		1,2,3,6			1,2,4,5,6			1,2,3,4,6			2,3,4,6		1	2,6			3,5		5	1,2,3	5,6	
Johnius dussumieri	3												3,4			3														
Johnius osseus													5												5					
Johnieops sina													3			3			2											
Johnius maculatus																												6		
Johnius hololepidotus													6																	
Otolithus argenteus	3								4				2,4,5			1,4			2,4						5			2		
Otolithoides brunneus										2			1,2,6			1		1		1								1		
Otolithes ruber	3									6			3,6			3,6												6		
Lethrinus microdon											1																			
Lethrinus nebulosus							1																							
Lethrinus ornatus											1					5														
Acanthopagrus berda					3			3		1	3					5														
Acanthopagrus latus																												2		
Argyrops spinifer	1							1,3		1,2			1			5,6	1,2	2	2,5,6	3	2	6	5	1,3	2,5	2		2,6	1,3	3,4
Upeneus sulphureus				3			5	1,3		2,3,5			4,5						6				3	3						
Upeneus vittatus	2			1,6			5			2,5,6			6			6			6						1	1		1,6		
Ephippus orbis										1,2						1									1			1		
Platax teira																												6		
Drepane punctata							1	3		1,2,5			4,5,6			5,6			2,5									1,2,4,6		
Chaetodon acuminatus																											5			
Chaetodon marleyi															1											1				

TABLE 14 (Contd.)

STRATA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Uranoscopus guttatus			5		3														5											
Callionymus japonicus				3																										
Naso tuberosus						1																								
Trichiurus lepturus	1,2,3,4,6	1,2,3,6	3	1,2,3,6	1,3,4,6	1,2,3	1,2,3,5,6	1,2,3	2,4,6	1,2,3,4,5,6	1,2,3,4,5,6	1,2,4	1,2,3,4,5,6	1,2,5,6	1,2	1,2,3,4,5,6	1,2	1,2,6	1,2,3,4,5,6	1,2,3,6	2,3,5	1,2,3,4,5,6	1,2,3,4,5,6	1,2,3	2,3,4,6	1,2,3	1,2,3,4,6	1,2,3,4,6	1,2,3,6	1,2,3,6
Rastrelliger kanagurta	1,2,3,6	3,6		1,2,3,6	1,3		3,6	1,3		2,3,5,6			4			1,4,5			6			2			1,2	1,2		1,2,6	2	
Auxis thazard	4			6					4,6	4		4	4	6				4,6	4,6		4						4	4,6		2,6
Auxis rochei									6	6			4															4,6		
Katsuwonus pelamis					2					2					1,2			1	1				1	1				4		
Euthynnus affinis									6	4		4,6	4,6	6	4	6	1	4	1			6		4	3,6			4		
Thunnus tonggol										6			4									4				3		4		
Thunnus albacares													4																	
Sarda orientalis					6	1	6	6	6	2	1	4,6	2,4		2,4	5,6		2,6	2		2		6	3,4	3,4	3	3			
Acanthocybium solandri													3																	
Scomberomorus commerson	2,6			1			4,6	3		2,3,4			2,3,4,6			1,2,3,5,6			1,2,3,6			1,2,3	2		1,2,4,6	1		1,2,3,6	1,2,3,6	1
Scomberomorus guttatus	1,2,6			1,2,6			4,6			2,3,4,6			2,3,4,6			1,2,3,4,6			1,2,3,4,6			1,2,3,4,6			1,3,4,6	1,2		1,2,3,4,6	1,2,3,6	
Scomberomorus lineolatus													6			4,6												4		1
Histiophorus gladius	4														4	4							4							
Centrolophus niger		5																	6				6						5	
Pampus argenteus	2,3			2	2		1,2,3	1,3		2,3,4,6			1,2,3,4,5,6			1,2,3,4,5,6			1,2,3,4,6			1,2	2		3,4,6			1,2,3,4,6	1,2,6	1
Pampus chinensis	6						6			5,6			3,6			6						6				6		6		
Apolectus niger	1,2,6			1,2,3,6			2,3,6	1		2,3,4,5,6			1,2,3,4,6			1,2,3,4,5,6			2,3,6			1,2,3,6		1	2,3,6	1,3	1,6	1,2,3,4,6	1,6	1
Psenes indicus				6					6	3,4,5			4						6	6		5,6	3	3	4,6	1,2,5	5,6	2	2,5	1
Pterois russelli	4			4				1					6									1								
Pterois miles										2						6														
Pterois volitans	1,4				4																									
Minous monodactylus																6												4		
Grammoplites scaber																6														
Suggrundus macracanthus																									1,4	1		2		
Thysanophrys crocodilus										3															4					
Lepidotrigla natalensis			1,3												1															
Lepidotrigla faurei					4																									
Trigla hemisticta	4	4	3,5		4									1	1		1													
Dactyloptena orientalis	4				1,2		2		6		5		1	4																
Psettodes erumei	1			3			5	1		1,2,3,5	3					5,6			2,3			1						1,6		
Arnoglossus microphthalmus																													4	
Grammatobothus polyophthalmus	4																													
Pseudorhombus arsius	4			1												6	1													
Cynoglossus arel													2																	
Cynoglossus microlepidotus													2			1														
Echeneis albescens												2				2			1											
Echeneis naucrates	4,6	2,4,6	2,6	1,2,4,6	1,3,4,6	4	4,6	2,3,4,6	2,6	3,5,6	3,4,5,6	4,6	4,6	2,4,6		4,5,6	4		1,4,6	4,6		4,6	6	4	1,4	6	2,5	3,4,6	2,4,6	1,6
Remora remora				4																	1									
Abalistes stellaris					1						1																			
Odonus niger	1,3,4	4			1		4,5	1	6	4,6	6	6	3,4			6		6		6										

TABLE 16 (Contd.)

STRATA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Alutera monoceros		4		3				1		2			6			3			6			6			2,6					
Bregmaceros macclellandi	4						4					4	4			6						6						4		
Cyclichthys echinatus												4			4															
Cyclichthys orbicularis		3		6	6			1	6		5,6	6	6			6				6			6							
Canthigaster margaritatus																							2		2	2	2		2	2
Lagocephalus inermis		6	6		2,6		1		6							5	3				3		3					3		2
Gastrophysus lunaris													4																	
Halieutea stellata	3																1													
Antennarius hispidus										2																				
Mola mola													2					2			2	4							2	
Partica filamentosa																								2	1					
Sepia aculeata	1,4	1			4	1	4	1,3	6	2,5	3,6		4				6		6			4,6		1				4		
Sepia esculenta									6		6					6	6													
Sepiella inermis							4						2,4			6	6		6	6		2						2		
Sepia pharaonis	1,4	2			1		5		6	2			6	6			6													
Loligo duvaucelii	1,4	1		1,4	4		4	1		2,5	6		2,4			4,6	6		2,6	6		4,6			4	1		2,4		
Argonauta argo										6		6				6														
Octopus vulgaris										4																				
Hippolysmata ensirostris				4									4															4		
Palaemon styliferus													3																	
Palaemon tenuipes				4						4			4															4		
Solenocera indica	4			4			3			2			2,3,4,5			2			1			4						4,6		
Solenocera alticarinata																														1
Penaeus indicus										6			3,5															6		
Penaeus monodon	3																		1,6									3		
Penaeus penicillatus													2			2			1											
Penaeus semisulcatus	3									6						6			1											
Metapenaeus affinis							3			2			2,3															6		
Metapenaeus monoceros	3									6			3			2			1											
Metapenaeus dobsoni													3																	
Metapenaeopsis stridulans																												4		
Parapenaeopsis hardwickii													1																	
Parapenaeopsis stylifera				4			3						4															4		
Scylla serrata	4							1																						
Neptunus pelagicus	3																													
Neptunus sanguinolentus	3																													
Charybdis callinassa	1		1																											
Charybdis cruciata	1									2			2						2									1		
Panulirus polyphagus							3	1,3					3,6			1						6								
Thenus orientalis	3									2,3			4			2			2			1			4			4		
Squilla sp.	4															6						1						4		
Acetes indicus										3			3											1	3					

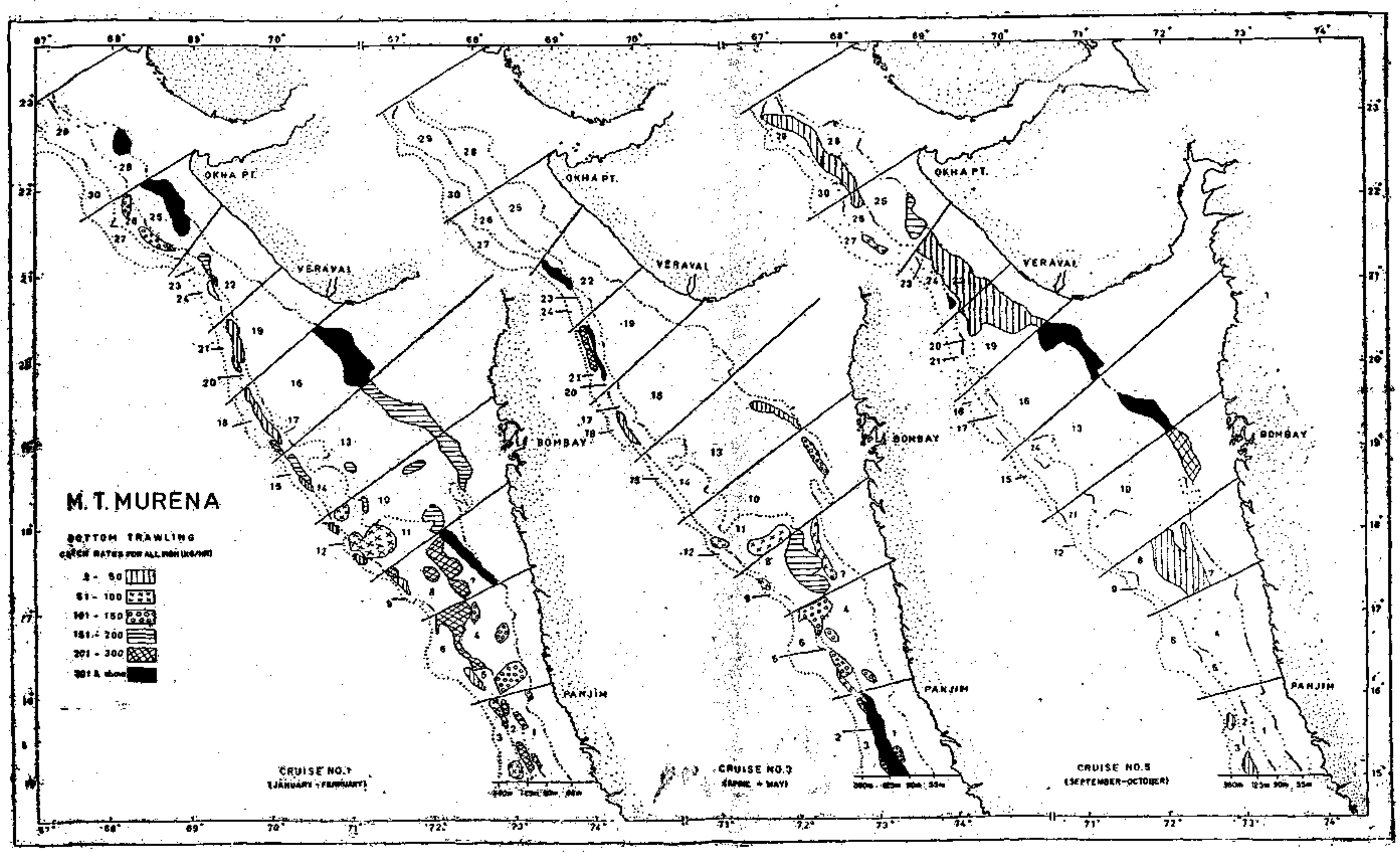


Fig. 9. Catch rates for all-fish by bottom trawl—Cruises I, III and V.

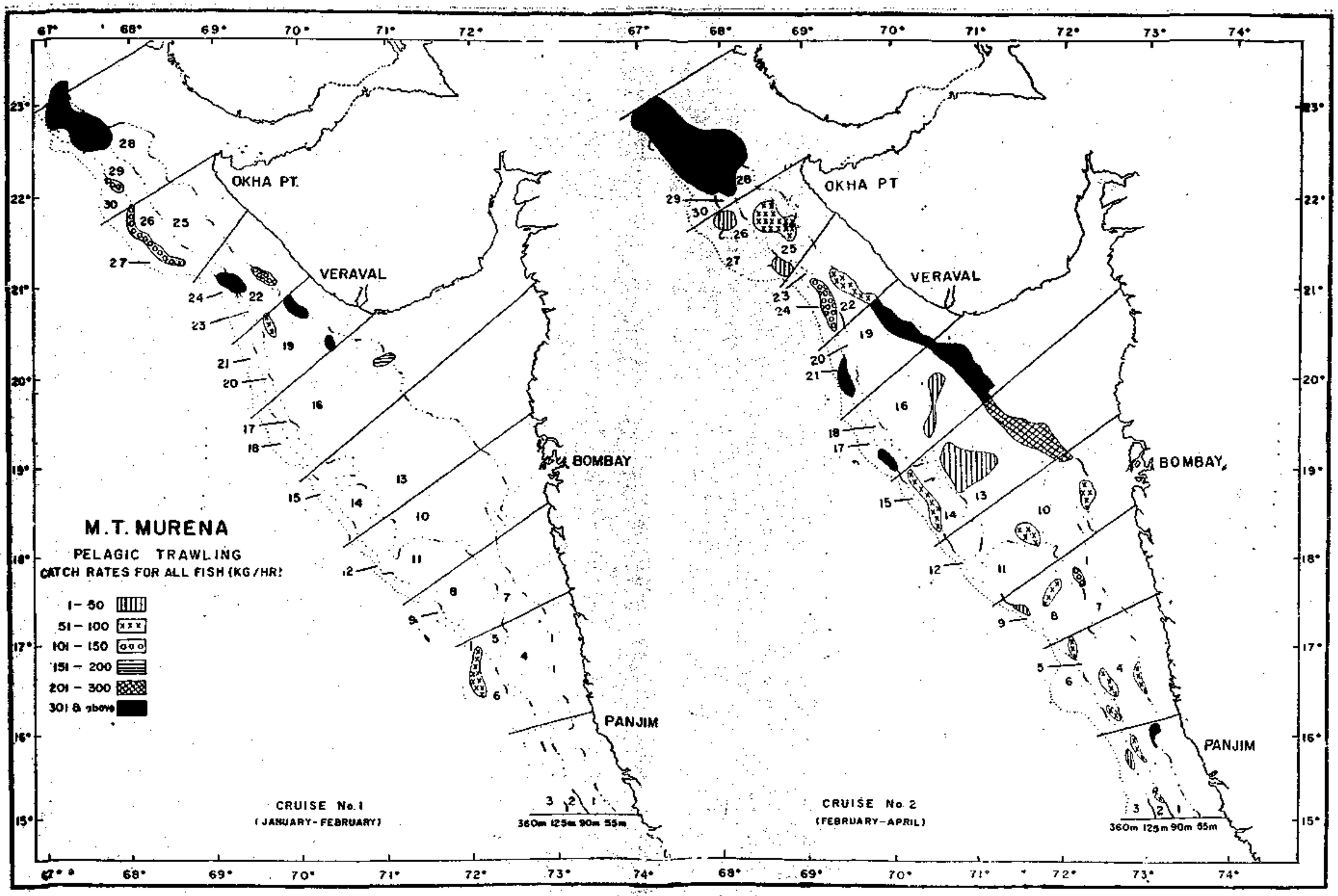


Fig. 10. Catch rates for all-fish by pelagic trawl—Cruises I and II.

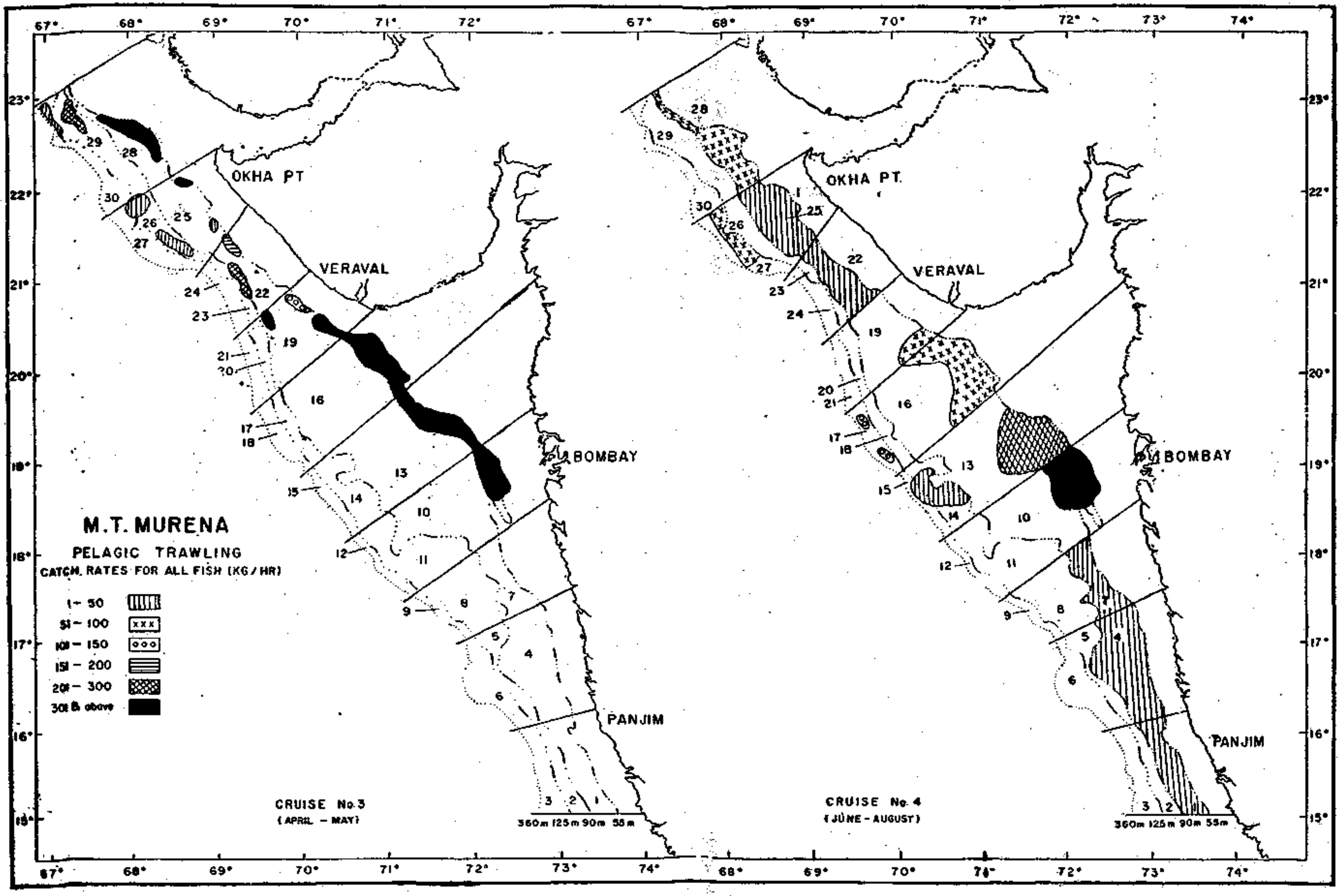


Fig. 11. Catch rates for all-fish by pelagic trawl—Cruises III and IV.

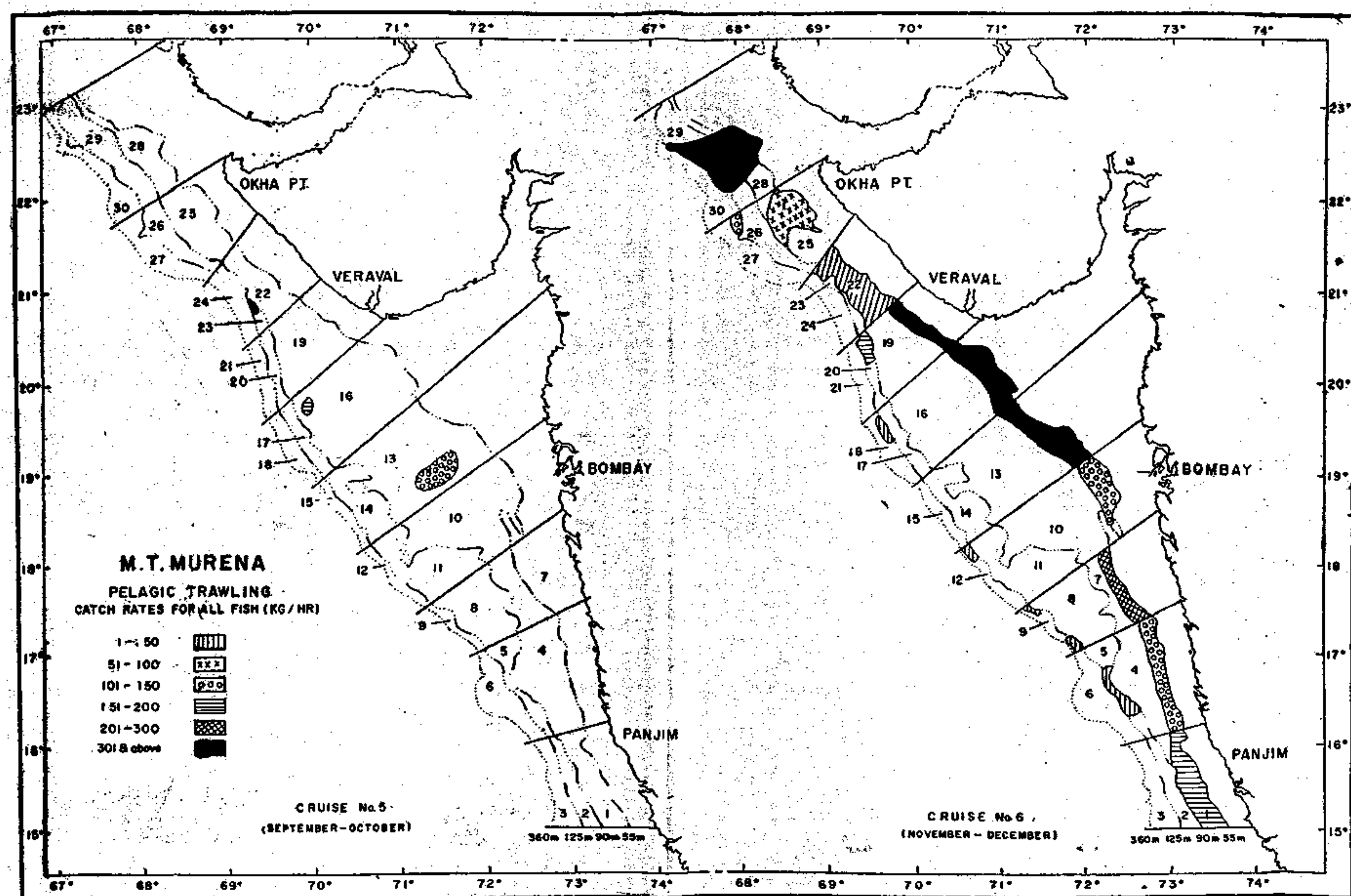


Fig. 12. Catch rates for all-fish by pelagic trawl—Cruises V and VI.

January-February, though the values were lower (152.73 kg/hr).

In general , however, the trend indicated that shoreward areas had greater abundance of fish during the winter and post-monsoon months.

The details of the catch and effort from these bottom trawl operations are presented, for each cruise separately, in Tables 6, 7 and 8. The higher catch-rates came in the 55-90 m range from stratum 28 (634.11 kg/hr) in January-February, followed by stratum 16 (479.72 kg/hr) also in January-February and 473.74 kg/hr in September-October. In the 91-125 m range, the higher catch-rates were 845.7 kg/hr in cruise III from stratum 23, followed by 818 kg/hr from stratum 20 in the same cruise. In the next depth-range stratum 24 gave rates of 752.16 kg/hr in Cruise III and 316.91 kg/hr in Cruise I. The areas of abundance for the ground fish resources, as observed during the demersal fishing, are shown in Fig. 9 for each demersal cruise.

PELAGIC FISHING

The pelagic survey was primarily based on acoustic observations of fish by echo-sounder, Sonar etc. So, necessarily, the survey grid had to be flexible depending on the abundance of fish schools. Thus a total number of 542 pelagic hauls was made during the six cruises, putting in a fishing effort of 1071.34 hr (Table 2).

In the 55-90 m depth-range 311 pelagic hauls were made with an effort of 679.31 hr. In the next deeper range, 125 hauls were taken in 214.27 hr and in the next depth-range 106 hauls were made in 177.76 hr (Table 9).

In the course of the survey, MURENA landed an estimated catch of 4,30,760 kg of fish by pelagic trawling for a fishing effort of 1071.34 hr., which gave a catch rate of 402 kg/hr. Details of the catch, catch-rates and effort are given strata-wise for each cruise separately in Tables 10 to 15. It may be noticed that, taken for the year, 63.4% of the pelagic trawling effort was put in the depth range 55-90 m, 20.0% in 91-125 m and 16.6% in the deeper range of 126-360 m. The catch and catch-rates obtained in these three depth-ranges were 2,67,680 kg at 394 kg/hr, 1,15,988 kg at 541 kg/hr and 47,092 kg at 265 kg/hr respectively, indicating that the middle depth-range was richer in pelagic fish resources.

Very high catch-rates were taken during February, March and April (Cruise II) in the depth ranges 91-125 m and 126-360 m, viz., 1480 and 1207 kg/hr respectively; while in the shallower region, the catch-rate was 489 kg/hr. The pelagic trawling during Cruise I had yielded lower catch-rates than during Cruise II, the catch-rates obtained in 91-125 m range being the best. In Cruise III (April-June) which was primarily meant for bottom trawling the depth-range 55-90 m yielded 84,931 kg of fish for an effort of 135.32 hr, with a catch-rate of 628 kg/hr. During the period, the pattern of distribution of catch rates indicated declining trends with increase in depth range. In Cruise IV (June-August) which was exclusively for pelagic trawling, the catch-rates at all depths were very low and varied between 5 and 142 kg/hr. The catches and catch-rates in Cruise V (September-October) were very poor; the catch-rates varied between 4 and 43 kg/hr. the pattern of distribution remaining the same. For Cruise VI, devoted for pelagic trawling, the best yield of 64,455 kg was obtained from 55-90 m range for an effort of 159.34 hr and a catch-rate of 405 kg/hr. Thus, the period from November/December to April, yielded comparatively better catch-rates with maxima in March for the pelagic resources.

The highest catch-rate of 611 kg/hr came from the depth range 55-90 m with a total catch of 88,502 kg from stratum 28. The other strata, in the order of abundance, were 13, 19, 16 and 10 and the catch rates varied between 503.76 and 315.75 kg/hr. In the remaining strata the effort, catch and catch-rates were lower.

The above trends in catch-rates indicate that, in general, the five northern zones gave comparatively better yield in pelagic resources and of these, the depth-ranges 55-90 m and 91-125 m off Veraval, Porbunder and Okha were more productive, particularly during December-March. A single shoaling species, *Megalaspis cordyla*, as would be shown later, was primarily responsible for the very high catch-rates in March in some of these strata.

The areas of greater abundance for pelagic fish resources are shown in Fig. 10-12.

IV

SPECIES COMPOSITION, DISTRIBUTION AND ABUNDANCE OF MAJOR GROUPS/SPECIES

In the catches made by MURENA, 228 species of fish, 24 spp. of crustaceans and 7 spp. of cephalopods were identified. These were grouped into 29 categories and the catch-rates were worked out, cruise-wise and strata-wise, in respect of the following major groups.

- Sharks
- Rays
- Skates
- *Congresox talabonoides*
- Catfishes
- Clupeids
- Scopelids
- *Pomadasys hasta*
- *Lutianus* spp.
- *Mene maculata*
- *Nemipterus japonicus*
- Serranids
- Other perches and perch-like fishes
- *Protonibea diacanthus*
- *Otolithoides brunneus*
- Lesser sciaenids
- Polynemids
- *Trichiurus* spp.
- *Megalaspis cordyla*
- *Carangoides chrysophrys*
- Other carangids
- *Pampus argenteus*
- *Apolectus niger*
- Scombroids
- Tunnies
- Flat fishes
- Other fishes
- Crustaceans
- Cephalopods

Sharks

Sharks formed an important component of the catch by both bottom and pelagic trawling. They accounted for 27,613 kg, forming 5.48% of the total catch. The species of sharks that contributed to the catch were :

Stegostoma faciatum (Seba)
Carcharias hemiodon Muller and Henle
Myrmillo manazo (Bleeker)
Scoliodon palasoorah (Cuvier)
Scoliodon sorrakowah (Cuvier)
Scoliodon walbeehmi (Bleeker)
Carcharinus macloti (Muller and Henle)
Eulamia spallanzani (Le Sueur)
Eusphyrna blochii Springer
Galeocerdo cuvieri (Le Sueur)
Eulamia melanoptera Quoy and Gaimard
Alopias vulpinus (Bonnaterre)

The total catch of sharks in bottom-trawling worked out to 2,267 kg, with a catch-rate of 5.7 kg, and formed 3.1% of total demersal catch. The catch rates in the three depth zones were 7.25, 4.79 and 2.14 kg/hr respectively (Table 3). The maximum landing of 1,552 kg came from the shallower depth range of 55-90 m.

The shark catches and rates coverage-wise, are given in Tables 6-8. During Cruise I (January-February) the highest yield of 832 kg, with a catch-rate of 8.52 kg, was obtained from the depth range 55-90 m, with a declining trend in the subsequent depth-strata. A similar pattern was noticed in Cruises III and V. The highest catch-rate of 32.9 kg/hr for sharks came from stratum 26, followed by 31.5 kg/hr from stratum 28 during January-February.

The shark catch in pelagic trawling was estimated at 25,346 kg with a catch-rate of 23.66 kg/hr and formed 5.88%. The catch-rates indicated a declining trend from 55-90 m depth-range to seaward depths. The catch and catch-rates in the three depth ranges were 21,601, 2,604, 1,141 kg and 31.80, 12.15, 6.42 kg/hr respectively (Table 3). In the depth range 55-90 m the highest catch-rate of 67.05 kg/hr was obtained in Cruise I. The catch-rates in Cruises II, VI and III were 45.10, 36.57 and 29.07 kg/hr. Good catches and catch-rates were obtained in Cruises I and II (January-April) from the depth-range 91-125 m. The catch-rates in the next depth range were comparatively low.

Strata-wise, the highest catch-rates were 232.97 kg/hr from stratum 28 and 95.42 kg/hr from stratum 29 during January-February.

November-May could be identified as good months for sharks. Some of the good grounds for sharks are shown in Fig. 13.

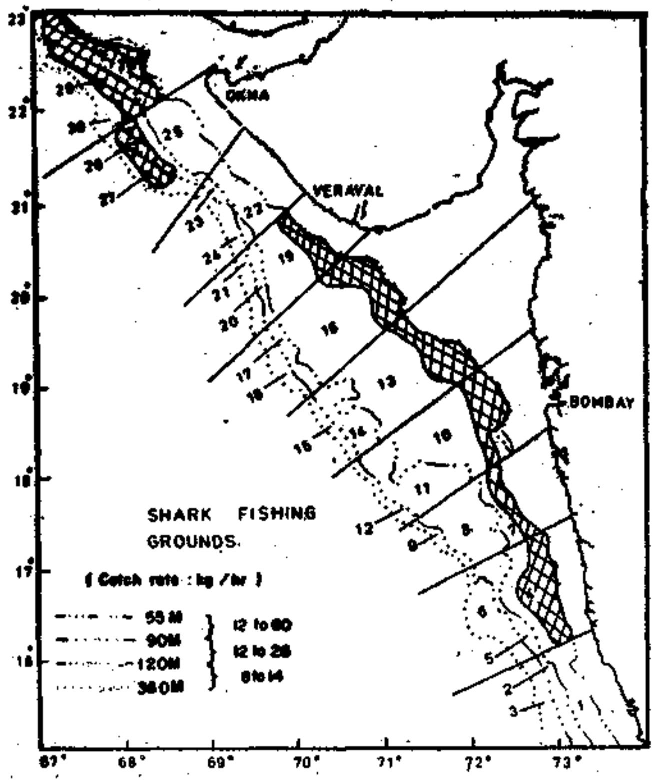


Fig. 13. Shark fishing grounds.

Rays

The rays, which were estimated at 13, 181 kg, formed 2.62% in the total landings of MURENA. They were caught more frequently in pelagic trawl than in bottom trawl. The following six species were recorded during the year :

Amphotistius zugei (Muller and Henle)
Gymnura micrura (Bloch and Schneider)
Aetobatus narinari (Euphrasen)
Aetomylaeus nieuhofii (Bloch and Schneider)
Narcine timlei (Bloch and Schneider)
Mobula diabolus (Shaw)

The catch of rays in bottom trawling accounted for 3,689 kg giving a catch-rate of 9.28 kg/hr. Their percentage in the bottom trawl catch was 5.05, slightly more than that of sharks. The catch rates between the three depth-zones showed marked variation, 12.51 kg in 55-90, 6.65 kg in 91-125 and 3.27 kg in 126-360 metres. The declining trend with increasing depth noticed in shark catches was seen in respect of rays also.

The occurrence of rays in the bottom trawl is shown in Tables 6 to 8 along with their catch-rates. The best catch of 2,493 kg, with a catch-rate of 25.25 kg, was taken from the depth-range 55-90 m in Cruise I. This declined to a very low level in the 91-125 m range. In Cruise III, during April-May, the 91-125 m depth-range yielded the maximum catch of 667 kg with a catch-rate of 15.97 kg/hr.

Stratum 22 gave the highest catch rate 66.67 kg/hr, followed by stratum 25 giving 54.0 kg/hr during January-February.

The total catch of rays by pelagic trawl was estimated at 9,491 kg, with a catch rate of 8.86 kg/hr, and formed 2.2% of the pelagic trawl catch. Out of this total, 9,012 kg, at the rate of 13.27 kg/hr, were obtained from the depth-range of 55-90 m. The catch rates varied between 0.63 and 1.78 kg/hr in the other two depth-ranges.

The highest catch rate of 40.24 kg/hr with a catch of 1,010 kg was recorded from 55-90 m depth range during January-February. In Cruise II (February-March) and Cruise III (April-May) from the same depth range catches of 1,912 and 1,372 kg of rays were made at the rates of 10.45 and 10.14 kg/hr respectively. In Cruise IV the catch rates were low but showed some improvement during Cruise V when the catch rate was 31.67 kg/hr. Thus, practically the entire catch of rays was obtained from the depth-range 55-90 m. The catches and catch rates in the other two depth-ranges 91-125 and 126-360 metres were insignificant.

Strata-wise, the highest catch rate of 133.33 kg/hr came from stratum 13 during September-October and 77.59 kg/hr from stratum 19 in November-December.

The season for rays appears to extend from November-December to April-May. A decreasing trend in abundance from shallower (55-90 m) to the deeper areas was evident from the present survey. The ray fishing grounds are shown in Fig. 14.

Skates

Skates contributed 3,265 kg forming 0.65% of the catch. The catch mainly comprised three species.

Pristis cuspidatus (Latham)
Rhynchobatus djiddensis (Forskal)
Rhinobatus granulatus Cuvier

A total quantity of 2,601 kg of skates with a catch rate of 6.54 kg was caught by bottom trawl, which formed 3.56% of the total catch. The catch rates in the three depth-zones were 7.20, 6.25 and 4.85 kg/hr and indicated the same declining trend towards greater depth, as seen in other elasmobranchs.

The highest catch rates came during Cruise I (January-February), 107.47 kg/hr from stratum 25 and 73.53 kg/hr from stratum 24.

For the bottom trawl, the better grounds seem to be strata 25 and 10 in the 55-90 m areas, and strata 5 and 24 in the deeper areas.

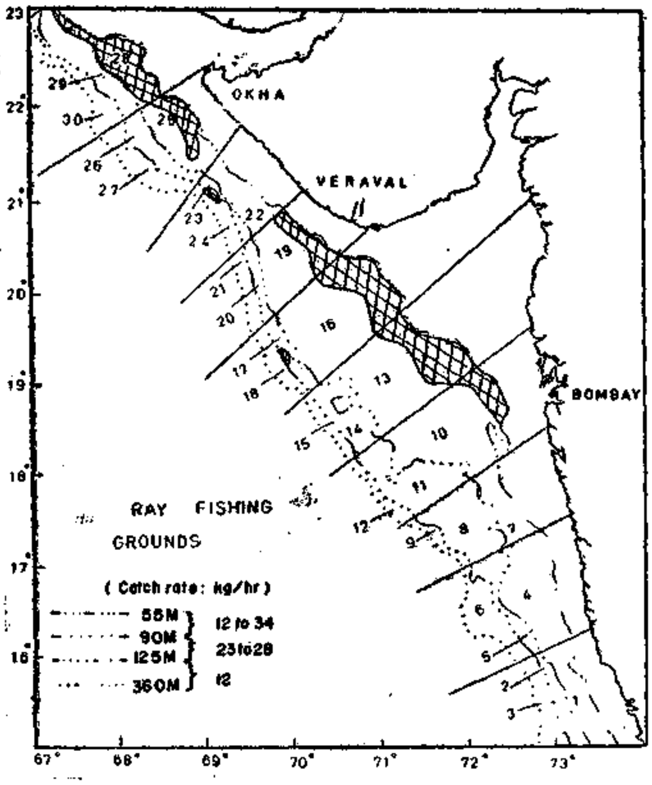


Fig. 14. Ray fishing grounds.

The catch of skates by pelagic trawl was negligible with 664 kg giving a catch rate of 0.62 kg/hr and forming 0.15% of the total catch, all from the shallow depth range 55-90 m. Of this 434 kg was taken in the last cruise at a catch rate of 2.72 kg/hr. Strata 19 and 25 gave catch rates of 5.12 and 2.53 kg/hr respectively.

Catch rates of 24.36 kg/hr from stratum 19 during November-December and 18.28 kg/hr from stratum 25 during April-May were the highest values obtained for skates.

Congresox talabonoides (Bleeker)

C. talabonoides, popularly known in Bombay as 'Wam', grows to more than a metre in length and is an economically important species. During the six cruises of MURENA 15,105 kg of this species were landed, forming 3% of the total catch.

A total quantity of 1,368 kg was landed by bottom trawling, with a catch rate of 3.44 kg, forming 1.87% of the catch. Of this 1,362 kg were taken in Cruise I during January-February with a catch rate 13.95 kg/hr from the depth zone 55-90 m. The remaining 6 kg were also taken from the same depth range in Cruise III. The species was not caught at all during Cruise V.

The higher catch rates of 44.59 kg/h from stratum 13, and 13.37 kg/hr from stratum 10 were obtained during January-February.

The greater part of 'Wam' landed by MURENA, 13,737 kg, was caught in pelagic trawls, at a catch rate of 12.82 kg/hr and forming 3.19% of the demersal landings. The 55-90 m depth range was the most productive area from which 13,690 kg were landed at a catch rate of 20.15 kg/hr in 679.31 hr of fishing. The other two depth-ranges gave a negligible catch of 47 kg with low catch rates. The bulk of the catch was recorded during Cruises II and III from February to May. The catches were 5,459 kg and 6,340 kg with catch rates of 29.83 and 46.85 kg/hr respectively.

Stratum 13 gave the highest catch rate of 140.22 kg/hr in April-May, followed by 117.97 kg/hr from the same stratum in February-April.

Stratum 13 appears to be the most productive area for 'Wam', as good catch rates were recorded for both bottom and pelagic trawling. The better fishing grounds for eel are shown in Fig. 15. According to Jayaraman *et al.* (1959), Kagwade (1969), Rao *et al.* (1972) and Nair (1974) the concentration of 'Wam' was confined to 20-30 fathom range, with increasing abundance from Bombay to Cambay. The catch rates, according to them, varied between 50 and 350 kg/hr in bottom trawling. Strata 13 and 16 from where good catches were obtained in the present study, are in the 55-90 m depth range on the seaward side of the rich grounds observed by the earlier workers.

Catfish

Catfishes formed an important component in the catches from offshore waters. The total catch landed was estimated at 20,678 kg and accounted for 4.10%. The major part of the catch was contributed by eight species.

Tachysurus dussumieri (Valenciennes)
Arius leiotetocephalus Bleeker
Tachysurus maculatus (Thunberg)
Arius polystaphylodon Bleeker
Tachysurus thalassinus (Ruppell)
Tachysurus venosus (Valenciennes)
Osteogeniosus militaris (Linnaeus)
Plotosus anguillaris (Bloch)

Catfishes accounted for nearly 8% of the ground fish catch. A total of 5,822 kg was landed by this gear, at a catch rate of 14.64 kg/hr. From the 55-90 m range 3,265 kg were landed, at the catch rate 15.25 kg/hr and from the next depth range 2,427 kg, at a catch rate of 19.96 kg/hr. In the deeper range, the catches were insignificant.

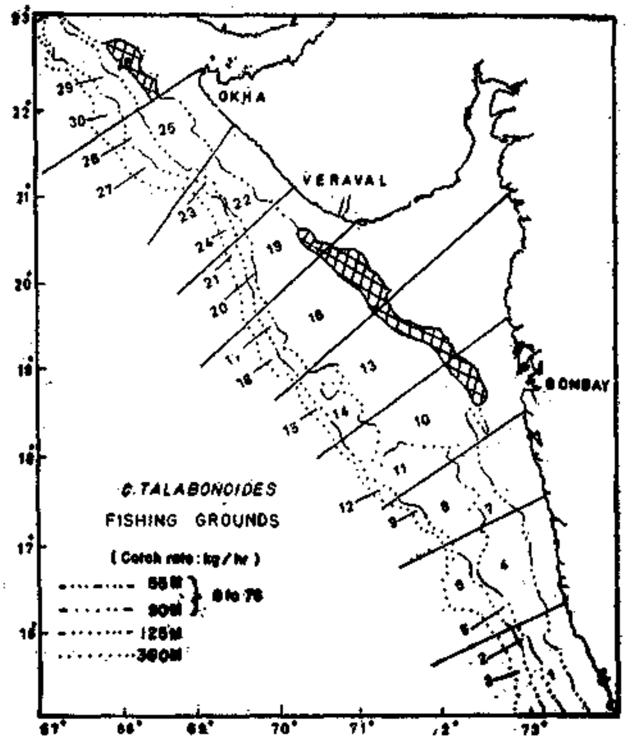


Fig. 15. Eel fishing grounds.

During the first cruise in January-February the middle depth-range yielded more than the 55-90 m range, the catch rates being 37.63 and 27.01 kg/hr respectively. A similar trend was observed during Cruise III also, though the catch rates were 12.45 and 5.35 kg/hr respectively, indicating lower abundance during the period compared to January-February. In Cruise V the catch of 510 kg, at the rate of 5.36 kg/hr, was exclusively from the 55-90 m range. While the highest yield of 2,636 kg was recorded during January-February from the 55-90 m the maximum catch rate was obtained from 91-125 m zone.

The higher catch rates of 214.59 kg/hr came from stratum 7 and 159.72 kg/hr from stratum 2 during January-February.

The catfishes landed by pelagic trawl were estimated at 14,856 kg, with a catch rate of 13.87 kg/hr and formed 3.45% of the pelagic catch. As in the case of eel, the 55-90 m range proved the most productive, as 14,456 kg were landed in 679.31 hr of trawling from this areas, at a catch rate of 21.28 kg/hr. The other two depth-ranges together contributed only 400 kg with catch rates of 1.76 and 0.12 kg/hr.

The best catch rate of 35.70 kg/hr with a catch of 6,533 kg in 183 hr was recorded during February-April from the 55-90 m area. The next best value of 4,736 kg in 159.34 hr with a catch rate of 29.72 kg/hr was obtained in October-December from the same depths in Cruise VI. Cruise III during April-May gave a catch rate of 18.00 kg/hr. The depth range 91-125 m gave a return of 4.98 kg/hr during Cruise II. It was significant that the catfish were totally absent during September-October in spite of the 100 hours of fishing effort evenly distributed in the three depth ranges.

Stratum 1 gave the highest catch rate of 681.22 kg/hr during February-April and stratum 13 gave 105.90 kg/hr during November-December.

The catfish grounds are marked in Fig. 16.

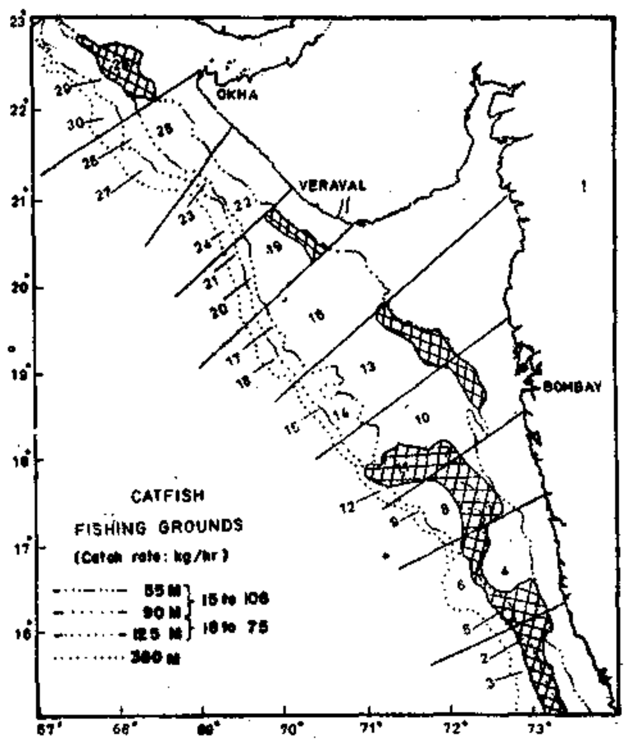


Fig. 16. Cat-fish fishing grounds.

Clupeids

Thirteen species of clupeids, listed below according to their importance in the catch, contributed to the landings by MURENA during her six cruises. The catch was estimated at 5,193 kg and formed 1.03%.

Megalops cyprinoides (Broussonet)
Euplatygaster indica (Swainson)

Ilisha elongata (Bennett)
Ilisha filigera (Valenciennes)
Tenualosa sinensis (Linnaeus)
Dussumieria hasseltii Bleeker
Spratelloides japonicus (Houttuyn)
Stolephorus commersonii Lacepede
Coilia dussumieri (Cuvier and Valenciennes)
Thryssa dussumieri (Valenciennes)
Thryssa mystax (Schneider)
Chirocentrus dorab (Forskal)
Chirocentrus nudus Swainson

The clupeids formed 1.8 per cent of the bottom trawl catch. They accounted for 1,315 kg with a catch rate 3.31 kg/hr. Almost the entire catch was taken from the depth range 55-90 m at a catch rate of 6.0 kg/hr.

Of the above 13 species nearly 75% of the catch was contributed by *Ilisha* spp. and *Chirocentrus* spp. Nearly 85 per cent of the catch was recorded during Cruise I in the depth zone 55-90 m with a catch rate of 12.74 kg/hr. The catch was insignificant in the other cruises as well as in other depth ranges. Stratum 16 gave the maximum catch of 824 kg with a catch rate of 27.54 kg/hr, followed by stratum 1 with a catch rate of 10.08 kg/hr.

Strata-wise, the highest catch rate 45.1 kg/hr came from stratum 16, the next 22.31 kg/hr from stratum 1 during January-February.

The clupeid catch in the pelagic trawls was estimated at 3,878 kg with a catch rate of 3.62 kg/hr and formed 0.90%. Most of the catch came from the shallower depth range of 55-90 m. In this depth range 3,830 kg were caught with a catch rate 5.64 kg/hr for an effort of 679.31 hr. In the next depth range 42 kg were recorded, followed by a meagre 6 kg in the 126-360 m area.

In the 55-90 m range the catches and catch rates obtained were 173 kg (6.89 kg/hr), 911 kg (4.98 kg/hr), 1,764 kg (13.03 kg/hr) and 901 kg (5.65 kg/hr) in Cruises I, II, III and VI respectively. In Cruise IV the catch was a meagre 80 kg and virtually nil in Cruise V. The catch and catch rates in the other two depth-ranges were not significant.

The catch rates of 27.66 kg/hr and 27.02 kg/hr from strata 28 and 16 obtained in April-May were the highest.

The better clupeid fishing areas are shown in Fig. 17.

Scopelids

Scopelids formed a minor group and accounted for a catch of 1,615 kg forming only 0.32%. Six species, listed below, contributed, *S. tumbil* being the principal species accounting for 95% of the scopelid catch.

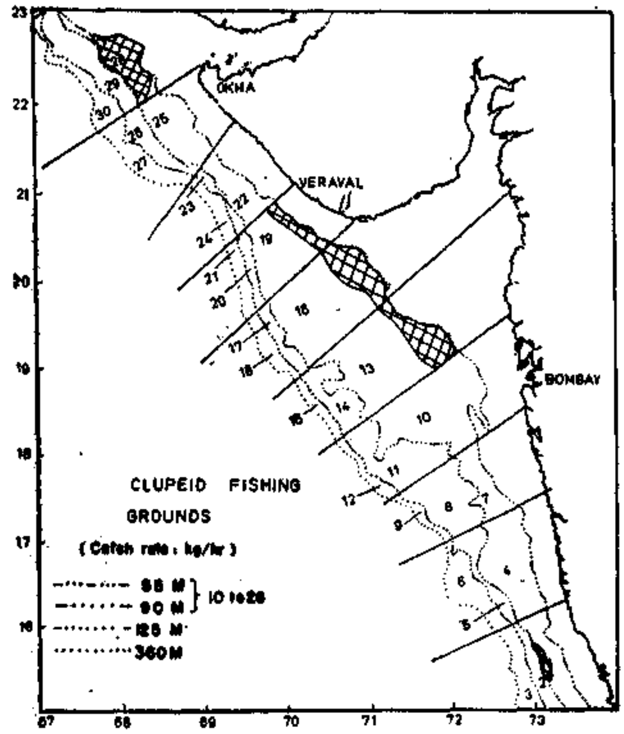


Fig. 17. Clupeid fishing grounds.

Saurida gracilis (Quoy and Gaimard)
Saurida tumbil (Bloch).
Saurida undosquamis (Richardson)
Synodus indicus (Day)
Diaphus splendidus (Brauer)
Harpodon nehereus (Hamilton-Buchanan)

Scopelids accounted for a small percentage (1.75) in the ground fish catch. Their catch by bottom trawl was estimated at 1,279 kg with a catch rate of 3.22 kg/hr. Nearly 80 percent of the catch was recorded from 91-125 and 126-360 m depth ranges with catch rates 5.91 and 5.69 kg/hr. respectively.

The higher catch rate of 53.0 kg/hr came from stratum 17 and the next highest 32.86 kg/hr from stratum 23 in April-May.

The scopelid catch by pelagic trawl was insignificant, being 336 kg with a catch-rate of 0.31 kg/hr. Of this 333 kg were obtained in the depth range 55-90 m in Cruises III, IV and VI. The catch-rates of 4.37 kg/hr from stratum 13 in November-December and 2.35 kg/hr from stratum 16 in April-May were the highest obtained for this group.

Bottom trawling appeared to be comparatively more effective for this group. *S. tumbil* which was the principal representative of this group was abundant in the deeper waters in the northern zones.

Pomadasys hasta (Bloch)

P. hasta, popularly known as ' Karkara ', is one of the economically important species usually taken in trawl nets. It grows to more than half a metre in length and fetches a reasonably good price. In the catches of MURENA the fish made up 4,730 kg and formed 0.94% of the total catch.

This species accounted for 1,387 kg in bottom trawl catches, at a catch-rate of 3.49 kg/hr, forming 1.9 per-cent of the total demersal catch. Almost all the catch came from the 55-90 m range (catch-rate 6.39 kg/hr), only 18 kg coming from the 91-125 m range at a catch rate of 0.15 kg/hr.

During the first cruise (January-February), 1,260 kg of this species were landed, of which 1,245 came from the depth range 55-90 m with a catch rate of 12.76 kg/hr. In Cruise III it was 91 kg with a catch-rate of 4.23 kg/hr from the same depths. In Cruise V also, though only 33 kg were taken, they came from the same depth-range with a catch-rate 0.35 kg/hr. The species thus seems restricted to the 55-90 m zone and available mainly during the months January-February.

The higher catch-rates for this species were 46.74 kg/hr from stratum 28 and 30.67 kg/hr from stratum 25 in January-February.

The catch of *P. hasta* by pelagic trawl was estimated at 3,343 kg with a catch-rate of 3.13 kg/hr and formed 0.78%. Most of the catch (3,206 kg) came from the 55-90 m depth range at a rate of 4.7 kg/hr. The 90-125 m range yielded 129 kg and the deeper areas, only 8 kg.

High yields of 815, 1,056 and 1,009 kg with catch rates 4.45, 7.80 and 6.33 kg/hr were obtained in Cruises II, III and VI respectively from 55-90 m. In Cruise I, 322 kg (catch-rate of 12.83 kg/hr) were caught from the same depths. The catch and catch-rates were low in Cruise IV and nil in Cruise V. In the next depth range, during Cruise I the highest catch was only 80 kg, followed by 38 kg in Cruise III and 10 kg in Cruise II. The catch and catch-rates in the 126-360 m depth were negligible.

Stratum 16 gave the highest catch-rate of 17.03 kg/hr in January-February, while stratum 28 gave the next highest 25.18 kg/hr in April-May.

Though the quantity of *P. hasta* caught in pelagic trawl was more, the catch-rates obtained by the two gears were more or less the same. Most of the catch came from strata 28, 25, 16, 22, 13 and 10, all from the depth range 55-90 m during November-May (Fig. 18).

Earlier observations (Jayaraman *et al.*, 1959 ; Rao *et al.*, 1972 ; Deshmukh, 1973 ; Nair, 1974) have shown

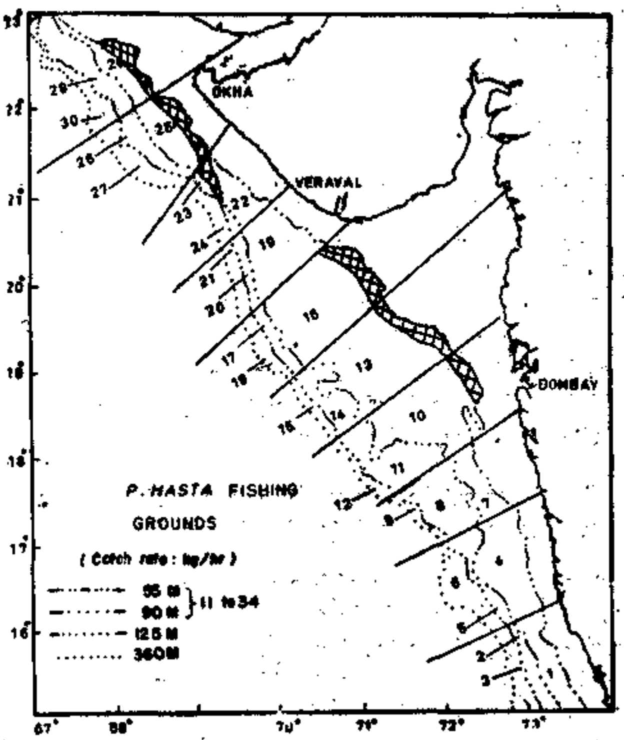


Fig. 18. *P. hasta* fishing grounds.

that this species was abundant in depths ranging from 20 to 60 metres in the Dwarka and Cutch regions. The present survey indicates that the distribution extends to 90 metre depth range, though less abundantly.

Lutianus spp.

Lutianus spp. form one of the important groups of perches commonly available along the north-west coast. During the present survey a total catch of 3,227 kg was landed by bottom and pelagic trawls, forming 0.64% of the total catch. The following six species were recorded :

Lutianus argentimaculatus (Forskål)
Lutianus johni (Bloch)
Lutianus lutianus (Bloch)
Lutianus malabaricus (Schneider)
Lutianus sanguineus (Cuvier)
Lutianus waigiensis (Quoy and Gaimard)

The catch of *Lutianus* spp. was estimated at 999 kg (1.37% of the total) with a catch-rate 2.51 kg/hr during the bottom trawl survey. The depth-wise distribution was 323 kg (1.51 kg/hr) in the 55-90 m range, 559 (4.60 kg/hr) in the 91-125 m and 117 (1.89 kg/hr) in the deeper areas of 126-360 m.

Almost 90% of the catch was taken during January-February and April-May. In Cruise I, 131 kg were taken in the 55-90 m range with a catch rate of 1.34 kg/hr but the highest catch of 239 kg came from the depth range 91-125 m at 4.71 kg/hr, while the 126-360 range gave 117 kg with a catch rate of 3.6 kg/hr. In Cruise III, the catch from 55-90 m was only 99 kg but the rate was 4.60 kg/hr. The highest catch of 315 kg (7.54 kg/hr), however, came from 91-125 m depth, while no catch was recorded from the deepest areas. However, in Cruise V 93 kg (0.98 kg/hr) were taken from 55-90 m range whereas only 5 kg was recorded from the 91-125 m range. The above catch trends would indicate that this resource was in greater abundance in the middle and outer depths during January-February and in the shallower regions during April-May.

The higher catch rates came in April-May, 32.7 kg/hr, from stratum 5, followed by 14.29 kg/hr. from stratum 4.

A catch of 2,228 kg with a catch-rate of 2.08 kg/hr. was obtained by pelagic trawling. It formed 0.52% in the total pelagic trawl catch. Almost all the catch of 2,222 kg, with a catch-rate of 3.27 kg/hr, was obtained from the shallow waters of 55-90 m. The catch returns were good in Cruises II, III, IV and VI, with catches of 646, 628, 437 and 508 kg and catch rates of 3.53, 4.64, 3.03 and 3.19 kg/hr respectively.

Stratum 28 gave the highest catch rate of 16.83 kg/hr in April-May while stratum 13 gave 10.55 kg/hr in June-August.

Good catch rates were obtained consistently from the shallower depths, though the middle depth range gave good catches by bottom trawl in January-February. From the distribution and abundance pattern it would appear that the lutianids are abundant in the southern strata of the surveyed region.

Mene maculata (Bloch)

This species was taken exclusively during pelagic trawling. A total of 655 kg was caught at a rate of 0.61 kg/hr and formed 0.15%.

The yield was good from the shallow waters of 55-90 m, where a catch-rate of 0.92 kg/hr yielded a total catch of 623 kg. In the other two depth-ranges, the catches were poor, accounting for 28 kg in 91-125 m and 4 kg in deeper waters of 126-360 m. The rates in these two depths were 0.13 and 0.02 kg/hr respectively.

The bulk of the catch of 580 kg was obtained in the second cruise from the shallow areas of 55-90 m with a catch-rate of 3.17 kg/hr. In Cruise IV catches of 40, 13 and 4 kg came from shallow, middle and deeper waters respectively where the catch-rate varied from 0.10 to 0.28 kg/hr. In the last cruise, from October to December, the catches were 10 kg from the middle and 3 kg from the shallow depth ranges.

The higher catch-rates of 72.0 kg/hr and 11.65 kg/hr came from strata 7 and 13 respectively during February-April.

Nemipterus japonicus (Bloch)

A catch of 2,970 kg of this species was landed during the year, forming 0.59% in the total catch.

A catch of 2,651 kg with a catch-rate of 6.67 kg/hr was obtained by the bottom trawl, forming 3.63% of the demersal catch. The fish was taken in reasonably good quantities from all the three depth-ranges and the catch-rates varied between 5.21 and 10.77 kg/hr.

It was taken in about equal quantities in Cruises I and III and was less in Cruise V. In Cruise I the distribution of catch in the three depth ranges was 362 kg (3.71 kg/hr), 540 kg (10.65 kg/hr) and 364 kg (11.46 kg/hr) respectively. Thus a gradual increase in the catch-rates with depth was noticed. In Cruise III (April-May) there was a change in distribution pattern. In the 55-90 m range, a catch of 671 kg with 31.2 kg/hr, the highest catch-rate for the species, was taken. In the middle range the catch-rate declined to 7.90 kg/hr and again showed a substantial increase to 16.98 kg/hr in the depth range 126-360 m. In Cruise V the catch-rates were of no significance.

The distribution pattern showed generally larger concentrations of this species in the southern strata, in all the three depth ranges during Cruises I and III survey periods. In strata 1, 7, 4 and 10 of the depth range 55-90 m, the catch rates were 22.13, 10.52, 9.33 and 5.81 kg/hr respectively. It was caught in small quantities from strata 16, 22 and 25 and was absent in 13, 19 and 28. In the next depth range, strata 8 and 26 returned catch rates of 25.22 and 10.00 kg/hr. It was taken in negligible quantities from strata 2, 5 and 11 and was totally absent in 14, 17, 20, 23 and 29. The highest catch rate of 100 kg/hr came from stratum 3 and the next 68.6 kg/hr from stratum 1 during April-

The catch rate for the species during pelagic trawling was 0.30 kg/hr. A total catch of 319 kg was obtained, forming 0.07% in the pelagic trawl catch. The concentration of this fish was in 55-90 m depth range, from which the yield was 302 kg with a catch-rate of 0.44 kg/hr. In the middle and deeper waters the catch was insignificant.

Compared to other cruises, a better catch of 166 kg. with 1.04 kg/hr was landed during Cruise VI in 55-90 m. In the same depth range the catches were 94, 16 and 25 kg with the catch rates of 3.75, 0.09 and 0.18. kg/hr during Cruises I, II and III respectively. In the second cruise, from the deeper waters of 126-360 m, 10 kg were caught with a rate of 0.28 kg/hr.

The returns were comparatively good in strata 19, 13 and 25 where the catches were 107, 120 and 25 kg respectively. The catch rates were 1.55,0.81 and 0.91 kg/hr in the same order.

The bulk of the catch landed by MURENA came from bottom trawling. Good catch rates were obtained from strata 1, 7, 4, 10, 8 and 3 which are all southern strata

Serranids

During the surveys of the north-west coast, MURENA caught 2,716 kg of serranids, constituting 0.54% of the total catch. Six species listed below contributed to the catch.

Epinephelus areolatus (Forskal)
Epinephelus fasciatus (Forskal)
Epinephelus malabaricus (Bloch and Schneider)
Epinephelus diacanthus (Cuvier and Valenciennes)
Promicrops lanceolatus (Bloch)
Serranus grammicus Day

Serranids contributed 2,406 kg with a catch-rate of 6.05 kg/hr and formed 3.29% of the total catch by bottom trawl. The highest yield of 1,616 kg came from the middle depth range, with a catch-rate 13.29 kg/hr; the shoreward areas contributing 413 kg (1.93 kg/hr) and the seaward areas 377 kg (6.10 kg/hr).

Cruises I and III shared the catch of 2,023 kg equally. In the two cruises, the middle depth range gave better returns of 12.09 and 22.77 kg/hr respectively. In Cruise I the depth range 55-90 m gave 151 kg (1.54 kg/hr) and the 126-360 m range 239 kg (7.52 kg/hr). In Cruise III the catches from the shoreward depths were insignificant while the seaward areas gave a return of 3.79 kg/hr. The catch rates in the three depth ranges of Cruise V varied between 1.78 and 5.74 kg/hr.

The highest catch-rate of 88.24 kg/hr came from stratum 9, followed by 69.4 kg/hr from stratum 8 during April-May.

Only 310 kg forming 0.07% in the total catch were caught with a catch-rate of 0.29 kg/hr during the pelagic trawling. They were taken in almost equal quantities from the shallow waters of 55-90 m and deeper waters of 126-360 m. In the former the catch was 192 kg (0.28 kg/hr) and in the latter 118 kg (0.66 kg/hr).

During Cruises I and II, from January to April, the fish was available in good abundance in deeper waters (126-360 m). A higher catch-rate (2.57 kg/hr) was noted in the second cruise while in the first cruise, catch-rate was 1.09 kg/hr. In Cruise VI during October-December, the fish was available only in the shallow waters 55-90 m. The return from this depth range was 186 kg, at 1.17 kg/hr.

Strata-wise the highest catch rates came from stratum 18 with 43.5 kg/hr in February-April and stratum 19 with 9.74 kg/hr in November-December.

Other perches and perch-like fishes

A total catch of 6,814 kg was obtained of other perches and perch-like fishes. This component formed 1.35% of the total. The species that were caught under this category were

Pomadasys maculatus (Bloch)
Ephippus orbis (Bloch)
Argyrops spinifer (Forskal)
Drepane punctata (Linnaeus)
Therapon theraps (Cuvier)
Therapon jarbua (Forskal)
Priacanthus hamrur (Forskal)
Priacanthus cruentatus (Lacépède)
Priacanthus tayenus Richardson
Upeneus sulphureus Cuvier
Upeneus vittatus (Forskal)
Spilotichthys pictus (Thunberg)
Uranoscopus guttatus (Cuvier & Valenciennes)
Sphyraena acutipinnis Day
Sphyraena jello Cuvier
Sphyraena langsar Bleeker
Sphyraena obtusata Cuvier
Apogon hyalosoma Day
Apogon aureus (Lacépède)
Apogon quadrifasciatus Cuvier
Lactarius lactarius (Bloch and Schneider)
Leiognathus bindus (Valenciennes)
Gazza minuta (Bloch)

Acanthopagrus berda (Forskal)
Apogon taeniatus Cuvier
Secutor insidiator (Bloch)
Nemipterus bleekeri Day
Nemipterus furcosus (Valenciennes)
Acanthocepola limbata (Curier)
Acropoma japonicum Gunther
Howella sherborni (Norman)
Coryphaena hippurus Linnaeus
Emmelichthys nitidus Richardson
Pristipomoides typus Bleeker
Caesio caerulaureus Lacépède.

The catch of 2,610 kg by bottom trawl formed 3.57% of the total. The average catch-rate worked out to 6.57 kg/hr. The highest catch of 2,193 kg came from the 55-90 m range, with a catch-rate of 10.24 kg/hr and the rates declined to 2.71 and 1.41 kg/hr in the deeper ranges.

The highest catch-rate 90.34 kg/hr came from stratum 25 in September-October followed by 69.47 kg/hr in stratum 28 in January-February.

Fishing operations with pelagic trawl yielded, 4,204 kg giving a catch-rate of 3.92 kg/hr and accounted for 0.98% in the catch. Comparatively higher catch and catch-rates were obtained in the shallow waters and a declining trend with increasing depth was noticed. In 55-90 m depth range the catch was 3,482 kg (5.13 kg/hr) which came down to 493 kg (2.30 kg/hr) in 91-125 m. In the third depth range of 126-360 m, 229 kg with 1.29 kg/hr were caught. The highest catch-rate of 9.13 kg was in Cruise III during April-May, followed by 8.79 kg/hr in Cruise IV from the depth range of 55-90 m. In Cruise I a catch-rate of 7.00 kg/hr was got in the deeper waters of 126-360 m, though the catch was only 161 kg.

Stratum 17 gave the highest rate of 220.36 kg/hr in February-April and the next stratum 28 gave 65.6 kg/hr in April-May.

The fishes included under this category in general appear to be more abundant in the depth range 55-90 m. In Cruises I and V, during January-February and September-October, they were obtained in greater quantities with better catch-rates in bottom trawling, while in Cruise III (April-May) their catch-rates were better in pelagic trawling. Good catch rates were recorded in October-December also by pelagic trawling. The principal catch consisted of (i) *Leiognathus bindus*, (ii) *Lactarius lactarius* and (iii) *Upeneus sulphureus*. The better grounds for this group are shown in Fig. 19.

Protonibea diacanthus (Lacépède)

This is an economically important fish popularly known as 'Ghol'. A total catch 8,189 kg of this species, forming 1.63%, was obtained by bottom as well as pelagic trawling. The species, growing to over a metre in length, fetches a good price in the Bombay market.

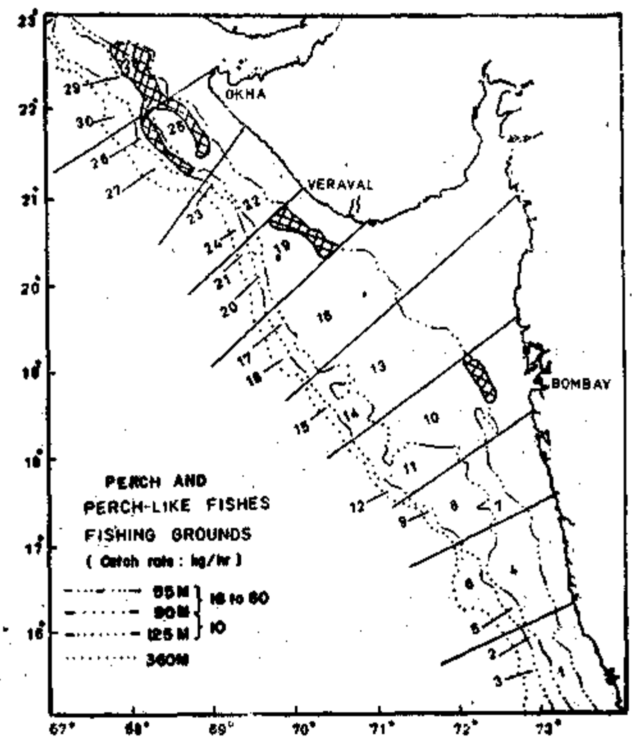


Fig. 19. Perch fishing grounds.

During bottom trawling, 1,294 kg of this species was caught at a catch rate of 3.25 kg/hr and it formed 1.77%. Of this 1,213 kg came from the depth range 55-90 m. Only 81 kg was taken from 126-360 m, and no catch from 91-125 m. In Cruise I the highest catch of 1,164 kg, at 11.92 kg/hr came from the shallow areas of 55-90 m. In Cruise III the catch was insignificant. Cruise V landed 108 kg with catch rates of 0.46 in 55-90 m and 5.17 kg/hr in 126-360 m.

Stratum 13 with a rate of 39.7 kg/hr in January-February and stratum 27 with a rate of 20.98 kg/hr during September-October provided the highest yield.

A total of 6,895 kg of this species was caught during pelagic trawl operations. It formed 1.60% of the catch, with a catch-rate 6.44 kg/hr. Its high concentration was recorded in the depth range 55-90 m where the catch was 6,892 kg and yield rate was 10.15 kg/hr. A small quantity of 3 kg came from 91-125 m depth range. No atch was obtained beyond 125 m depth. Cruises

III and VI landed high catches of 2,323 and 2,997 kg at 17.17 and 18.81 kg/hr of trawling, respectively. In the Cruises I, II and IV, the catches were 15, 1,111and 446 kg respectively with catch rates from 0.60 to 6.07 kg/hr.

Stratum 16 with 77.25 kg/hr in April-May and stratum 13 with 66.23 kg/hr during November-December gave the best catch rate figures for this species.

Earlier studies by Jayaraman *et al.* (1959), Rao (1965), Rao *et al.* (1972) and Nair (1974) have shown concentration of 'Ghol' upto the 30 m depth contour. The present results indicate an extended distribution of the species upto 90 m in strata 13, 16 and 19.

The better fishing grounds of *P. diacanthus* are shown in Fig. 20.

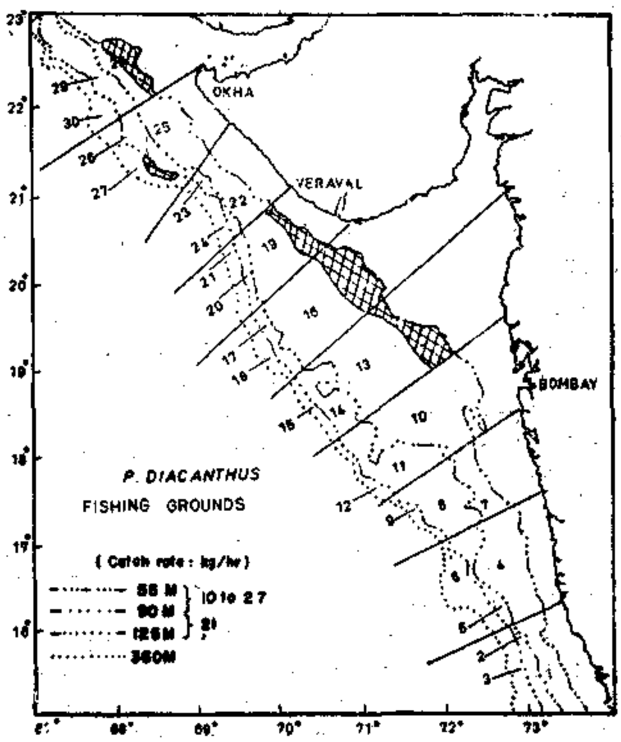


Fig. 20. *P. diacanthus* fishing grounds.

Otolithoides brunneus (Day)

A total of 164 kg of *O. brunneus*, popularly known as 'Koth', was caught and this formed 0.03% of the catch. This is one of the sciaenid species of economic importance known to grow to a metre and more in length.

Bottom trawling yielded only 149 kg, at 0.37 kg/hr, which was just 0.20% of the total catch. Of this 129 kg came from the 55-90 m with a catch rate of 0.60 kg/hr during January-February.

The highest catch rate of 5.1 kg/hr came from strata 13 and 18 during January-February.

Only 15 kg of the fish were caught during pelagic trawling, from 55-90 m, at a catch rate of 0.02 kg/hr. They were taken from strata 13, 7 and 16, where the catch rates varied from 0.03 to 0.15 kg/hr.

Earlier reports on the distribution of 'Koth' by Jayaraman *et al.* (1959), Rao (1969) and Nair (1974), indicate that good catch rates of *O. brunneus* in bottom trawling off Dwarka were obtained mainly from the depth range 30-60 metres. The survey results of MURENA, beyond the 55 m line, only confirm the earlier results.

Lesser Sciaenids

Since the inception of trawling in India by mechanised boats, this resource, popularly known as 'Dhoma', has been contributing to the extent of 40-50% of the trawl catch. MURENA during its surveys landed a sizeable quantity of lesser sciaenids, an estimated 11,922 kg by bottom and pelagic trawling, which formed 2.37% of the catch. Six species of lesser sciaenids caught during the survey are listed below :

Atrobucca nibe (Jordan and Thompson)
Johnius dussumieri (Valenciennes)
Johnius osseus (Day)
Johnieops sina (Cuvier)
Otolithus argenteus Cuvier
Otolithus ruber (Schneider)

Lesser sciaenids formed one of the two major components in the bottom trawl catch forming as much as 10.51%. During trawling operations, a total of 7.680 kg was caught with a catch rate of 19.32 kg/hr. The highest catch and catch rate of 7,349 kg and 34.32 kg/hr respectively were recorded in the depth range of 55-90 m. In the subsequent depth ranges the catches as well as the catch rates decreased.

During the first cruise, the grounds in the 55-90 m range were highly productive for lesser sciaenids accounting for the major catch, with a catch rate of 33.34 kg/hr. Catches were almost nil in the second depth range. In the deeper waters (126-360 m) the catch rate was 6.23 kg/hr. In Cruise III, sciaenids were insignificant. During Cruise V the landings were better in the shallow waters of 55-90 m with a catch rate of 42.97 kg/hr, higher than that of the first coverage. The catch and catch rate were lower in deeper waters.

During the period of bottom trawling, stratum 28 gave the highest catch rate of 385.26 kg/hr in January-February, followed by 348.48 kg/hr in stratum 13 during September-October.

The total catch of 'Dhoma' by pelagic trawl was estimated at 4,242 kg with a catch rate of 3.96 kg/hr and formed 0.98 % of the catch. Almost all the catch was obtained from the 55-90 m depth range with a catch rate of 6.21 kg/hr. Small catches of 2 and 20 kg were landed from the remaining two depth ranges.

In the depth range 55-90 m the catch and catch rates obtained were 712 kg (28.37 kg/hr) ; 395 kg (2.16 kg/hr) ; 1,157 kg (8.55 kg/hr) ; 583 kg (3.70 kg/hr) and 1,423 kg (8.93 kg/hr) during Cruises I, II, III, IV and VI respectively. No catch was recorded in the other two depth ranges.

The period January-February gave the highest catch rates for this group, 52.13 kg/hr from stratum 19 and 35.94 kg/hr from stratum 16.

Nearly 65 % of the catch of 'dhoma' came from bottom trawling and the rest from pelagic trawling. Good catch rates were obtained by bottom trawl in strata 28, 13, 16, 25 and 19 from November to March (Fig. 21).

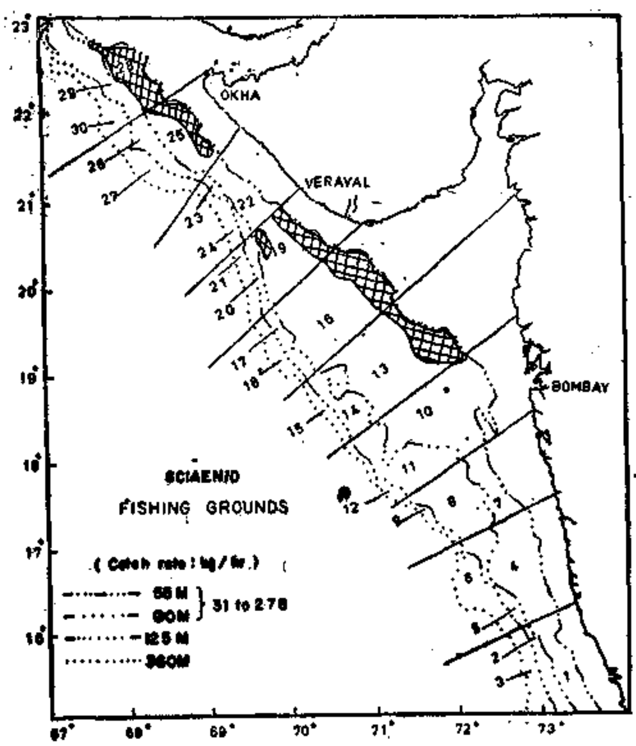


Fig. 21. Sciaenid fishing grounds.

Polynemids

Five species of polynemids were recorded in the landings by bottom and pelagic trawl operations. Of these, two species *E. tetradactylum* and *P. indicus* are of economic importance but their catch was comparatively very poor. The following polynemids contributed 2,341 kg and formed 0.46 % in the total catch,

Eleutheronema tetradactylum (Shaw)
Polynemus indicus Shaw
Polynemus heptadactylus Cuvier
Polynemus plebeius Broussonet
Polynemus sextarius Schneider

In bottom trawling, polynemids accounted for a total catch of 1,450 kg with a catch rate of 3.65 kg/hr and formed 1.98 %. *E. tetradactylum* and *P. indicus* accounted for 40 and 99 kg and the bulk of the catch of 1,304 kg was of *P. heptadactylus*. Of the demersal catches, 1,427 kg were taken from the 55-90 m depth with a catch rate of 6.66 kg/hr. In the remaining two depth ranges, only 8 kg and 15 kg were recorded with catch rates of 0.07 and 0.24 kg/hr respectively.

In Cruise I during January-February the entire catch of 1,220 kg came from the depth range 55-90 m with a catch rate of 12.50 kg/hr. In Cruise III in April-May the catch was insignificant, only 38 kg, more or less evenly distributed in the three depth ranges. In September-October, 192 kg were taken with a catch rate of 2.02 kg/hr from the 55-90 m range.

Stratum 16 giving 45.83 kg/hr and stratum 28 giving 22.11 kg/hr during January-February yielded the highest catch rates.

Polynemids were scarce in pelagic trawling in spite of a higher fishing effort. Only 891 kg were landed at a catch rate of 0.83 kg/hr and they formed a meagre 0.21 % of the catch. The entire catch was obtained from 55-90 m depth range with a low catch rate of 1.31 kg/hr.

The bulk of the catch amounting to 424, 308 and 115 kg with catch rates 2.32, 2.28 and 0.72 kg/hr were obtained during Cruises II, III and VI respectively. Cruise I and IV recorded low yields, whereas the fish were totally absent in Cruise V. The highest catch rate of 11.7 kg/hr came from stratum 19 in February-April followed by 6.67 kg/hr from stratum 16 in April-May.

In trawl fishing conducted during earlier years, *P. indicus* accounted for 4-5 % of the catch when the fishing was more or less restricted to shallower areas of less than 30 fathoms. According to Jayaraman *et al.* (1959) and Nair (1974) this species was taken in quantities on the landward side of the 20-fathom line. Kagwade (1970) concluded that the zone of 31-70 m depth was rich in *P. heptadactylus*. The present observations confirm their conclusions by the poor representation of *P. indicus* and the concentration of *P. heptadactylus* in the 55-90 m depth range.

Trichiurus spp.

Two species, *Trichiurus lepturus* Linnaeus and *T. savala* (Cuvier), came in the catches by bottom as well as pelagic trawling, the former being more common. The ribbon fishes are not considered quality fish and were mostly converted into fishmeal on board the vessel. In view of the large quantity landed, the group has come into prominance in the present survey. During the six cruises, the total catch was estimated at 1,42,256 kg, next in importance only to *Megalaspis cordyla*, and accounted for 28.23%.

The ribbon fishes formed 34% of the catch, the biggest component contributed by any single group in bottom trawling. A total of 24,872 kg was landed with an overall catch rate of 62.56 kg/hr. They were landed in large quantitites (10,210 and 10,415 kg) from the depth ranges 55-90 and 91-125metres with catch rates 47.68 and 85.66 kg/hr respectively. In the last depth range, 4,247 kg were recorded at a catch rate of 68.71 kg/hr.

Cruise-wise the highest yield of 12,118 kg was taken in Cruise III, followed by 7,549 and 5,025 kg in Cruises V and I respectively. In Cruises I and V large quantities of 3,711 and 6,449 kg were landed from the depth range 55-90 m with catch rates of 38.03 and 67.83 kg/hr respectively. In the second depth range more or less equal quantities were landed with catch rates of 21.45 and 37.72 kg/hr respectively. In the third depth range of 126-360 m, the catch rate in Cruise I was 12.81 kg/hr and nil in Cruise V. The pattern of depth-wise distribution during Cruise III in April-May was quite different. The highest yield of 8,228 kg with a catch rate of 197.03 kg/hr was obtained from the 91-125 m range, followed by 3,840 kg with a rate of 217.32 kg/hr from the 126-360 m range and poor catches from the shallow areas of 55-90 m.

The strata-wise yield rates were also of interest. In strata 16 and 10 in the depth range 55-90 m the yields were 7,422 kg and 1,579 kg with catch rates 248 and 50 kg/hr respectively. The highest catch rate of 783.29 kg/hr came from stratum 20, followed by the next highest 637.9 kg/hr from stratum 24 during April-May.

The catch by pelagic trawling was estimated at 1,17,384 kg and formed 27.25%, with a catch rate 109.57 kg/hr. The bulk of the catch amounting to 1,00,219 kg came from 55-90 m range with a catch rate of 147.53 kg/hr. The contribution by the other two depth ranges were 7,644 and 9,521 kg, with catch rates 35.67 and 53.56 kg/hr.

In the 55-90 m depth range, the catches and catch rates were 42,590 kg (314.71 kg/hr), 30,723 kg (167.89 kg/hr) and 23,413 kg (146.94 kg/hr) during Cruises III, II and VI. In Cruises I and IV the catch rates were 37.61 and 17.38 kg/hr respectively. In the next depth range, the catch rates were 161.67, 76.89, 30.38 and 27.24 kg/hr in Cruises I, III, VI and II respectively. A good catch rate of 226.97 kg/hr was obtained in Cruise II from the depth range 126-360 m. The catch and catch rates in other crusises were comparatively lower.

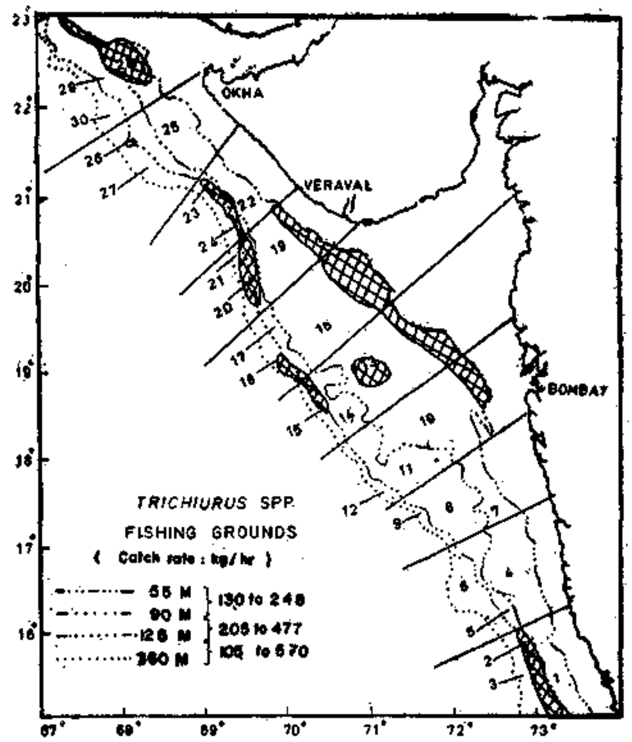


Fig. 22. *Trichiurus* fishing grounds.

In the 55-90 m range strata 13, 28, 16 and 19 gave a catch rate of 231.46, 205.78, 212.69 and 137.78 kg/hr respectively. In the remaining strata, it varied between 16.01 and 50.12 kg/hr. Stratum 13 proved the most productive with a record catch of 34,351 kg. Stratum 23 in the 91-125 m range gave the highest rate of 147.25 kg/hr. The catch rates in strata 20, 29 and 5 were 51.43, 36.65 and 19.96 kg/hr respectively. In the deeper range of 126-360 m stratum 21 gave a good catch rate of 569.94 kg/hr, followed by stratum 18 with 105.10 kg/hr, Strata 27 and 9 gave returns of 29.30 and 10.93 kg/hr respectively. In the remaining strata of these two depth ranges, the catch rates were less than 10 kg/hr.

The better yields came from stratum 21 with 1345.75 kg/hr during Feb.-April, followed by stratum 23 giving

790 kg/hr during Jan.-Feb. In contrast to the observations made by Prabhu and Dhawan (1974), the pret sent results indicate that this group may be abundant in depths ranging from 55 to 90 m also. Northern areas appear to be more productive compared to the other- in the surveyed areas (Fig. 22).

Megalaspis cordyla (Linnaeus)

The discovery of large resources of the horse-mackerel, *M. cordyla,* in the northern strata was a major contribution of MURENA during the present survey; since the existence of such large resources were unknown so far. The estimated catch was 1,72,016 kg and formed 34.14% of the total catch.

About 2.86% of the landings by bottom trawl, the catch of horse mackerel was estimated at 2,092 kg, with a catch rate of 5.26 kg/hr. The catch rates were in the increasing order with increasing depth indicating greater accumulations on the seaward side of the shelf.

In Cruise I, 1,000 kg were taken from 55-90 m range with a catch rate of 10.24 kg/hr. The catch was insignificant in the next depth range and 160 kg were recorded in the 126-360 m range with a rate of 5.03 kg/hr. In Cruise III 55-90 m range proved very poor. In the middle depth-range 620 kg were recorded at a rate of 14.85 kg/hr and 300 kg in the 126-360 m range with a rate of 16.98 kg/hr. The species was not caught during Cruise V.

The higher catch rates obtained for this species were: 177.14 kg/hr from stratum 23 and 56.29 kg/hr from stratum 24 during April-May.

The bulk of the horse-mackerel catch was got by pelagic trawling. A total quantity of 1,69,924 kg was landed with a catch rate 158.61 kg/hr and this formed 39.45% of the pelagic catch. The depth range 55-90 m yielded 34,830 kg for a fishing effort of 679.31 hr at the rate of 51.27 kg/hr. The next depth range 91-125 m gave a substantial yield of 1,01,597 kg with a high catch rate of 474.15 kg/hr. The third depth range yielded almost the same quantity as the first range but gave a higher catch rate, 188.44 kg/hr.

In Cruise I, the 91-125 m depth range gave a higher catch rate of 135.33 kg/hr than the other two depth ranges. During Cruise II greater effort was spent in locating and fishing this valuable resource. The total catches and catch rates in the three depth ranges were in the order of 10,216, 98,430 and 33,440 kg with 55.83, 1,421.58 and 944.37 kg/hr respectively for the second ruise in February-April, whereas in Cruise III, the bulk of the catch of 16,710 kg came from the depth range 55-90 m with a catch rate of 123.48 kg/hr. The catch and catch rates were low in Cruise IV and very poor in Cruise V. Some improvement was again noticed during Cruise VI, when 6,320 kg were taken with a catch rate of 39.66 kg/hr in the 55-90 m range. The catch rates in the other two depth-ranges were 19.90 and 0.87 kg/hr respectively.

In the 55-90 m range strata 10, 19 and 28 yielded catch rates of 116.36, 105.30 and 101.65 kg/hr respectively. Stratum 29 in the depth range 91-125 m proved the richest fishing ground during Cruise II for *M. cordyla* where the catch and catch rate were as high as 98,857 kg and 1,251.51 kg/hr respectively. Stratum 23 gave a catch rate of 108.85 kg/hr. Strata 30 and 21 gave a yield of 31,037 and 2,350 kg with yield rates of 736.70 and 205.96 kg/hr. In the rest of the strata in all the three depths, the catches were either nil or very poor.

In bottom trawling, strata 16, 23 and 24 yielded good catch rates, whereas in pelagic trawling strata 10, 19, 21, 23, 28, 29 and 30 proved productive (Fig. 23). The highest catch rates of 2,563.68 kg/hr were obtained from strata 29 and 2,465 kg/hr from 30 during February-April by pelagic trawling. Catches with very high catch rates were obtained during March-April which could be considered as the best season for fishing. It is primarily a new resource highlighted by the work of

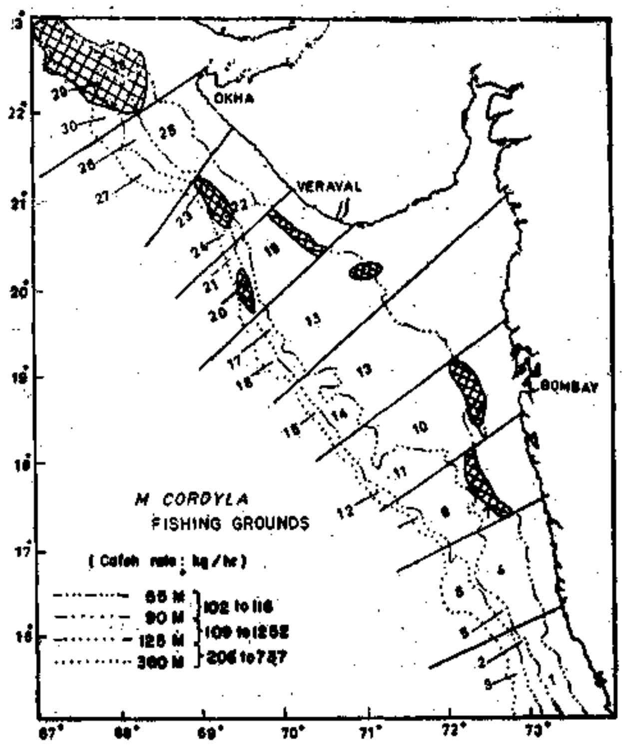


Fig. 23. Horse-mackerel fishing grounds.

MURENA, and has to be exploited cautiously as it is not known whether we can obtain a sustained yield with increasing fishing pressure.

Carangoides chrysophrys (Cuvier)

During the survey, 562 kg of this species were landed, forming 0.11% of the total catch. Amongst the carangoids recorded this is the only species which grows to a big size.

During bottom trawling, 326 kg of this species were caught, which formed 0.45% in the total catch, the catch rate being 0.82 kg/hr.

A slightly better catch 170 kg was obtained in the middle depth range of 91-125 m where the catch rate was 1.40 kg/hr. A catch of 114 kg at 0.53 kg/hr., came from 55-90 m. In the deeper waters (126-360 m) only 42 kg. were caught with the catch rate 0.68 kg/hr. This species was caught by bottom trawl only in Cruise I.

Strata-wise highest figures were :—10.84 kg/hr from stratum 5, and 9.1 kg/hr from stratum 2 during January-February.

By the pelagic trawl 236 kg were landed. The percentage in the total catch was 0.05 and the catch rate was 0.22 kg/hr. The middle depth range 91-125 m yielded a better catch of 188 kg with a rate of 0.88 kg/hr and in the shallow and deeper ranges the catch was 28 kg and 20 kg respectively.

Almost all the catch came during Cruises I and II from January to April. A negligible quantity was caught in Cruise IV. In the first cruise the catch rate gradually declined from 0.64 to 0.61 to 0.30 kg/hr from shallow to deeper ranges. In Cruise II the middle depth range of 91-125 m yielded a good catch of 178 kg with a catch rate of 2.57 kg/hr. In the other two depth ranges the catch as well as the rate was poor.

February-April gave the highest rates of 41 kg/hr from stratum 2, and 12.5 kg/hr from stratum 14.

From the results of bottom and pelagic trawling, it can be inferred that the species is available during January to April and that the southern strata 1, 2, 5 and 6 in different depth ranges yield good catch rates.

Other Carangids

A total catch of 9,216 kg of other carangids was made by MURENA during January to December, 1977. This catch constituted 1.83 percent of the total catch. The following species contributed to the catch :

Alectis indicus (Rüppell)
f*Atropus atropus* (Bloch and Schneider)
Alepes djedaba (Forskål)
Carangoides malabaricus (Bloch and Schneider)
Caranx carangus (Bloch)
Casangoides ferdau (Forskål)
Carangoides oblongus (Cuvier)
Caranx melampygus Cuvier
Caranx sansun (Forskål)
Caranx sexfasciatus Quoy and Gaimard
Decapterus russelli Bleeker
Selar crumenophthalmus (Bloch)
Selar boops (Cuvier)
Alepes mate (Cuvier)
Elagatis bipinnulata (Quoy and Gaimard)
Scomberoides tala (Cuvier)
Scomberoides lysan (Forskål)
Scomberoides tol (Cuvier)
Trachinotus blochi (Lacépéde)
Seriolina nigrofasciata (Rüppell)
Rachycentron canadus (Linnaeus)
Trachurus trachurus Linnaeus

The total of 2,420 kg, with a catch rate of 6.09 kg/hr formed 3.31% of the demersal catch. More than half the catch (1,637 kg) was obtained from 55- 90m depths at a catch rate of 7.64 kg/hr, followed by 712 kg with a catch rate 5.86 kg/hr from 91-125 m area. The catch and rate from the deeper range were negligible.

Almost two-thirds of the catch was recorded during Cruise I (January-February), the 55-90 m range yielding the highest catch of 1,247 kg at a rate of 12.78 kg/hr. The catch and catch rates in the next depth range were 497 kg and 9.80 kg/hr, while they were insignificant in the deeper range. In Cruise III the catch rates in the 55-90 m range were higher at 13.02 kg/hr though the catch was low. The catch rates in the other two deeper areas were 4.43 and 3.74 kg/hr respectively. Small quantities of this group were taken in the 55-90 m range with low catch rates in Cruise V.

Stratum 25 recorded the highest catch rate of 86.13 kg/hr during January-February and stratum 4 yielded 75.14 kg/hr during April-May.

The carangids caught by the pelagic trawl made up a total of 6,796 kg at 6.34 kg/hr and formed 1.58% of the total catch. The bulk of the catch was landed from shallow waters (6.539 kg at 9.63 kg/hr). In the middle depth range 91-125 m the catch was 65 kg(0.30 kg/hr) and in the deeper waters 192 kg (1.08 kg/hr).

A high catch rate of 20.03 kg/hr was obtained during Cruise IV from June to August in the depth range of 55-90 m where the catch was 2,889 kg. A catch of 2,096 kg at 13.15 kg/hr was obtained during October to December from shallow waters. In Cruise V the catch rate was 9.18 kg/hr for a catch of 290 kg from the same depth range. A good catch of 1,006 kg was landed at 5.50 kg/hr during Cruise II. In the other depth ranges, the catch and catch rates were low.

Stratum 10 gave the highest rate of 141.79 kg/hr during June-August while stratum 19 gave 44.12 kg/hr in November-December.

Nearly 66% of the other carangids catch was obtained by pelagic trawling. The concentration of fishes during the survey was better in the depth range of 55-90 m than in the others. Of the 22 species listed for the group, the major part of the catch was constituted by *C. malabaricus*, *A. mate*, *T. trachurus*, *S. lysan* and *S. tol.* Areas of abundance of this group are shown in Fig. 24.

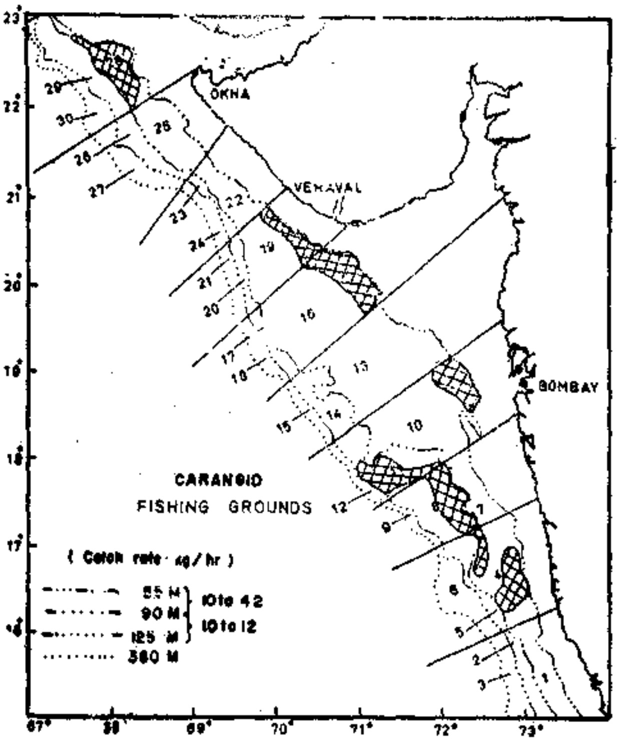


Fig. 24. Carangid fishing grounds.

Pampus argenteus (Euphrasen)

This is one of the pomfrets considered a prime table fish and so is of considerable economic value. The silver pomfret, known as 'Saranga' in local dialect, was caught by bottom and pelagic trawl and the total catch estimated at 9.443 kg and formed 1.87% of the catch.

A total catch of 1,219 kg, forming 1.67% of total catch, was landed by bottom trawl with a yield rate fo 3.07 kg/hr. Its distribution was restricted to shallow waters of 55-90 m with a catch rate of 5.69 kg/hr. The returns were 789, 113 and 317 kg during Cruises I, III and V respectively.

Stratum 16 with a rate of 26.5 kg/hr in January-February and 25.17 kg/hr during September-October gave the highest catch-rate figures for this species.

The total catch of this species by pelagic trawl was estimated at 8,224 kg with a catch rate of 7.68 kg/hr and it accounted for 1.91%. The catch and catch rates showed a declining trend with increasing depth. The depth range 55-90 m contributed to the major part of the catch amounting to 6,658 kg for a total effort of 679.31 hrs at a catch rate of 9.80 kg/hr. In the next depth range the catch and catch rates declined to 1,406 kg and 6.56 kg/hr respectively. In the deeper range only 160 kg with a rate of 0.90 kg/hr were recorded.

During Cruise I in January-February, the catch and catch rates were low, 334 kg and 13.31 kg/hr respectively, in the 55-90 m range. A good catch and catch rate of 1,380 kg and 84.51 kg/hr were obtained in the next depth range followed by poor catch rates in the deeper range. In the subsequent Cruises II, III, IV and VI, almost all the catch came from the 55-90 m depths with catch rates 9.11, 8.26, 6.11 and 16.68 kg/hr. No landings were recorded from Cruise V.

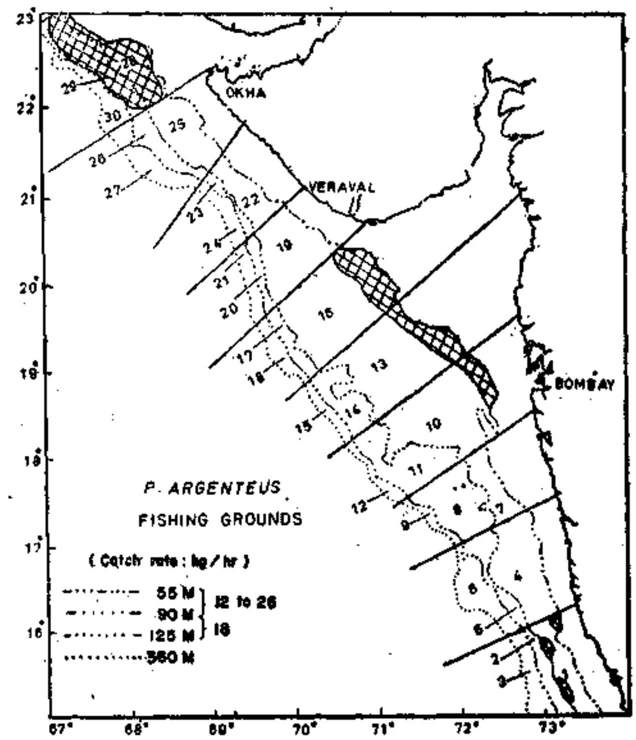


Fig. 25. Silver-pomfret fishing grounds.

PLATE I A. Fishing deck of M. T. *Murena*; B. Net paid out; C. Catch being hauled in; D. Unsorted catch on the deck.

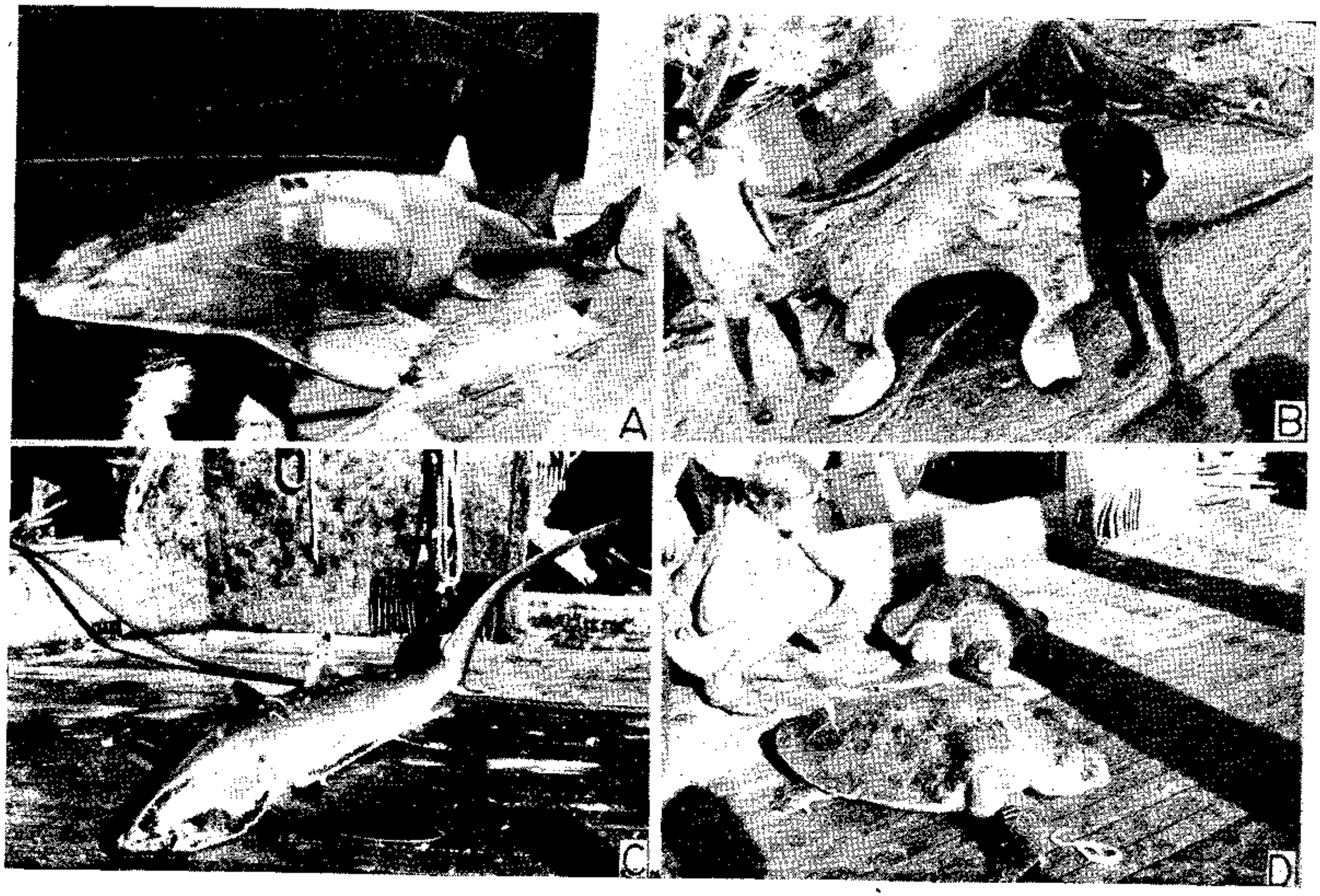


PLATE II A. A large sized sawfish (saw removed); B. A huge Devil ray; C. A giant Fox Shark D. Marine turtles.

PLATE III A. Hauling of a huge trawl catch; B & C. A good catch emptied from the trawl net on the deck and D. Asorted larger Carangids.

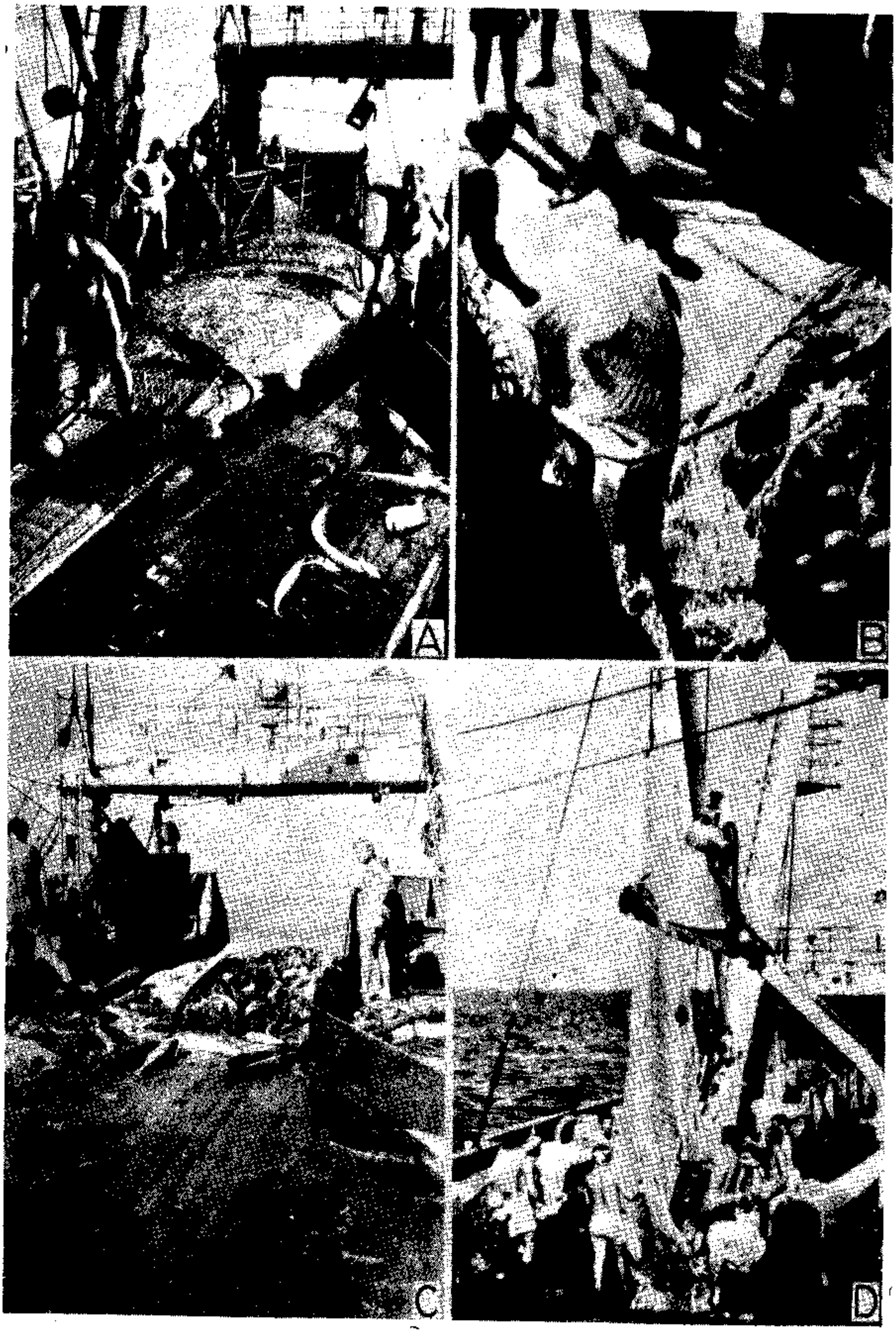


PLATE IV Fishing activities on board M. T. *Murena*.

Strata-wise, the highest rate of 103.53 kg/hr came from stratum 29 during January-February while the next highest 51.66 kg/hr came from stratum 13 during November-December.

The concentration of the resource appears to be restricted to the 55-90 m range, as poor or no catches were recorded from the deeper waters. The peak season appears to be restricted to 4-5 months from November to March-April. Good catch rates were recorded from strata 16 and 28 in bottom trawling and 13, 28, 16 and 29 in pelagic trawling (Fig. 25). A declining trend in catch rates with increasing depth was also observed. The strata in the area north of 19°N were generally more productive than the others.

Apolectus niger (Bloch)

This species, popularly known as black pomfret and locally called 'Halwa' at Bombay, is abundant in the north-west coast of India and fished mostly by the same type of gear as used for the other species along Maharashtra and Gujarat coasts. A total quantity of 20986 kg forming 4.17% was landed by MURENA during its surveys by bottom and pelagic trawling.

Only a small quantity of 582 kg was taken by the bottom hauls at a catch rate of 1.46 kg/hr and this formed only 0.80% of the bottom trawl catch. Almost all this catch was from the depth 55-90 m, only 33 kg coming from 91-125 m. In Cruise I,273 kg came from 55-90 m with a catch rate 2.79 kg/hr. Again the same depths gave 221 kg and 55 kg with catch rates 10.28 and 0.58 kg/hr in Cruises III and V respectively. The catch rates in the next depth range were low and there was no catch from the next deeper range.

Stratum 10 with 53.4 kg/hr during April-May and stratum 25 with 14.67 kg/hr in January-February gave the highest catch rate figures for this species by bottom trawl.

Pelagic trawling yielded better results with an estimated catch of 20,404 kg. It formed 4.74% of the pelagic landings and was taken at a catch rate of 19.05 kg/hr. Almost the entire catch of 19,907 kg was from 55-90 m with a catch rate of 29.30 kg/hr. This was followed by 463 kg from 91-125 m and only 34 kg from the deeper range 126-360 m. The catch rates showed a declining trend with increasing depth.

Cruise I recorded a small catch of 473 kg from all the three depth ranges with the highest catch rate of 16.84 kg/hr from 91-125 m. Cruise II gave the highest yield of 16,324 kg with a catch rate 89.20 kg/hr during February-April from the 55-90 m depth. The landings during Cruises III and IV were poor, with insignificant catch rates, followed by no catch in Cruise V. In Cruise VI during October-December a catch of 3,047 kg, at the rate of 19.12 kg/hr was landed from the depth range of 55-90 m. A small catch of 159 kg was also recorded from the 91-125 m.

The highest catch rate of 217 kg/hr came from stratum 28 in February-April and 57.76 kg/hr from stratum 28 during November-December.

The pelagic trawl proved to be the more effective gear of the two in terms of catch and catch rates for this species as well. The period February-April proved more productive. Strata 28, 7, 29 and 25 yielded good catch rates. The rich grounds of this species are shown in Fig. 26.

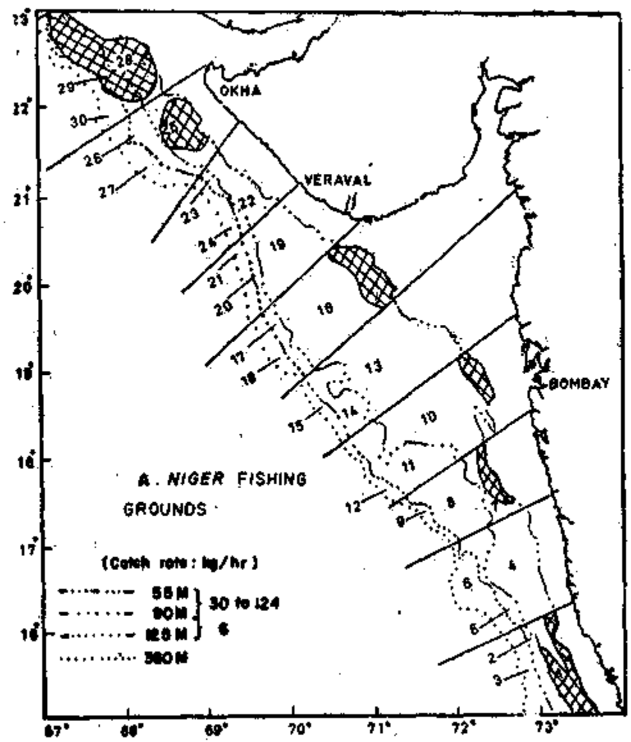


Fig. 26. Black-pomfret fishing grounds.

Scombroids

A catch of 4,744 kg of scombroids was landed from January to December and accounted for 0.94% in the total catch. The following five species constituted the catch.

Rastrelliger kanagurta (Cuvier)
Scomberomorus guttatus (Bloch and Schneider)
Scomberomorus lineolatus (Cuvier)
Scomberomorus commerson (Lacépède)
Acanthocybium solandri (Cuvier)

The scombroid catch by the bottom trawl amounted to 307 kg, forming 0.42% of the catch. The contribution of the Indian mackerel *Rastrelliger kanagurta* amounted to 194 kg, the rest of the catch mainly comprising *Scomberomorus guttatus* and *Scomberomorus commerson*. The other two species represented, *Acanthocybium solandri* and *Scomberomorus lineolatus* were caught as stray specimens.

The depth-wise distribution of the catch was in the order of 252, 53 and 2 kg from the depth zones 55-90, 91-125 and 126-360 m respectively. Most of the catch (66%) was taken in Cruise I during January-February. Of this 195 kg came from 55-90 m range at the catch rate of 1.99 kg/hr. The catch and catch rate in the other two ranges were meagre. In Cruise III during April-May, 52 kg from 55-90 m range and 36 kg from 91-125 m, with catch rates 2.42 and 0.86 kg/hr, were obtained. Only 5 kg of mackerel were taken in Cruise V from 55-90 m area. The mackerel catch came mainly from strata 2, 4, and 10.

With a catch rate of 4.14 kg/hr, a catch of 4,437 kg was landed by pelagic trawl which formed 1.03% of the catch. The catch was mainly supported by *Scomberomorus guttatus* and *Scomberomorus commerson*. The mackerel catch of 93 kg was only of academic interest. A major part 4,275 kg of the catch was obtained from the depth range 55-90 m at a rate of 6.29 kg/hr. In the next two depth ranges, 91-125 and 126-360 m, the catches were 149 and 13kg with catch rates 0.70 and 0.07 kg/hr respectively.

During the Cruises I and VI, the catch rates were high (13.94 kg/hr and 12.06 kg/hr) from 55-90 m. In Cruise II from the same depth range the catch was 1,439 kg but the catch rate was low (7.86 kg/hr). In the first cruise the catch rate was 3.61 kg/hr, from 91-125 cm. In the subsequent cruises it was even lower from the same depth range.

Strata-wise, highest catch rate figures were 26.15 kg/hr from stratum 16 during January-February, and 21.64 kg/hr from stratum 13 during November-December.

The catch and catch rate of scombroids by pelagic trawl was better than by bottom trawl. The inshore depth range was the most productive area compared to other depth ranges. Landings were particularly good during February-April and October-December. *Rastrelliger kanagurta* in small quantities was caught in Cruises II, IV and VI and from strata 16, 25, 10, 13 and 7.

Tunnies

During the present survey an estimated 1,308 kg. of this group was landed forming 0.26% in the total catch. The species which constituted the catch were :

Auxis thazard (Lacépède)
Auxis rochei (Risso)
Euthynnus affinis (Cantor)
Thunnus albacores (Bonnaterre)
Sarda orientalis (Temminck and Schlegel)
Katsuwonus pelamis (Linnaeus)

During bottom trawling only 12 kg of *K. pelamis* were caught, of which 11 kg came from the 126-360 m range during Cruise I. They were taken from strata 10, 15, 6, 18 and 24 with low catch rates.

A total catch of 1,296 kg was landed by pelagic trawl with a catch rate of 1.21 kg/hr, which formed 0.30%. The highest concentration of this group was seen in deeper waters. A catch of 850 kg with 4.78 kg/hr was trawled from the depth range of 126-360 m followed by 421 kg (0.62 kg/hr) from 55-90 m.

The catches were low in Cruises I and V and comparatively higher in Cruise IV. In the depth range 126-360 m, 731 kg were caught at the rate of 17.48 kg/hr. From 55-90 m the catch was 217 kg giving a rate of 1.50 kg/hr. A catch rate of 2.26 kg/hr was recorded during Cruise II from the depth zone of 126-360 m with a catch of 80 kg. A catch of 120 kg was obtained in Cruise III from 55-90 m, at the catch rate of 0.89 kg/hr.

From stratum 18 with 140 kg/hr and from stratum 27 with 52.4 kg/hr came the highest catch rates during June-August.

Flat fishes

A meagre catch of 32 kg was landed by MURENA during her survey. This catch formed hardly 0.01% in the total catch. The following species were represented.

Psettodes erumei (Schneider)
Arnoglossus micropthalmus (von Bonde)
Grammatobotus polyophthlamus (Bleeker)
Pseudorhombus arsius (Hamilton)
Cynoglossus arel (Bloch and Schneider)
Cynoglossus macrolepidotus (Bleeker)

Bottom trawling accounted for 23 kg and pelagic trawling 9 kg, the entire catch coming from Strata 10, 16 and 22 in 55-90 m depth range.

Crustaceans

Survey in the waters of north-west coast by MURENA gave 748 kg of crustacean catch, which formed 0.15% of total catch. This group was mainly constituted by prawns, crabs and lobsters. As the bottom and pelagic trawls were primarily fish trawls with larger mesh, the catch of crustaceans was only incidental.

The crustacean catch by bottom trawl amounted to just 113 kg and formed 0.15% of the total catch. They were recorded from the 55-90 and 126-360 m depth ranges. Prawns were represented by 15 species, crabs 7 and lobsters 3.

A total of 635 kg of crustaceans was landed during pelagic trawl operations. The catch rate was 0.59 kg/hr and formed 0.15% in the catch. The catch of 630 kg came from the depth range 55-90 m with a catch rate of 0.93 kg/hr. The yield of 243 kg during Cruise III gave a catch rate of 1.80 kg/hr. 119 kg were caught in Cruise II at a low rate of 0.65 kg/hr. In Cruise I the catch rate was the highest (3.94 kg/hr) but the catch was low at 99 kg. In Cruises IV and VI the returns were 88 and 79 kg respectively.

Strata 13 and 19 gave better yields. The catch and catch rates were 400 kg (2.70 kg/hr) and 105 kg (1.52 kg/hr) respectively. The highest strata-wise catch rate was 10.82 kg/hr from stratum 19 in January-February and 5 kg/hr from statum 13 in April-M ay.

Cephalopods

At one time this resource was only of academic interest; but recently it has gained commercial importance and is listed as one of the export commodities. During the MURENA survey, a total of 1,015 kg of cephalopods was caught, which formed 0.20% in the total catch. They were represented by seven species.

Sepia aculeata (Ferussac and d' Orbigny)
Sepia esculenta Hoyle
Sepia pharaonis Ehrenberg
Sepiella inermis (Ferussac and d' Orbigny)
Loligo duvaucelli d' Orbigny
Argonauta argo Linnaeus
Octopus vulgaris Lamarck

Among these, the first, third and fifth species were of greater abundance and contributed most to the catch.

The total catch of cephalopods in bottom trawl was estimated at 761 kg and formed 1.04%. The depth-wise distribution of catch and catch rates was 458, 210 and 93 kg and 2.14, 1.73 and 1.50 kg/hr from 55-90, 91-125 and 126-360 metres respectively.

More than 50% of the catch was recorded during Cruise I. Out of this 192 kg was obtained from 55-90 m range and 180 kg from 91-125 m range. The third range accounted for a meagre 38 kg. The catches during Cruise III were generally low with catch rates between 0.17 and 0.45 kg/hr at different depths. Cruise V again yielded good catches, of 259 kg and 52 kg from 55-90 and 126-360 m depths. The highest catch rates by bottom trawl came from stratum 2 (23.45 kg/hr) in January-February and stratum 3 (10.53 kg/hr) in September-October. ***Sepia pharaonis*** is the large-sized cuttle fish which accounted for the highest catch.

A yield of 254 kg was obtained by pelagic trawling. The highest catch of 229 kg was got from the shallow waters of 55-90 m. Catches were lower (22 kg) from the depth range of 91-125 m and (3 kg) 126-360 m.

In all the cruises except V, the cephalopod catches were obtained from shallow waters of 55-90 m, 42 kg in Cruise I, 50 kg in Cruise II, 14 kg in Cruise III, 55 kg in Cruise IV and 67 kg in Cruise VI. In the first cruise the catch rate was better (1.67 kg/hr), while in the others it ranged from 0.10 to 0.42 kg/hr. In the fifth cruise during September-October, a catch of 20 kg was obtained only from 91-125 m with a catch rate of 0.66 kg/hr.

The highest catch rate of 13.33 kg/hr came from stratum 23 during September-October and next to it, 3.12 kg/hr from stratum 28 in June-August.

V

BIOLOGICAL NOTES ON IMPORTANT SPECIES

Some additional biological observations made and samples collected by the Institute, in the course of the specified survey programme, yielded significant, though limited, data on the length frequency, scales/otoliths, sex ratio, maturity stages, food and feeding of some of the important species. These data pertaining to 38 species are presented here and relate to fishes caught from deeper areas from where little fishing has been done so far. Thus, though for some of the species discussed here we do have fairly good knowledge of the biology from specimens caught within the inshore waters (within 55 m depth), the present data for these and other species from beyond this range would be an addition to our knowledge of the biology, behaviour and distribution of the species studied.

Congresox talabonoides (Bleeker)

Eighteen specimens in December from stratum 13 ranged in sizes from 121 to 195 cm with a mode at 145 cm.

The male to female ratio was 1.3 : 1. Stages II to III of maturity were seen among males, with stage III dominant. Only stages I and IV were represented in females, with the latter stage predominant.

Tachysurus dussumieri (Valenciennes)

A total of 98 specimens of this species caught by pelagic trawl in December from stratum 13 was measured. Their sizes ranged from 36 to 65 cm with modes at 46 and 55 cm.

Of these, 30 specimens, measuring 36-55 cm in length, were examined for maturity condition. Stages II to III of maturity were seen in males and II to IV in females. The stage II predominated among males, stages II and III in females. The male to female ratio was 1.1 : 1.

Ilisha filigera (Valenciennes)

Length-frequency observations in respect of this species were based on 1094 specimens from four strata 1, 16, 25 and 28. Their lengths varied between 18 and 42 cm. Stratum 1 recorded a single mode at 24 cm in January. The modal value in stratum 16 in February was 30 cm and continued to remain at that level during March-May. There was a mode at 32 cm in November. Another mode at 22 cm was also noticed in this month. In stratum 25 a single mode at 24 cm was observed in November, whereas two modes at 20 and 34 cm were noticed in Stratum 28 in March.

Among the 41 specimens examined, ranging in size 24-35 cm, only 2 individuals showed rings on otoliths and 15 on the scales. The rings observed were 1-3 in number.

A total of 132 specimens in the size range 19-35 cm obtained from strata 16 and 28 in 55-90 m depth range during February-May was examined for maturity and sex ratio. Individuals (30-35 cm) in advanced stages (IV-VI) of maturity formed a high proportion. Fishes in stage I were absent, whereas fishes (19-29 cm) in the stages II and III were represented in small percentages in March and May. One female (35 cm) in spent condition was obtained in February. The occurrence of specimens in stage VI in high percentage in February and May indicates that this species may spawn during this period.

The male to female ratio for the entire period was 1 : 1.2. However, there was a preponderance of males in March and May and females in February and April. Fishes in stages II-VII were recorded in stratum 16 and stages II-VI in stratum 28.

Dussumieria hasseltii Bleeker

A total of 312 specimens (17-21 cm) was measured from stratum 29. A prominent mode at 19 cm was noticed.

Sixtysix specimens, 31 males (14-21 cm) and 35 females (14-20 cm) collected from stratum 29in May and from stratum 16 in October, were examined for maturity and sex ratio. In May, out of 41 specimens analysed, 22 were males and 19 females. 68.2% of the males were in stage II (17-21 cm) and 31.8% in stage III (18-20 cm), whereas 68.4% of the females were in stage V (19-20 cm) ; 15.8% each in stages II (18-19 cm) and IV 18 cm).

During October, the sample consisted of 9 males and 16 females. In the males, 44.4% were in stage II (15-17 cm); 33.3% in stage VII (14-16 cm) and 22.2% in stage III (16-17 cm), whereas 50% of the females were in stage VI (15-18 cm), 25% in stage IV-V (16-17 cm) and 25% in stage VII (14-17 cm). The above data suggest that this species may be spawning in the area during the period.

Chirocentrus dorab (Forskal)

This species was encountered in the pelagic trawl only in the depth range 55-90 m. The size range of 131 specimens measured was 39-86 cm with modes at 55 and 76 cm during March-April (Cruise II) and 43 cm in July (Cruise IV).

Prabhu (1953) studied this species from Palk Bay and Gulf of Mannar. Based on length frequency and growth rings on scales and otoliths, he had established that fish measuring 28, 44, 62 and 76 cm were 1, 2, 3 and 4 years old respectively. On the above basis, *C. dorab* in the landings of MURENA appeared to be of second, third, fourth and may be of fifth year-classes with preponderance of second and fourth year classes. Out of the 20 specimens (42-84 cm) comprising 4 males and 16 females examined from stratum 28 in 55-90 m during February, 17 fishes (50-84 cm) were in advanced stages (IV-VI) and the rest were in immature and maturing stages. In April, 30 fishes (45-86 cm) from stratum 19 were analysed, of which 4 were males and 26 females. Twenty-seven specimens (45-86 cm) were in stages IV and V and the rest in stage III.

The occurrence of fishes in advanced stages of maturity in good numbers during March-April indicates that the species may spawn in the area during the period.

Saurida tumbil (Bloch)

A total of 323 specimens was measured from strata 15 and 18 in January and from stratum 9 in October from the 126-360 m depth range. Their sizes varied from 9 to 44 cm with modes at 16 and 34 cm in January and 12 and 14 cm in October. In stratum 8 of the middle depth range, the mode was at 36 cm in April and in stratum 7 in the 55-90 m depth range, the mode was at 22 cm in September.

Scales from 12 fishes measuring 29-41 cm in length and otoliths of 35 fishes measuring 29-42 cm were examined. Growth rings were noticed in 33.3% of the scales and 51.4% of the otoliths. The number of rings noticed varied from 1 to 7. Growth rings on otoliths in this species were more distinct than those on the scales.

A total of 61 specimens (18-42 cm) of this species, collected from strata 7, 8 and 18 in 55-360 m depth range during January, April and September were examined for maturation and spawning. In January 50% of the specimens (29-41 cm) were in stage III, 33.4% (35-39 cm) in stages I-II and the rest in stages IV (39 cm) and VI (29 cm). During April, 70.8% of the specimens (33-40 cm) were in spent condition, 16.7% (38 cm) in stage II and 12.5% (33-35 cm) in stage I. In September specimens (18-26 cm) were mostly in stage I (64%); some (19-24 cm) in stage III (20%) and a few (16-43 cm) (16%) in stage IV.

Males predominated during these months. Females occurred more in January; males in April and September. In stratum 7 (55-90 m), 25 specimens (18-43 cm) were analysed of which 19 were males (16-43 cm) and 6 females (18-42 cm). Males were in stages II-IV of maturity and females in the stages III and IV. Out of 24 specimens obtained from stratum 8 (91-125 m), 10 were males and 14 females. Most of the specimens were either in spent (66.7%) or in immature condition (33.3%). In stratum 18 (126-360 m), 12 specimens consisting of 4 males and 8 females were examined; 6 specimens were in stage III; 2 each in I and II and one each in IV and VI.

The occurrence of spent specimens in good percentage in April in stratum 8 and spawning specimens in stratum 18 in January indicates that spawning in this species may take place during January-March.

Pomadasys hasta (Bloch)

A total of 206 specimens was measured. Fish measured from stratum 28 showed modal sizes at 46 and 52 cm in May (Cruise III) and 34 and 42 cm in November (Cruise VI).

The rings on scales and otoliths of this species appeared to be very distinct and good indicators of age. Sixty-four specimens examined in the size-range 28-56 cm showed 2-7 rings on the scales and otoliths. In the size ranges 33-36, 39-44, 46-48, 46-51, 49-52 and 55-56 cm, the number of rings observed were 2, 3, 4, 6, 7 and 8 respectively. There is considerable agreement in the size range and number of rings as noticed by Deshmukh (1973) and the present observations. The age composition of the species showed that the catch was mainly supported by fish in the 1-5 year age-group.

A total of 89 specimens ranging in size 31-55 cm collected during March, April and December from strata 10, 25 and 28 in the depth range 55-90 m was examined for maturation and spawning condition. Specimens were mostly immature (stages I-III) in March and April, their percentage being 87.7 and 96.5 respectively. A few mature specimens (V stage) were also seen. In May, 52.4% of the observed specimens were in stages II-III and 47.6% in advanced stages (IV-VI). Immature specimens dominated (92.0%) in December. A few spent fish (8%) were also recorded in this month. The occurrence of mature specimens in high percentage in May along with a few ripe individuals and spent ones in December indicates that spawning in this species may start from May onwards and continue upto November. Earlier studies by Deshmukh (1973) have indicated that spawning in this fish takes place during September-December.

Males were predominant during May and December, the male to female ratio being 1.3 : 1. In the monthwise distribution, males dominated during March, April and December, and females in May. In stratum 10 (April) the male to female ratio was 1 : 1.1. Fishes in II-III stages of maturity were dominant (91.3%) along with a few in stage IV. In stratum 25 (March) males were dominant over females, the male to female ratio being 1.3 : 1. Here also, immature stages (I-III) dominated (85.7%) with the V stage forming the rest. In stratum 28 (May) also, males out-numbered females, the sex-ratio being 1.6 : 1. In addition to the dominant immature stages (71.2%), mature stages IV-V (23.1%); ripe stage (1.9%) and spent condition (3.8%) were also noticed. The occurrence of specimens in the ripe and spent condition in the latter stratum, indicates that spawning may take place probably in this region.

Pomadasys maculatus (Bloch)

Out of 21 specimens obtained from stratum 30 during August, 8 were males and 13 females. The II-IV stages of maturity were observed among males, with the III stage dominating. Among females the II-IV and VII stages were encountered, the dominant being the III stage.

Lutianus johni (Bloch)

Specimens of *L. johni* numbering 82 were measured during March-April. Their size ranged from 48 to 83 cm with three modes at 52, 61 and 67 cm.

Forty specimens obtained during March and April in strata 25 and 28 were examined for maturation and spawning. Males were dominant over females in this period. Strata-wise and depth-wise, males predominated. The fish examined in March were mostly in stages I and II of maturity, though a few, 59-71 cm in length, were maturing in April.

Mene maculata (Bloch)

A total of 245 specimens collected from strata 20, 22 and 5 during July and October was measured. The size range was 14-22 cm with two modes at 17 and 21 cm.

Nemipterus japonicus (Bloch)

Samples for the length frequency study of this species were collected mostly from bottom trawl catches, particularly during January-February (Cruise I) and from strata, 1, 2, 3, 4, 5, 8, 15, 18 and 26. The modal value in the 55-90 m depth range was 26 cm ; in 91-125 m 23 cm ; and in the deeper range of 126-360 m at 11 and 14 cm, indicating a decrease in the modal size with increase in depth. In Cruise II (February-April) only stratum 18 provided a modal value of 26 cm in the 126-360 m range. In Cruise III (April-May) samples from strata 4 and 8 had a mode at 23 cm. In Cruise V (June-August) samples obtained from strata 7, 10, 19 and 25 showed modal values at 14, 20, 11 and 17 cm respectively. In the Cruise VI (Nov.-Dec.) again the smallest modal value of 11 cm was obtained from stratum 9 in the 126-360 m range. The above observations are based on length measurements of 1,679 specimens which varied in length between 10 and 31 cm. In earlier studies Krishnamoorthi (1971) has indicated that the sizes 15, 21 and 24 cm represent the lengths attained by the species at the end of 1, 2 and 3 years of its growth.

Scales and otoliths of 151 specimens ranging in size between 12 and 28 cm were examined. All of them had growth rings. Specimens in the size ranges of 19-23, 21-25, 23-26 and 25-27 cm showed 2, 3, 4 and 5 rings on scales and otoliths respectively.

A total of 276 specimens (214 males and 62 females) obtained from strata, 1, 4, 5, 8, 18, 24 and 26 was examined for maturity and sex ratio. Mature fishes in stage VI and spent ones occurred in January. Specimens in stage V were present in March. These observations indicate that this fish may probably spawn during December-March.

From stratum 1 (55-90 m), a total of 10 specimens was examined in January in the size range 24-26 cm. All were males, 7 in stage III, one in stage I and 2 in stage II of maturity. From stratum 4 (55-90 m) 30 specimens in the size range of 22-27 cm were analysed in January and 21 in the range of 17-26 cm in April. The male to female ratio was 3.3 : 1. Of the 13 females, 9 (22-26 cm) were in stage IV in January one (25 cm) in ripe condition ; and 2 specimens (25-26 cm) in April were in stage II. Out of the 51 specimens (23-28 cm) examined from stratum 5 (91-125 m), 37 were males and

14 females. All fishes were in immature stages (I-III). In stratum 8 (91-125 m), out of 66 specimens (16 specimens in the size of 19-25 cm in January and 50 in 18-27 cm in April) 64 were males and 2 females. The females (23-25 cm) were in stage IV. From stratum 26 (91-125 m) a sample of length range 18-28 cm, consisting of 22 males and 3 females, was examined in January. All were in immature condition (stages I-III). In stratum 18 (126-360 m), 14 in the range 18-25 cm in January and 29 in the range 23-29 cm in March were examined. Of this, 26 were males and the rest females. All females were immature (stages I-II). Out of 30 specimens in range 17-23 cm from stratum 24 (126-360 m), 17 were males and 13 females. Females were immature (I-II).

Epinephelus diacanthus (Cuvier & Valenciennes)

The species occurred in bottom trawls in all the 3 depth-zones. 468 specimens were measured in size range of 15-46 cm. In stratum 8 in January, the mode was at 36 cm which shifted to 38 cm in April. In strata 7 and 25 in September, the modes were at 20 and 24 cm respectively with a second mode at 38 cm in the latter.

A total of 123 specimens, consisting of 67 males and 56 females ranging in size 19-46 cm, was examined for maturation and spawning. They were collected during, April, September and October from strata 8, 7, and 27. In April, out of 48 specimens from stratum 8 (91-125 m) 25 were males and 23 females. The females were in stages I to IV with stage II as dominant (73.9%). Specimens examined during September were taken from strata 7 and 25 in 55-90 m depth range. Stages II-III of maturity were recorded from stratum 7, whereas from stratum 25 in addition to the stages II-III, stages IV and VII were also recorded. The male to female ratio was 1.8 : 1 and 1.5 : 1 in strata 7 and 25 respectively. In October, out of 25 specimens obtained in stratum 27 in 126-360 m depth zone, 11 were males and 14 females. Maturity stages were II (64.0%); IV (4.0%) and spent (32.0%).

Epinephelus fasciatus (Forskal)

Only 15 specimens in size range 29-41 cm taken from stratum 8 during January were examined for maturity. Out of that 8 were males and 7 females. All were in immature stages (I-II).

Lactarius lactarius (Bloch and Schneider)

A total of 26 specimens in the range 15-22 cm examined from stratum 28 (91-125 m) during May was studied for maturity and sex-ratio. The male to female ratio was 1 : 1.9. Their maturity condition ranged from stage II to IV, females in stage III dominating.

Protonibea diacanthus (Lacépède)

This species was caught in the depth range 55-90 m by the pelagic trawl. Specimens numbering 81 in the size 61-115 cm showed two modes at 68 and 103 cm. They appeared to be 2 to 5 years of age (Rao, 1961).

Out of 28 specimens examined in November (stratum 16) in the range 63-113 cm, 18 were males and 11 females. Females were in stages II and III of maturity. During December, the sample consisted of 25 males and 27 females (range 90-111 cm). All females were in stage II. The male to female sex ratio for this period was 1.1 : 1.

Otolithus argenteus (Cuvier)

Samples of this species were obtained from 55-90 m depth zone during Cruises IV and V (August-September). A total of 170 specimens was measured and they had the size range of 17-40 cm showing dominant modes at 21.5 and 25.5 cm.

Scales and otoliths of 25 specimens ranging in size between 19 and 34 cm were examined. Rings were noticed on 84% of the scales examined and were considered useful in age determination. The number of rings noticed was 2-4.

A total of 55 specimens ranging in size from 22 to 34 cm collected during August and November from strata 13 and 16 in 55-90 m depth range was examined for maturation and spawning. During August the fishes were obtained from stratum 13. Males dominated over females, the ratio being 4 : 1. Of the females, one (26 cm) was in stage IV and one (30 cm) in stage VII. The rest were in stage III.

Johnius carutta (Bloch)

This species was taken in the bottom trawl from all the three depth zones. In all, 368 specimens were measured and their size-range was 12-30 cm with a single mode at 19.5 cm.

A total of 51 specimens in size range 19-31 cm caught from strata 13 and 25 in 55-90 m depth during September was analysed for maturation and spawning. All stages of maturity excepting I were encountered. The male to female ratio was 1.4 : 1. In stratum 13, stages III-IV (80.8%) dominated, whereas stages V-VII (76.0%) dominated in stratum 25.

Trichiurus lepturus (Forskal)

Two species of ribbon fish, *T. lepturus* and *T. savala* occurred in the catches, the former being more abundant. They were taken in all the depth ranges and were more common in the northern strata. A total number 3,714 specimens of *T. lepturus* was measured during the six cruises and their size ranged between 11 and 115 cm.

In the depth range 55-90 m, modal values at 75, 70 90 and 95 cm were observed in strata, 1, 7, 10 and 16 during Cruise I (Jan.-Feb.). In Cruise II (Feb.-April) they could be sampled only from stratum 19 when the modal value was 75 cm and during Cruise IV (June-August) in strata 13 and 28 their modes were at 85 cm in the former and 30 and 80 cm in the latter. Strata 13 and 16 showed modal values at 75 cm and 55 and 80 cm, respectively in Cruise V (Sept.-Oct.). In Cruise VI (Nov.-Dec.) smaller fish with modal sizes at 65 and 50 cm in strata 1 and 4; at 55, 70 and 85 cm in stratum 10; 85 cm in stratum 13; 65 and 85 cm in stratum 16; and 40 and 90 cm in stratum 19 were observed.

In the depth range 91-125 m, the fish was sampled from strata 2, 5, 11, 14, 20 and 23 in all the cruises. In most of the strata the modal values were between 70 and 105 cm except in stratum 23 where a mode at 55 cm was observed during Cruise V. In the deeper region 120-360 m, samples were measured from strata 3, 9, 12, 15, 18, 24 and 27 and the modal values fluctuated within a small range of 70-95 cm except on one occasion in stratum 217 in Cruise VI when a mode at 55 cm was recorded.

From the distribution pattern of modal values of the species it is evident that the smaller fish were abundant in the shallower waters (55-90 m), bigger fish in the middle depth (91-125 m) and medium-sized fish in the deeper area (126-360 m). The smaller modal groups were recorded by and large during Cruises IV, V and VI indicating the period of their initial recruitment to the stock.

Otoliths of 237 specimens ranging in size between 36 and 40 cm were examined for age determination but not a single otolith showed a ring on it.

A total of 451 specimens in the size range 52-114 cm was examined for maturation studies. Mature specimens (65-105 cm) in stages IV to VI appeared in appreciable percentage during February-May (Fig. 27) indicating the possibility of spawning during these months. This assumption is further supported by the appearance of spent individuals in large numbers from August onwards. Prabhu (1955) in his studies on the biology of this species from Madras observed that this species migrates to offshore waters for spawning during April-June. The availability of VI stage specimens in good percentage in the present samples collected from the depth zone 91-125 m during April-May suggests that spawning in this species in the area may start from Apri onlwards.

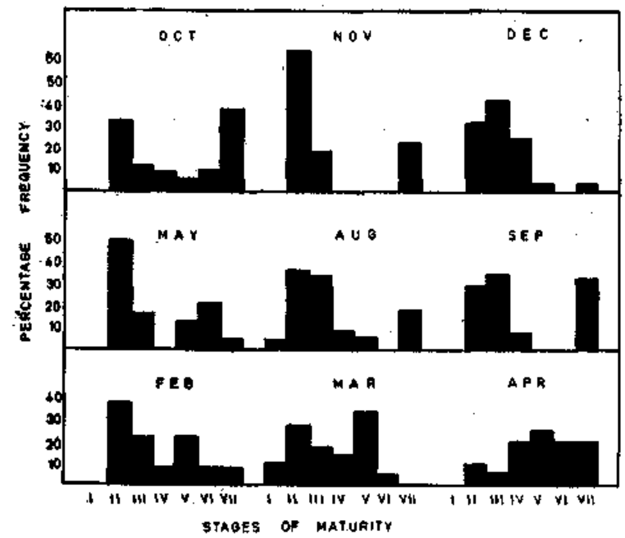


Fig. 27. Month-wise distribution of maturity stages in *T. lepturus*.

The ova diameter studies indicated two distinct modes; one measuring 26-30 md representing immature group and the other measuring 61-65 md denoting mature crop in ovary at stage IV and 26-30 md and 81-85 md groups in ovaries of stage VI (Fig. 28). Intermediate

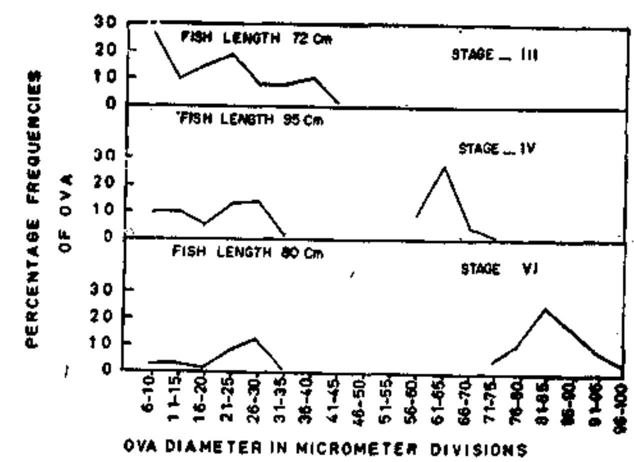


Fig. 28. Percentage frequency of ova-diameter measurements in *T. lepturus*.

size-groups of mature ova were absent. From this it is concluded that this species spawns once in a year, the spawning period extending over a short duration.

This is in conformity with the earlier observations of Prabhu (1955).

In the depth zones 55-90 m immature fishes (I-III stages) dominated the catch, followed by spent and mature ones. The availability of different maturity stages was almost similar in the males as in the females in this zone. In the 91-125 m depth, occurrence of mature stages was slightly higher among males than in females. But spent individuals were more among females. In general the percentage occurrence of mature and spent individuals was slightly higher in 91-125 m depth zone than in the 55-90 m zone. In the 126-360 m depth spent individuals were not recorded. The percentage occurrence of mature stage (62%) in the case of males and immature stages in females was high. The percentage occurrence of mature fishes was higher here than in the previous two depth zones.

In general, male to female ratio was 1.4 : 1. However, males outnumbered females during February, August, September, October and females were more in March, April, May, November and December. In the areas north of Bombay females were dominant over males (1 : 1.2) and it was the reverse south of Bombay (3.5 : 1). In the 55-90 m and 91-125 m depth ranges, the ratio was 1.8 : 1 and 1.7 : 1 respectively. Females outnumbered males in 126-360 m depth range, the male to female ratio being 1 : 2.8.

Megalaspis cordyla (Linnaeus)

This species was caught in all the cruises except V, the maximum catch taken being in Cruise II. A total number of 3,763 specimens was measured for length. The minimum and maximum sizes recorded were 13 cm from strata 4 and 7 and 50 cm from stratum 19 respectively. In all the strata only one mode was observed at any given time. Both the minimum and maximum sizes recorded were from the depth zone 55-90 m. The distribution of modal values in the three depth-zones is also striking. In the 55-90 m zone the modal values varied between 16 and 42 cm. In the next depth range of 91-125 m it varied between 26 and 36 cm whereas in the deepest range of 126-360 m it varied between 36 and 38 cm.

The 16 cm modal value was recorded during Cruise VI (November-December) in strata 4 and 7 whereas the 42 cm value was from stratum 19 in Cruise I (January-February).

Otoliths and scales of 133 specimens (25-32 cm) were examined. Only 12% of these showed rings on otolith or scale or on both; the number of rings observed ranged from 1 to 4. Otoliths and scales appear to be poor indicators for age determination in this species.

Chacko and Mathew (1955) mentioned that *M. cordyla* of the size 11-35 cm was found in the commercial catches in South Canara and Malabar. The gears used were the indigenous boat seine, drift net, cast net, long lines and whiffing lines. According to Day (1889) this species grows to a maximum size of 3 to 4 ft. in length.

A total of 706 specimens in the size range 24-43 cm was examined for maturation and spawning. Mature fishes in stages IV-V were recorded during June-August in good percentages and a few in February and March (Fig. 29). In May in addition to stages IV-V a specimen (32 cm) with VI stage was also obtained. Spent individuals started appearing from August, were more numerous in November and touched its peak occurrence in January (67%) and thereafter decreased gradually in the subsequent months until May. It is inferred from the data that spawning in this species takes place over a prolonged period commencing from August and continuing up to April-May with a peak during December to February in the area.

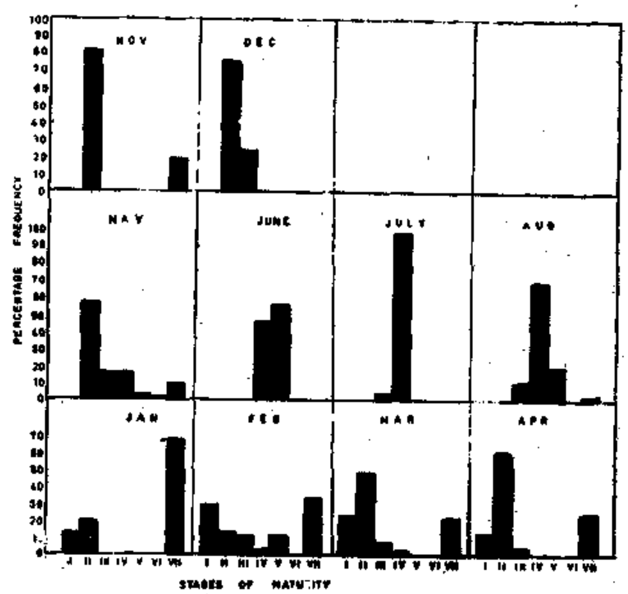


Fig. 29. Month-wise distribution of maturity stages in *M. cordyla*.

The percentage of occurrence of mature specimens (IV-V stages) was sightly higher (28.5%) in the 55-90m depth range than in 91-125 m depth range. Specimens (34-42 cm) collected from the depth range of 126-360 m were either immature (I stage) (65%) or spent (35%) condition. In 55-90 m depth range the percentage occurrence of advanced stages of maturity was higher among females (37%) than in males (23.4%) ; whereas there was no marked difference in the males and females caught from 91-125 m depth range.

Mature as well as immature specimens (24-40 cm) in equal proportions were met with in zones 2 and 3 (strata 4, 7 and 8) and 5 and 6 (strata 13 and 16). But the percentage of spent individuals was slightly high in zones 2 and 3 when compared with zones 5 and 6. In zones 7 and 8 (29-42 cm) (strata 19, 21, 22 and 23) and zones 9 and 10 (29-38 cm) (strata 25, 28 and 29) immature specimens were high, followed by spent ones with mature specimens becoming rare.

Out of a total of 657 specimens analysed for sex ratio, 418 were males and the rest females, male-to-female ratio in the depth zones 55-90, 91-125, 126-360 m being 1.7 : 1, 1.9 : 1 and 1.8 : 1 respectively. The males predominated in January-May, August and November and the females in July and December. The ratio was equal in June.

A total of 390 specimens of *Megalaspis cordyla* in the size range of 151 to 420 mm (T.L.) was examined for food and feeding. The volume of stomach contents varied from 0.1 to 3.8 ml per fish. The food items consisted of *Acetes indicus*, myctophids, juvenile *Trichiurus* sp., *Bregmaceros* sp, *Leiognathus* sp., *Stolephorus* sp, juveniles of crab, *Sepia* sp, *Cavolinia* sp, Alima larvae, copepods and amphipods. *M. cordyla*, thus, seems to be a carnivorus feeder capturing its prey from the pelagic regime.

Carangoides chrysophrys (Cuvier)

Samples of this species collected from the depth 55-125 m were examined. The size range of 106 specimens measured was 36-85 cm. A single mode at 63 cm was noticed.

Scales of 20 specimens, 36-65 cm in length, showed 1-3 rings.

A total of 20 specimens obtained during August from stratum 10 was examined for maturation and spawning. The male to female ratio was 1.4 : 1. The majority of the fishes were in stage III.

Carangoides malabaricus (Bloch and Schneider)

In all 224 specimens in the range of 15-65 cm were measured. A distinct size difference in the distribution pattern was noticed. Smaller specimens with a mode at 23 cm from stratum 28 and larger specimens with the modes at 52 and 61 cm from stratum 7 were recorded.

A total of 23 specimens (49-64 cm) collected from stratum 7 in 55-90 m depth range in December was examined for maturity. They were in maturity stage II to IV, with III dominating. The male to female ratio was 1.9 : 1.

Caranx sansun (Forskal)

The species was obtained from stratum 4. Only 40 specimens ranging in size from 31 to 41 cm were measured. They had a mode at 38 cm. Scales of 22 specimens (33-40 cm) showed 2-3 rings.

A sample of 20 specimens examined from stratum 4 during April had 17 males, all immature.

Decapterus russellii (Rüppell)

This species was caught by the pelagic trawl mostly in the depth 55-90 m. The size range of 641 specimens varied between 11 and 23 cm. The modal values were 15 cm in strata 10 and 11 in Cruise IV (August) and 16 cm in strata 13 and 19 in Cruise VI (November-December).

A total of 107 specimens, 72 males and 35 females caught from strata 11, 13, 19, 22 and 25 in 55-90 m depths during August and November, was examined for maturity and sex ratio studies.

During August the males (13-17 cm) analysed from 91-125 m depth were in maturity stages II-VI and the females (10-17 cm) in stages III-VII. Stages III and IV dominated among males, V and VI among females. The male to female ratio was 1.5 : 1.During November stages II-V were encountered from 55-90 m depth range. In males of 15-20 cm length stage II dominated followed by stage IV (31.6%) and stage V (26.5%). Among females (16-21 cm) stage V (64.0%) was abundant followed by stage IV (20.0%). The male to female ratio was 2.3 : 1.

The availability of specimens in running stage (VI) in 91-125 m and in the V stage in 55-90 m indicates that this fish probably migrates to the deeper waters after attaining the penultimate stage of maturity. The sex ratio data indicate that the males were predominant in the catches.

Alepes mate (Cuvier)

This species was caught by bottom trawl in 55-90 m. The number of specimens measured was 87 in the size range 10-20 cm with a dominant mode at 12 cm.

Nineteen specimens, 13 males and 6 females, in the size range 11-24 cm taken from stratum 13 in 55-90 m during September, were examined for maturation and spawning. Fishes were in the II-IV stages of maturity.

Among males the occurrence of III stage was more, whereas it was the IV stage in females.

Selaroides leptolepis (Cuvier)

Specimens landed by bottom trawl from stratum 16 were measured. The size range of 40 specimens was 54-69 cm, with a mode at 63 cm.

Twenty four specimens obtained during October from stratum 16 were examined for maturity condition. Stages IV-VI were seen among males and IV-VII in females.

Trachurus trachurus (Linnaeus)

They were obtained in the bottom trawl catch from strata 4, 7, 13 and 25 in the Cruise I (January). The size range of 364 specimens was 13-23 cm, with a mode at 18 cm.

Examination of gonads from 40 specimens (17-22 cm) from strata 8 and 25 in January showed that 50% of the specimens were in stages I-II, 27.5% in stages IV-VI and 22.5% were spent. The presence of fish in stage VI and VII during the month in stratum 25 may indicate these to be the spawning period and the spawning grounds.

Pampus argenteus (Euphrasen)

This species was caught by bottom and pelagic trawls in all cruises from all the three depth ranges (strata 10, 13, 15, 16, 21, 28, 29, 30). A total of 1057 specimens was measured for length (furcal) in the size range 14-32 cm. Stratum 16 proved to be the best sampled. Here the modes were at 23 cm in Cruise I, 28 cm in Cruise II, 21 cm in Cruise III, 27 cm in Cruise IV and 26 cm in Cruise VI. In strata 13 there was a mode at 25 cm during Cruise II and at 26 cm in Cruise IV. In the other strata the distribution of modes was in stratum 29 at 26 cm in Cruise I, stratum 30 at 25 cm in Cruise I, stratum 10 at 23 cm in Cruise II, stratum 21 at 25 cm in Cruise II, stratum 28 at 28 cm in Cruise II and stratum 15 at 28 cm in Cruise V.

Otoliths of 262 specimens in length range 17-35 cm were examined and the majority of them showed 2-9 growth rings. A critical examination of the material showed 2, 3, 4 and 5 rings in the size groups 17-22, 21-27, 23-28 and 25-30 cm respectively.

Fish (24-27 cm) with gonads in ripe (VI stage) and spent condition were collected during February in stratum 16 (Fig. 30). In August also, specimens (23-30 cm) in the V stage were abundant in Stratum 16 along with a few spent individuals (26-30 cm). It is inferred that spawning in this species may take place over a protracted period probably with peaks during January-February and in July-August. Availability of fish with running gonads from stratum 16 in the depth range 55-90 m indicates that this area may be the probable spawning ground for this species. Females outnumbered males during the entire period in the depth range 55-90 m, the male to female ratio being 1 : 3.2.

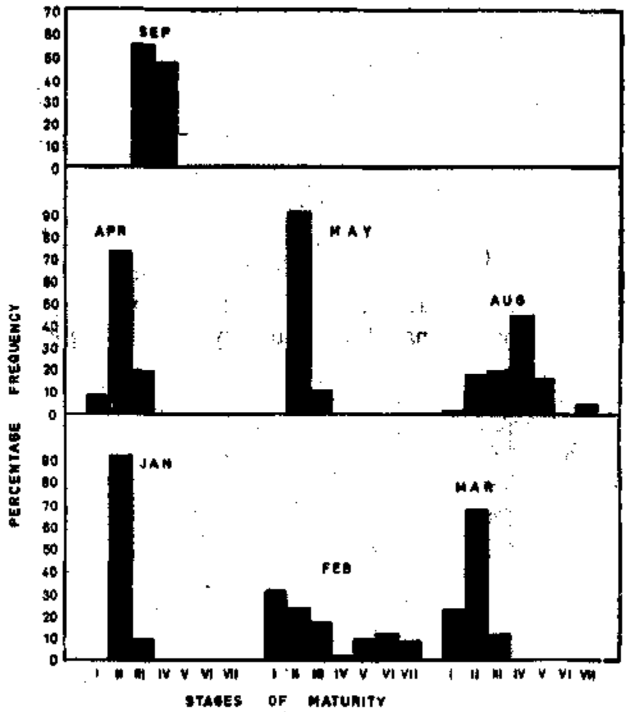


Fig. 30. Month-wise distribution of maturity stages in *P. argenteus*.

Pampus chinensis (Euphrasen)

These were caught in pelagic trawls in small numbers from strata 7 and 25. The size range of 83 specimens was 22-28 cm with modes at 24 and 27 cm.

Apolectus niger (Bloch)

Length measurements of 1,737 specimens were taken during the six cruises. The minimum and maximum sizes recorded were 15 and 50 cm. The species was abundant in strata 1, 4, 7, 10, 13, 22, 25, 28, 30 with the modes as follows : in stratum 30 mode at 30 cm in Cruise I, in stratum 28 at 36 cm in Cruise II and 38 cm in Cruise VI ; in stratum 25 at 30 cm in Cruise I and at 18 cm and 30 cm in Cruise VI and in stratum 22 at 30 cm in Cruise III and 18 cm in Cruise VI ; In stratum 13 there was mode at 28 cm during Cruise IV ; in stratum 10 at 24 cm in Cruise II and 36 cm in Cruise III ; in stratum 7 at 22 cm in Cruise II and at 30 cm in Cruise VI, in stratum 4 at 22 cm in Cruise II and in stratum I at 20 cm in Cruise IV.

A total of 212 specimens ranging in size between 19 and 50 cm was examined for growth rings on scales and otoliths. Of the 86 scales examined, 68 (forming 79%) and of the 137 otoliths examined, 10 (forming 7.3%) showed rings. Scales appear to be more useful in age determination than otoliths in this species. The number of rings noticed on the scales were 1 to 5, in the size groups 185-200, 200-215, 245-275, 260-295 and 275-310 mm respectively.

For maturity, spawning and sex ratio studies, a total of 296 specimens ranging from 19 to 50 cm collected from 55-90 m depth range during January-May and August-December were examined. Immature fishes were noticed in high percentage in all months except in January (Fig. 31) when the percentage of spent individuals was high.

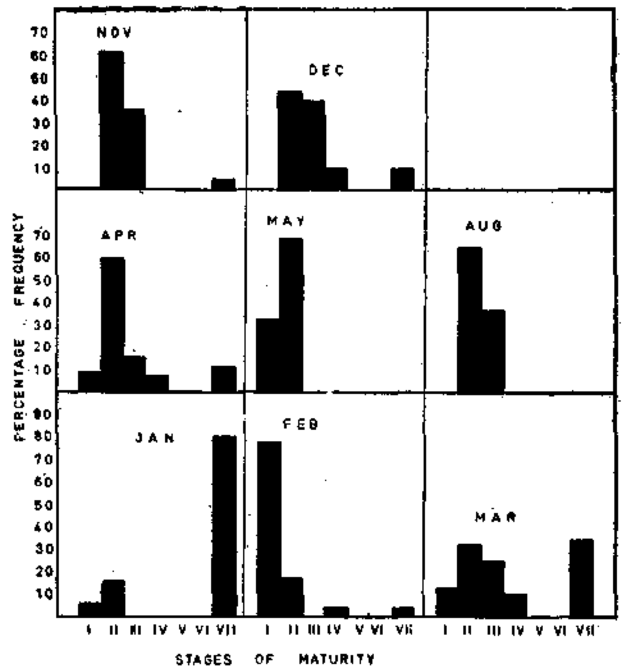


Fig. 31. Month-wise distribution of maturity stages in *A. niger*.

Spent fishes were obtained during January-April and November-December thereby indicating that spawning in this species may take place from November to March. The ova-diameter studies also confirmed that the fish spawned once in a year over a prolonged period (Fig. 32). Males dominated over females in April, August, November and December and females in January to March and May. The male to female ratio for the northern zones (north of Bombay, i.e. strata 16, 22, 25, 28 and 29) was 1 : 1.4 and for the southern zones (south of Bombay i.e. strata 4, 10, 13 and 7) it was 1.6 : 1.

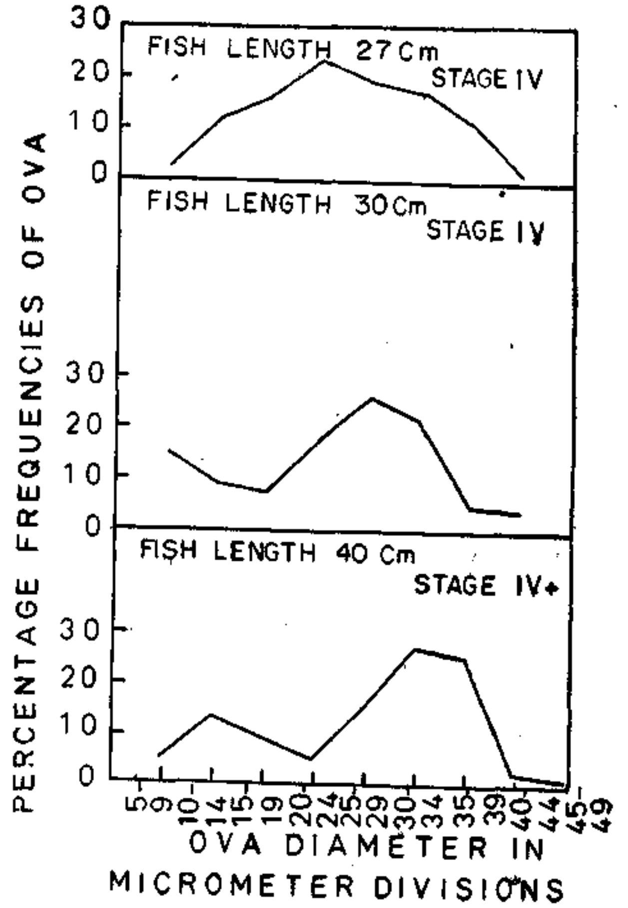


Fig. 32. Percentage frequency of ova-diameter measurements in *A. niger*.

Ariomma indica (Day)

This species appeared in both bottom and pelagic trawl catches. The size range of 276 specimens was 11-24 cm with a dominant mode at 16 cm.

Sixtyone specimens ranging in size 15 to 21 cm obtained from strata 19 and 23 during November were studied for maturity conditions. In general, specimens in stage V predominated (45.9%) followed by those in stage IV (32.8%) and in stage III (21.3%). The male to female ratio was 1 : 1.

In stratum 19, out of 25 specimens 17 were males and the rest females. Among males stages IV and V of maturity were noticed, the dominant being IV stage. Only stage V was recorded among females. Out of 33 specimens from stratum 23, 14 were males and 19 females. Maturing stage (III) dominated in males and IV and V in females.

Rastrelliger kanagurta (Cuvier)

A total of 349 specimens of *R. kanagurta* in the size range of 19-22 cm was measured. They showed two modes at 21 and 24 cm, the former in Cruise VI from stratum 7 and the latter in Cruise III during April-May from strata 2 and 4.

Of the 53 specimens (23-26 cm) examined for rings on their scales, 69.8% showed a single ring. A specimen measuring 26 cm showed 2 rings. Seshappa (1958) mentioned that rings were absent on the scales of *R. kanagurta* below 22 cm. Also he stated that practically in all other sizes, there was only one ring on the scale.

Maturity studies on 162 specimens (size range 22-28 cm) collected during February, April, November and December from strata 2, 4, 7, 10 and 28 showed that all specimens were from 55-90 m depth range, excepting for 20 from 91-125 m in stratum 2. In January spent condition dominated (59%), followed by stage III (37%) and stage V (4%). Maturing fishes were abundant (83%) in February. A few specimens in stage IV were also noticed in this month. Individuals in spent recovering condition were observed in November and immature (II stage) and maturing (III stage) condition in December. The sex ratio between males and females during this period was almost equal, males dominated in February and in the remaining months females predominated.

In stratum 2 (91-125 m), 95% were males and all of them were in maturing stage, excepting one individual in stage IV. Maturing (71%) and mature (24%) stages were noticed in specimens obtained from stratum 4. The male to female ratio was 1.3 :1. All specimens (85) from stratum 7 were in spent - recovering stage. The male to female ratio was 1:1.3. In stratum 10, all specimens were males with spent (59%) and maturing (37%) gonads. One specimen was in stage V of maturity. In contrast to the high occurrence of maturing fishes (95%) in 91-125 m depth range, the percentage of spent fishes was high in 55-90 m. The male to female ratio in this zone was 1.2:1.

A total of 246 specimens of mackerel in the size range from 119 to 280 mm (T.L.) and weighing 79 gm to 230 gm was examined for food and feeding. The volume of gut contents varied from less than 0.1 ml to 4.0 ml. The highest feeding intensity was noticed in the months of April and October, the primary and secondary zooplankton seasons of the year. In general very little food, from 0.2 to less than 1.0 ml, was noticed in most of the fishes. The stomach contents consisted of *Coscinodiscus* sp, copepods, *Evadne*, *Acetes indicus*, *Pleurosigma* sp, *Peridinium* sp, pteropods and fish eggs in that order of abundance.

Acetes indicus was found in large numbers, particularly in the month of October. The occurrence of one penaeid prawn and a salp in the stomach may be accidential. There was no appreciable variation in the nature of the food in the different size-groups.

Scomberomorus guttatus (Bloch and Schneider)

Among the three species, viz. *Scomberomorus commerson*, *S. lineolatus* and *S. guttatus*, the last was the dominant species in all cruises except I and V and 413 specimens were measured. Their sizes varied from 26 to 80 cm in length. The modal sizes were 48 and 53 cm in stratum 28 in March (Cruise II) ; 53 cm in stratum 28 in May (Cruise III) ; 38 cm in stratum 16 in August (Cruise IV) and 43 cm in strata 13, 16 and 28 in November and December (Cruise VI).

A total number of 197 specimens consisting of 88 males and 109 females collected during March, May, August, November and December from strata 16 and 28 was examined for maturation and spawning. The sizes ranged from 30 to 78 cm in length. Mature fishes in size range 48-67 cm (IV-VI stages) were abundant (68%) in March. The percentage of specimens in VI stage (48-60 cm) was about 14. Spent fishes (67 cm) were also noted suggesting that spawning may take place during this month. In May (size range 46-66 cm) and August (32-69 cm), they were either immature or in maturing condition. Males dominated in May and females in March, August, November and December.

Auxis thazard (Lacépède)

Samples of this species were measured from strata 18 and 27 in Cruise IV (August) and 9 and 18 in Cruise VI (November) in the depth range 126-360 m. The modal sizes were at 29 cm in stratum 18, 24 cm in stratum 27 and 23 cm in stratum 9. The size range varied between 22 and 34 cm.

Ninety specimens, 37 males and 53 females, collected from strata 18 and 27 in 55-90 m depth range in August and from strata 9 and 18 in 126-360 m depth range in November were examined for maturity condition. In August the sizes ranged from 23 to 32 cm. Fishes were in the V stage (75%), IV stage (20.5%) and III stage (4.5%). The male to female ratio was 1.3:1. During November the sizes were from 23 to 31 cm. Most specimens were in the II stage (91.3%) and the rest in spent condition. Females dominated over males, the ratio being 2.3 :1.

Euthynnus affinis (Cantor)

The size range of 158 specimens measured was 15-77 cm. Larger specimens above 45 cm occurred in stratum 28 in June-August with a mode at 56 cm and smaller ones below 45 cm in strata 13, 14, 22 and 25 in October-November with modes at 32, 38, 23 and 20 cm respectively.

Thirty one specimens in size range 24-37 cm caught in strata 13 and 22 from 55-90 m depth range during November were examined for maturity conditions. In stratum 13, out of 25 specimens analysed, 18 were males and the rest females. Among males 5 were in the II and the rest in VII stage. All females were in spent condition. Six specimens were observed from stratum 22 out of which 5 were females and one male. All were in the II stage. The male to female ratio for this month was 2. 9:1.

The occurrence of spent individuals in large numbers in November indicates spawning in this species may have occurred during the immediate preceding months.

Sarda orientalis (Temminck and Schlegal)

Sarda orientalis was obtained in the pelagic trawl from 55-360 m. In all, 100 specimens were measured. Smaller specimens up to 42 cm with a mode at 31.5 cm were from stratum 7 in the depth range of 55-90 m zone and larger ones beyond this size with the mode at 46.5 cm were from stratum 18 in the 126-360 m zone.

A total number of 132 fishes comprising 74 males and 58 females in the size range 29-57 cm was studied for maturation and spawning. They were obtained from strata 6, 7, 18 and 23 during March and November. 94% of the fishes in March were spent and 97% immature (stage II) in November. Most of the fishes obtained from stratum 18 (94%) were spent, while most from stratum 6 (100%), 7 (96%) and 23 (100%) were immature. In 55-90 m and 91-125 m depth immature fishes (29-36 cm) dominated in November-December, whereas spent fishes (42-51 cm) were more in 126-360 m depth range in February-April. Males were dominant over females in all strata. The male to female ratio was equal in March and females were slightly more in November.

Sphyraena obtusata (Cuvier)

In all 133 specimens of this species were measured from stratum 25 in September (Cruise V) and the size range was 19-27 cm with a mode at 22 cm.

Out of 25 specimens examined for maturation and spawning from stratum 25, during September 16 were males and 9 females. Thirteen males and eight females were in stage III and three males in stage IV and one female in V stage.

Echeneis naucrates (Linnaeus)

This species was obtained by the pelagic trawl from all the depth zones. A total of 73 specimens between the sizes 36 and 74 cm showed a single mode at 61 cm.

Fifty-six specimens ranging in size 36-73 cm obtained during October and November were examined for maturity condition. They were taken from strata 1, 2, 3, 13, 16 and 23. All stages of maturity except stage I, were encountered during this period. Spent fish dominated in both months. Running specimens were recorded from strata 23 and 3. The male to female ratio was 1.3 : 1, except for a slight dominance of females over males in October and males over females in November.

Odonus niger (Rüppell)

This is a bathypelagic species and was taken in pelagic trawls from strata 10 and 16. The size range of 365 specimens measured was 12-20 cm with a mode at 16 cm.

VI

DISTRIBUTION PATTERN OF THE MAJOR FISHES

As mentioned earlier the MURENA made six cruises from January to December, 1977. During all the cruises samples of fish, prawns and cephalopods were drawn and identified in the laboratory. In all 227 species of fishes, 24 species of crustacea and 7 species of cephalopods were recorded (Table 16). As the distribution of major groups by stratum, time and depth has already been discussed in detail earlier, only significant observations in respect of a few important species are given below.

The majority of the species occurred, in lesser or larger quantities, in strata 10, 13, 16 and 28 in the depth range 55-90m. The first three are off Bombay and the last is off Okha. As pointed out earlier, these strata comprise the richer fishing grounds according to the present survey.

The eel *C. talabonoides* (' Wam ') was recorded from all strata in the 55-90 m depth range and also from strata 27, 29 and 30 of deeper waters off Okha. The black pomfret, *A. niger*, was caught from all the strata in the depth range 55-90 m and .was also taken from deeper waters from strata 24, 26, 27, 29 and 30 which are off Porbunder and Okha. The fishing grounds off Porbunder support a good black-pomfret fishery by traditional fishing methods. The distribution pattern of the silver-pomfret, *P. argenteus*, was more or less the same as that of the former. The white pomfret, *P. chinensis*, was taken only from shallower strata 7, 10, 13, 16, 22, 25 and 28 and that too mostly during the winter months of November and December in Cruise VI They were recorded on two more occasions in strata 10 and 13 in Cruises V and III.

The ' Karkara ' *P. hasta* was recorded from all the shallow water strata (55-90 m) in addition to strata 8, 26 and 29 in the 91-125 m range and stratum 30 in the 126-360 m range. They were caught in all the cruises from strata 10, 13 and 16. The ' horse-mackerel ', *M. cordyla*, was observed in shallow waters only upto 20° N lat and from 20° to 23° N lat. They were taken in all the strata irrespective of the depth. Of particular interest is the capture of this fish in enormous quantitise in the strata 29 and 30 during April. *Nemipterus japonicus* was taken in almost all the strata except 6, 17, 20 and 23 during Cruise I and their availability was restricted to the shallow waters during Cruise II. In the remaining cruises they were more or less scattered. *Trichiurus lepturus* showed a wide distribution in all the strata. They were taken in all the cruises from strata 10, 11, 13, 16, 19, 22 and 23. *Saurida tumbil* was caught from all strata except 29 and 30.

The mackerel *R. kanagurta* is generally taken in large quantities south of Ratnagiri in conventional gear. Its appearance in strata 10, 13, 16, 19, 22, 25, 26, 28 and 29 all north of Bombay indicates its wider distribution in the Arabian sea. Similarly the conventional fishery for Bombay-duck, *H. nehereus*, is restricted to coastal waters, but the species was got in strata 9, 24 and 27 during Cruises IV and V.

Cephalopods were represented by species of *Sepia* and *Loligo*. The former were taken from all strata of shallower depth-range in addition to strata 6, 9 and 24 in the depth range 126-360 m. The latter were restricted to the depth-range 55-90 m. The octopus, *Argonauta argo* was recorded for the first time from strata 10, 12 and 16 along with the external shell and eggs during Cruise VI.

VII

RESOURCE POTENTIAL AND ECONOMICS OF FISHING IN DEEP-SEA GROUNDS

The question of the economic feasibility of exploiting the resources of our deep sea areas is of immediate relevance in the context of the present fairly intensive exploitation of the inshore areas and the possibilities after the declaration of the Exclusive Economic Zone. Even though the present statistics show that the Indian fishermen capture 46% of the total fish landings from the Indian Ocean, our annual estimated production of marine fish is only 12.5 lakh tonnes in 1980 (CMFRI, MFIS. No. 32), of which over 8.5 lakh tonnes are landed on the west coast (and nearly half of this from the N W region) and 95% of this comes from within the 55 m. zone. There is at present virtually no established commercial fishing beyond this depth.

The potential of the regions beyond this has been a point of discussion. Various authors, using different techniques, have attempted to assess it, and their estimates show wide variations, from 16 to 20 million tonnes for the entire Indian Ocean and 2.3 to 8.5 million tonnes for the Indian waters (Table 17). It is obvious that such vastly differing estimates can be of little value to the fishing industry, except to indicate that our present production could be stepped up, at least doubled, by a more intensive exploitation of the partially exploited stocks as well as the unexploited resources in areas beyond the present fishing grounds.

A survey, such as the one carried out by MURENA provides information on the catches possible from the surveyed region, i.e., in this case from 15° to 24° N and from 55 to 360 m depth.

From the catch and effort data provided by the six

TABLE 17. *Comparative Estimates of Potential Yield*—(in million tonnes/year)

AUTHOR	INDIAN OCEAN	INDIAN WATERS	WEST COAST	N.W. COAST
Moiseev (1971)	7.8	3.79*	2.7**	1.17***
Gulland (1971)	14.25	7.12*	5.1**	2.21***
Cushing (1971)	4.00	2.00*	1.4**	0.62***
Shomura (1976)	13.50	6.75*	4.9**	2.1***
Panikkar (1966)	10.20	5.00*	3.6**	1.55***
Qasim (1977)	15.17	8.50*	6.12**	2.64***
Prasad *et al.* (1970)	11.00	5.5*	4.0**	1.71***
Prasad and Nair (1973)	10.00	5.0*	3.6**	1.55***
Jones and Banerji (1973)	..	2.3*	1.7**	0.71***
Subrahmanyan (1959)	..	..	1.1	0.46****
Anon (1976)	..	..	..	0.5
George *et al.* (1977)	..	..	..	0.3
Nair *et al.* (1973)	..	..	1.7	0.71****
Antony Raja (1974)	..	2.6	1.9**	0.81
Silas (1977)	..	4.0	2.88**	1.24
MURENA	..	..	..	0.15

* Extrapolated on the basis that 50% of Indian Ocean catch comes from Indian waters.
** 72% of the Indian catch from West Coast.
*** 31% of the Indian catch from Northwest Coast.
**** on 42% of West coast catch.
Percentage on the basis of average catch data from 1967-1976.

cruises using bottom and pelagic trawl a rough estimate of the standing stock and the potential yield from the area has been made (Table 18).

The method of estimating the standing stock is based on the assumption that catch per unit of effort (CPUE) is a function of stock density in the area surveyed and changes in the CPUE are directly proportional to the variations in density (Ricker, 1940; Gulland, 1964). In such estimates the average CPUE, average sampling speed and average working gape of the gear and the total area covered are taken into consideration (the 'Swept Area method') for the demersal fishes. As for the pelagic resources, a ratio that was worked out between the over-all CPUE values of the demersal and pelagic trawls has been used for an approximate estimate. This is, by no means, an entirely correct or satisfactory method, but was used as the only practical means, in the context of the mixed coverages made by MURENA.

The estimates of the resources in the area, as given in Table 18, do not, by themselves, indicate whether it is economically feasible to exploit them. The availability of the resource has to be assessed in the light of the input-output ratio for any industrial undertaking.

As an industry, deep-sea fishing is highly capital-intensive and Indian fishermen, either individually or on co-operative basis, are not at present in a position to exploit the resources of the Economic Zone. Even a big industrial house or a well-established entrepreneur has to be supported for such attendant needs as harbour facilities, cold storages, workshop and other storage facilities. Even so the ever-increasing operational costs make deep-sea fishing a hazardous proposition. One has, therefore, to be cautious in assessing whether such deep-sea fishing could be economically feasible under the present circumstances.

The total catch figures of MURENA would show (Table 3) that the 55-90 m zone yielded more than the deeper regions. As this shallower region is being fished now more or less at a fairly intensive level and can be covered by smaller vessels, the point to be considered is whether a large vessel like MURENA could be

TABLE 18. *Strata-wise Standing Stock in Tonnes*

Depth Zone	55-90 m		91-125 m			126-360 m		
Strata	Pelagic	Demersal	Strata	Pelagic	Demersal	Strata	Pelagic	Demersal
1	2200	2129	2	96	3854	3	42	996
4	1689	3360	5	383	3330	6	252	1499
7	1554	2103	8	323	4703	9	57	39
10	11116	13366	11	192	2575	12	26	51
13	21664	21491	14	238	1632	15	205	242
16	15680	39348	17	346	922	18	957	624
19	8624	1708	20	227	3412	21	3976	577
22	937	886	23	753	3532	24	155	6022
25	1172	8948	26	85	1435	27	534	1050
28	6963	10451	29	19210	437	30	6441	..
Total	71599	103790		21853	25832		12645	11100
Area	75852 Km^2		36677 Km^2			22027 Km^2		
Total Resources	175389		47685			23745		
Potential Harvestable	105233		28611			14247		
Resource/Km^2	2.31 mt.		1.46 mt.			1.08 mt.		

Total resources (55-360 m) for an area of 130566 Km^2	.. 2,46,81,9 mt.
Potential Harvestable Yield (at 60%)	.. 1,48,09,1 mt.
Resource/Km^2	.. 1.89 mt. or 19 Kg/ha.

used for exploiting the deeper area and be reasonably profitable.

In any attempt at computing the operational costs of such deep-sea fishing, based on these six cruises, a major constraint has been that no information is available on the actual cost of operations of MURENA or the shore expenses connected with it. Two options are then available for an attempt to assess the former. One is to take the charter charges paid for these cruises and the second is to calculate a rough equivalent of the operation of such a large vessel in an Indian setting. for the crew and other factors befitting the conditions here.

The Government of India paid Rs. 85-95 lakhs for one year as the vessel's charter charges. The operational costs of an equivalent vessel in Indian conditions have been worked out by Bhadury *et al.* (1977), who arrived at a figure of Rs. 78.07 lakhs for the running of the vessel. They also calculated that the shore expenses (as cold storage rent, transport, marketing etc.) would come to about Rs. 6.98 lakhs. Applying this figure to the former calculation based on charter charges, the total operational cost comes to over Rs. 90 lakhs, and in the latter case, the total is Rs. 85.05 lakhs. Thus an input of approximately Rs. 85 to 90 lakhs has to be balanced against the gains by sale of the catches and the fish meal produced.

As regards the catch, MURENA, having fished for the greater part on an exploratory pattern and having lost many fishing days due to engine trouble, fished only for 218 days and landed 504 tonnes. This is, however, no fair assessment of the catches possible by a vessel doing commercial fishing. Not only would an experienced skipper, with increasing familiarity with the grounds, get at a greater percentage of better quality fish, but a trouble-free vessel could put in, say 300 days at least, of fishing in a year. An approximation, giving wide latitudes to these two factors (i.e. assuming a greater percentage for Grade A+B fishes and 300 days of fishing) is indicated in Table 19. Also, whereas a purely commercial venture would have the vessel proceed directly to areas of good production (such as the areas where MURENA came across the shoals of *Megalaspis cordyla* during Cruise II), in the survey programme a good deal of time was spent in conforming to a regular survey pattern in going from stratum to stratum, irrespective of the catch at each station. All this makes the results of the MURENA survey not entirely amenable for an accurate economic feasibility study.

Be that as it may, the catches brought in by MURENA have been such as to seem inadequate as a dependable index for a profitable commercial venture. Even considered against the minimum operational costs, as worked out by Bhadury *et al.* a vessel of MURENA type has been calculated to need an annual catch of 6,000 tonnes to mark a 10% profit. They state that 'if a large vessel of this type (69 m) has to be commercially successful, it should be out at sea for a minimum of 300 days in a year (taken actual fishing days as 240 days) and should catch, on an average, 25 tonnes per day'. The results of the MURENA cruises, even on the basis of the latitude given to compensate for the limitations of the programme and the operations, seem to indicate little possibility of such a large catch from the deeper (i.e., over 90 m depth) areas of the EEZ in the region studied.

TABLE 19. *Economics of Operations*

Presumptions: (i) Only direct expenses have been taken into account.
(ii) Total catch has been computed at 300% of the actual catch of MURENA and catch composition adjusted.

RECEIPTS		Rs. (in lakhs)	EXPENDITURE	Rs. (in lakhs)
1. By sale of fish				
a. Pomfrets	=166.56 tonnes @ Rs. 8,750 per tonne	14.57	1. Towards charter charges for one year as per agreement.	85.95
b. A-Grade Fish	=62.46 tonnes @ Rs. 3,000 per tonne	1.87		
c. B-Grade Fish	=208.20 tonnes @ Rs. 2,000 per tonne	4.16		
d. C-Grade Fish	=624.60 tonnes @ Rs. 1,000 per tonne	6.25		
	Sub-total	26.85	2. Towards shore expenses *ad hoc* basis	5.00
e. Fish Meal	=204.00 tonnes @ Rs. 3,000 per tonne	6.12		
f. Receipts from sale of unserviceable stores, rebate from excise etc.		0.47		
	Total Receipts	33.44		
	Loss	57.51		
	Total	90.95	Total	90.95

VIII

ENVIRONMENTAL FACTORS

Hydrography

In January '77, the winter season of the year, the surface temperature values in the region from Panjim to Veraval along the west coast showed conspicuous spatial variation, there being a gradual negative temperature gradient towards north. Intense surface cooling in the northern latitudes was observed (Fig. 33) and in the region south of Bombay, more or less uniform conditions prevailed. A weak eastward drift in the region off Bombay was perceptible although it is not well defined in the other region, but this region could be considered as a temperature boundary between the northern and southern waters.

This boundary region again was one where a noticeable ascendent in salinity northward could be observed. The salinity maximum region was well developed around 20° N, with the usual decreasing trend towards north and south (Fig. 34). The intense winter cooling in the northern region seemed not to affect the dissolved oxygen distribution in the surface layers where high uniformity in the distribution pattern was observed (Fig. 35). A moderate increase in the oxygen values was observed in the southern region, associated with the lower salinity values and higher temperatures. Mostly the surface waters were saturated upto about 80-85% with respect to dissolved oxygen.

The winter cooling in the surface layers appeared to have spread towards the southern regions but the waters had become warmer in the northern region during February. Uniformity of the thermal pattern was more well defined than in January (Fig. 36) and the weak eastward drift had disappeared. One salient feature for the month of February was the more or less uniform distribution of salinity with a maximum in the northern region (Fig. 37). The warmer waters during February seemed to favour the abundance of dissolved oxygen in

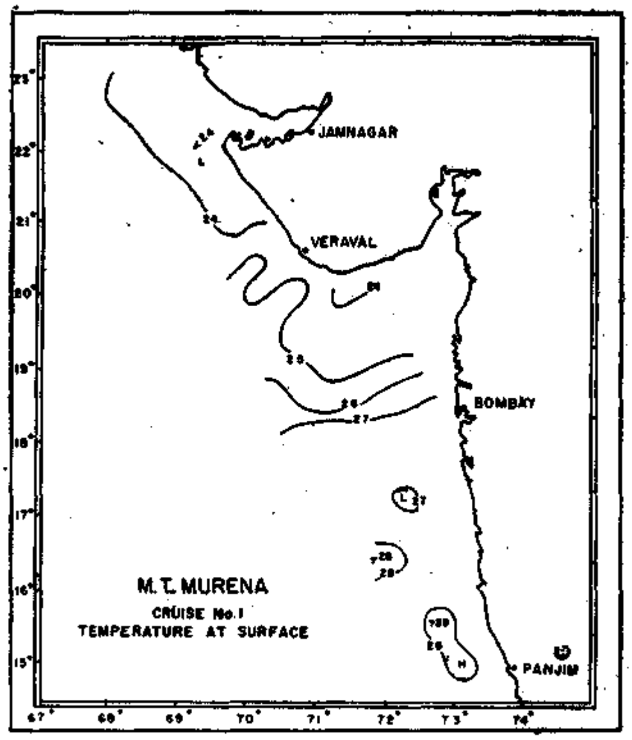


Fig. 33. Distribution of surface temperature (°C) values during Cruise I.

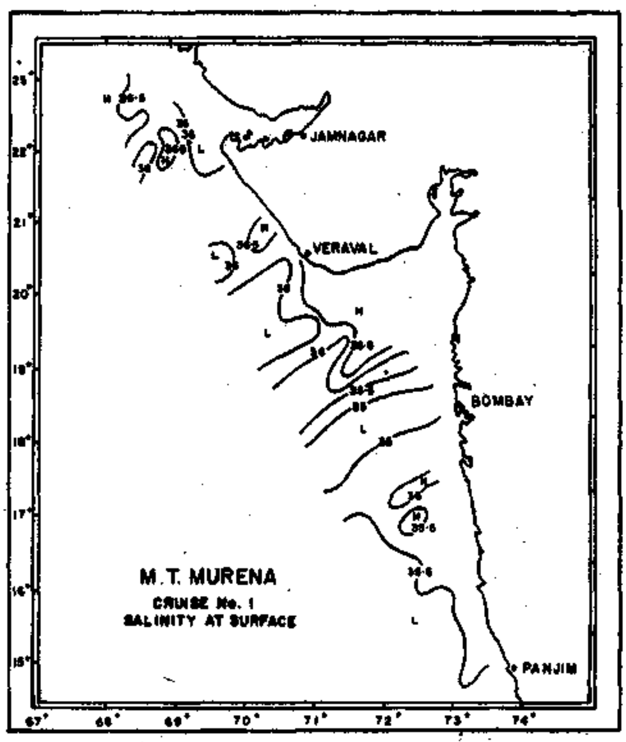


Fig. 34. Distribution of surface salinity (‰) values during Cruise I.

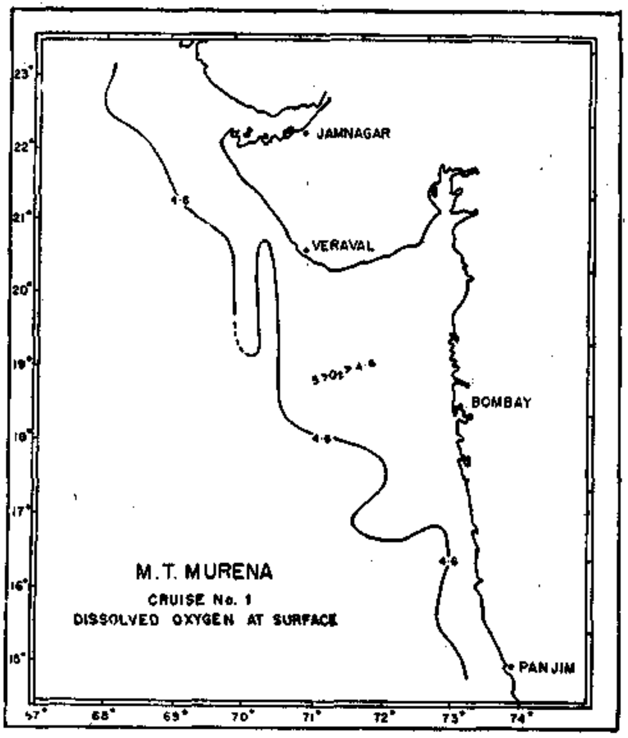


Fig. 35. Distribution of surface dissolved oxygen (ml O_2/l) values during Cruise I.

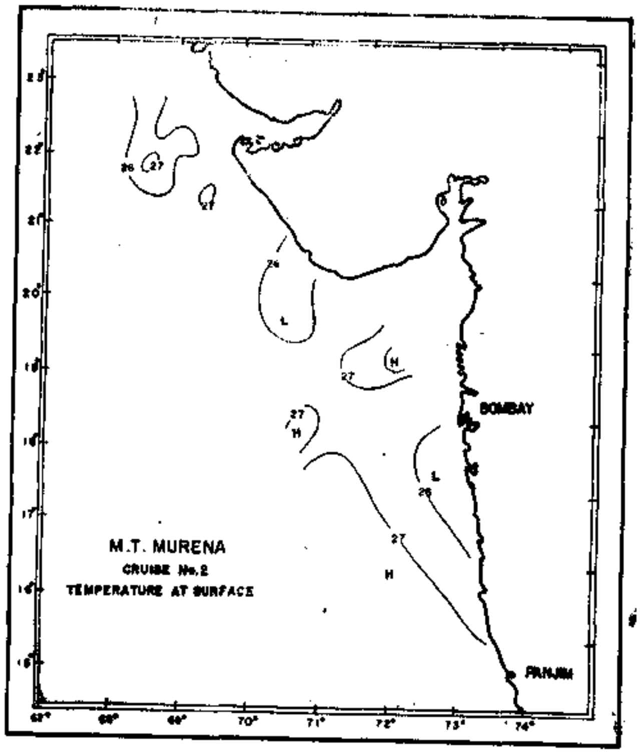


Fig. 36. Distribution of surface temperature (°C) values during Cruise II.

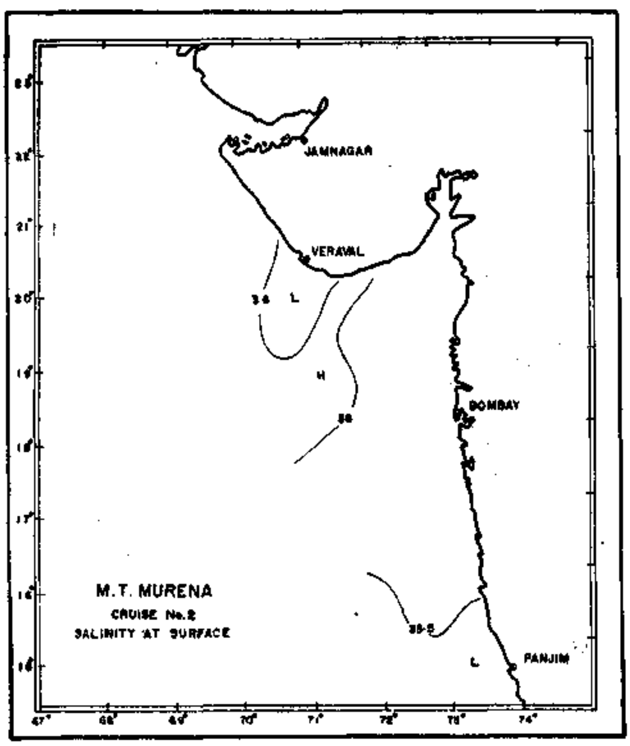


Fig. 37. Distribution of surface salinity (‰) values during Cruise II.

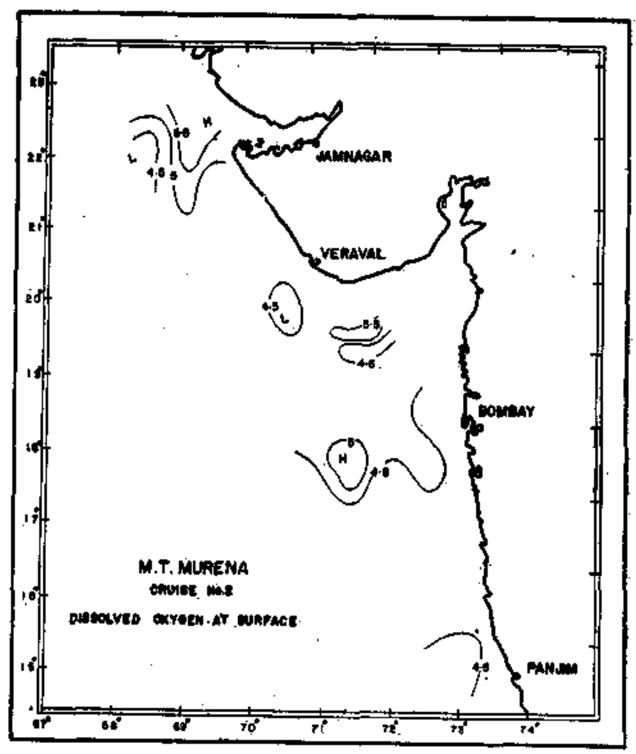


Fig. 38. Distribution of surface dissolved oxygen (ml O_2/l) values during Cruise II.

the surface layers in the sense that dissolved oxygen values were decidedly higher by about 0.5 ml/L, than in January. The spatial distribution again was more or less uniform (Fig. 38).

By the approach of summer, during late April, the temperature conditions in the investigated area were strikingly uniform, except for a slightly lower value in the region of Gulf of Cutch (Fig. 39).

The salinity values were noticeably higher than in February, especially in the northern regions, and a tongue of high salinity was observed to extend eastwards in the region off Bombay (Fig. 40). Probably this was an extension of the northern high-saline waters spreading to the lower latitudes. Again the distribution of dissolved oxygen content was uniform, unlike in the predious months, the 4.6 ml/L isopleth extending meridianally in the whole of the region (Fig. 41).

The conditions during middle June in the area from Panjim to Cutch indicated a predominance of eddies, especially in the northern regions. Thermal distribution was again uniform and the monsoon conditions were not clearly perceptible (Fig. 42). A noticeable increase in the salinity values in the region north of Bombay was another feature that was unusual but due south of Bombay salinity values were lesser and a uniformity could be observed (Fig. 43). More or less two distinct zones of salinity with the zonal boundary off Bombay could be visualised.

The dissolved oxygen values in the region due north of the above zonal boundary were conspicuously higher than the southern values. The highest values, viz., 7 ml/L and more, were observed off Jamnagar which feature can again be considered peculiar considering the conditions along the southwest coast of India. But the uniformity of distribution was more developed in the region south of Bombay (Fig. 44).

In September, when usually the intense activity of the south-west monsoon along the west coast of India had mostly weakened, the surface waters had already become warmer after monsoon, which feature could be observed in the region Panjim to Bombay and a strikingly uniform distribution was observed (Fig. 45). Due north of the zonal boundary mentioned elsewhere, a weak northeastward gradient in temperature could be observed and it was developed well off Jamnagar. Probably this marked the remains of the previous monsoon when there would have been a strong southward drift and a coastward temperature gradient. A southeastward flow was indicated from the temperature distribution pattern.

The salinity values showed a decided decrease than in June, although there was a more or less uniform distribution (Fig. 46). The zonal boundary off Bombay was not well defined during September, unlike in June. Precipitation and run-off from the land during the monsoon could be attributed as a probable cause for the decrease in the salinity and uniformity of its distribution. But the dissolved oxygen showed a peculiar distribution pattern during the post-monsoon period (September), in the sense that a high degree of uniformity was observed in the surface layers (Fig. 47). Still the higher values in the northern region were maintained, compared to the southern regions of investigation.

During late October the waters had become warmer especially in the region between Panjim and Bombay. The weak temperature gradients observed during September were still present in the region off Jamnagar with a changed direction, i.e., the gradients were now northward, indicating an eastward flow (Fig. 48). Unlike in the previous month, the salinity values in the northern region were a bit lower than in the southern ones (Fig. 49). The occurrence of this low saline zone where the temperature gradients were developed was noteworthy. The weak eastward salinity gradients off Bombay could again be attributed to the effects of run-off from the land occurring during the previous monsoon.

Due south of Veraval the distribution of dissolved oxygen was uniform, but in the region of the temperature gradient off Jamnagar, a southward gradient in dissolved oxygen values was observed (Fig. 50). The pattern of distribution of the isotherms and the dissolved oxygen isopleths were quite comparable, and integrating both it can probably be taken as a local phenomenon occurring as an after-effect of the south-west monsoon. The anticyclonic movement in the Arabian Sea during monsoon got weakened by October and the above-mentioned feature might be the remains of the large-scale movement which had already faded in the Arabian Sea to a considerable extent.

ZOOPLANKTON

Vertical hauls using an Indian Ocean Standard Net were made for the collection of zooplankton samples during the three seasons, namely, premonsoon (February-March), southwest monsoon (June-August) and post-monsoon (October-December). The samplings were done from a standard depth of 200 metres to surface, or from bottom to surface where the depth was less than 200 metres. A total of 48 samples was collected during the pre-monsoon season, 49 in the

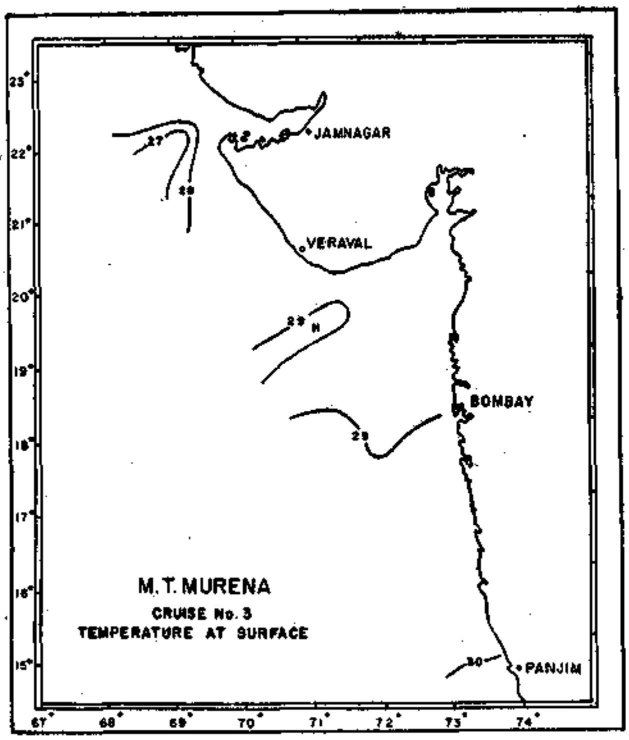


Fig. 39. Distribution of surface temperature (°C) values during Cruise III.

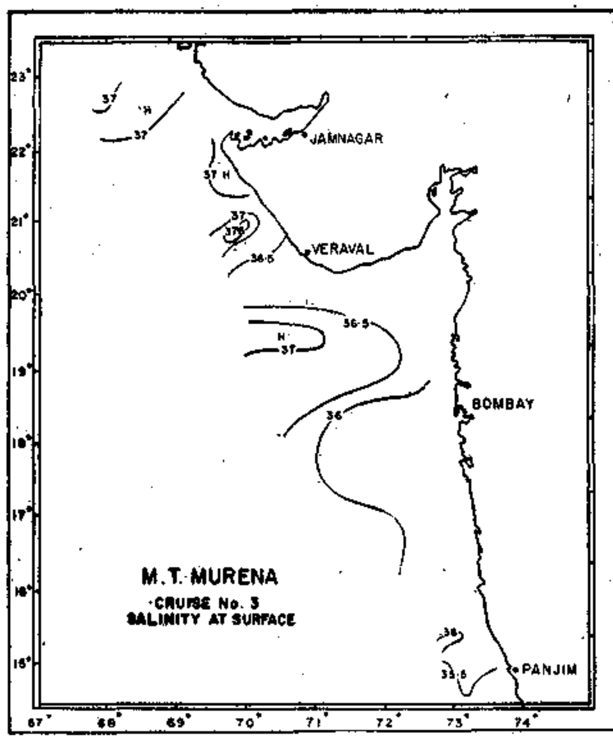


Fig. 40. Distribution of surface salinity (‰) values during Cruise III.

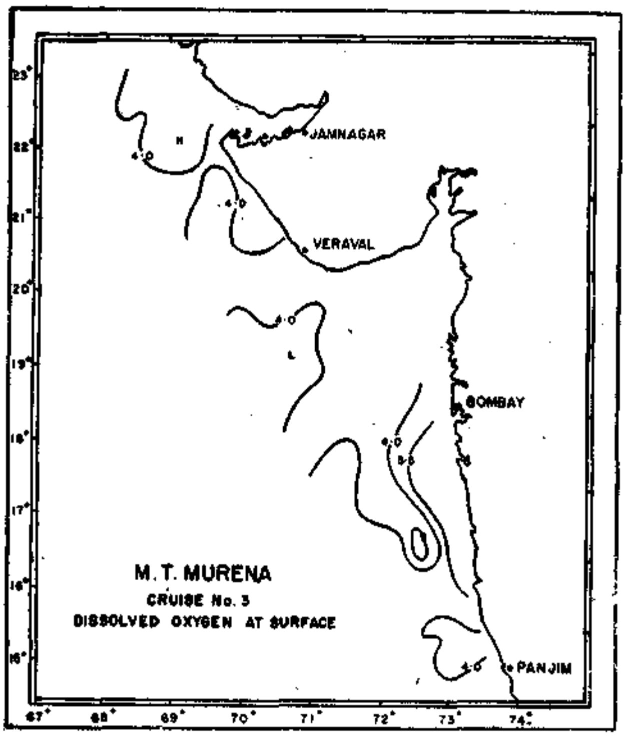


Fig. 41. Distribution of surface dissolved oxygen (ml O_2/l)values during Cruise III.

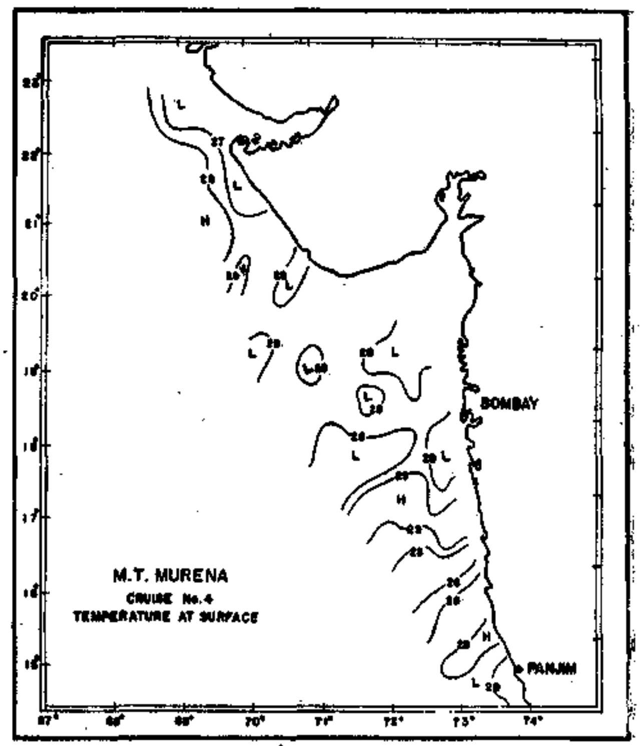


Fig. 42. Distribution of surface temperature (°C) values Cruise during IV.

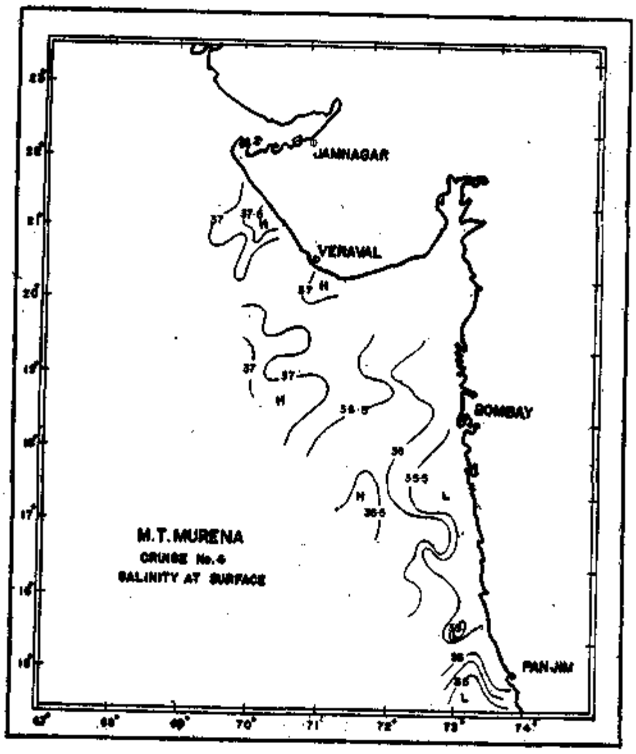


Fig. 43. Distribution of surface salinity (‰) values during Cruise IV.

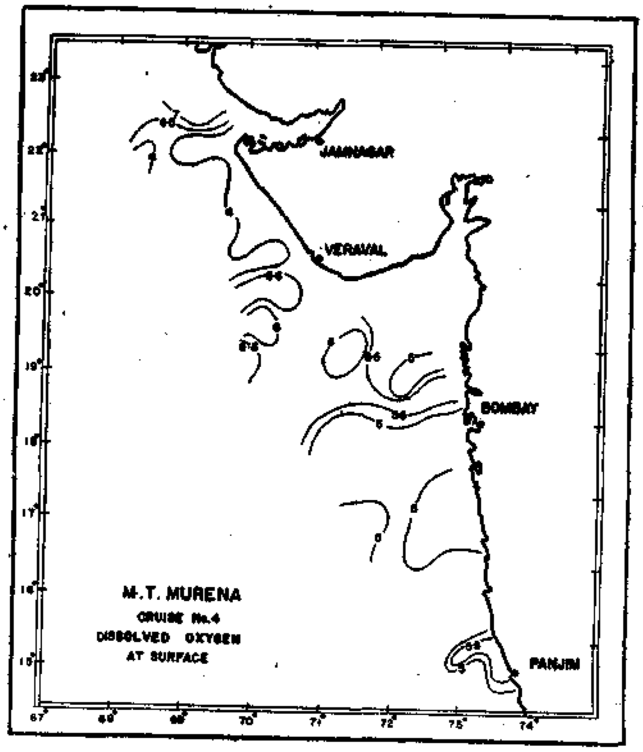


Fig. 44. Distribution of surface dissolved oxygen (ml O_2/l) values during Crusie IV.

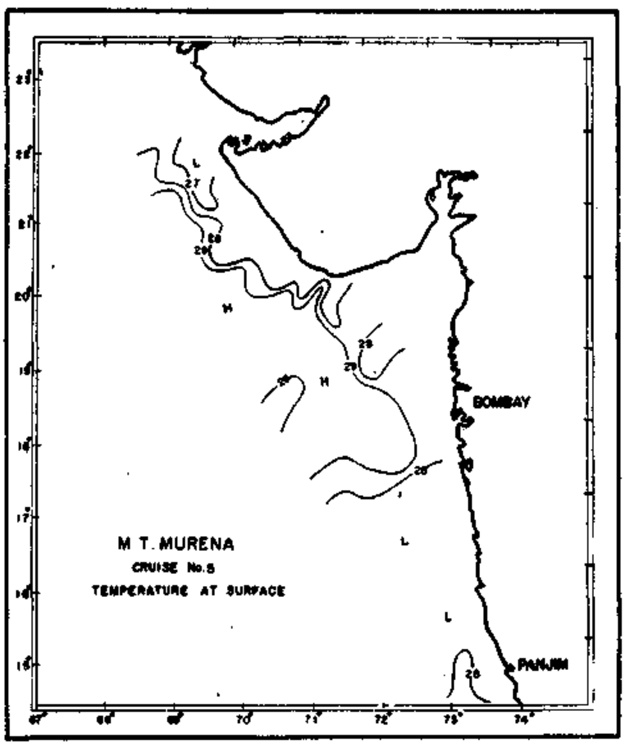


Fig. 45. Distribution of surface temperature (°C) values during Cruise V.

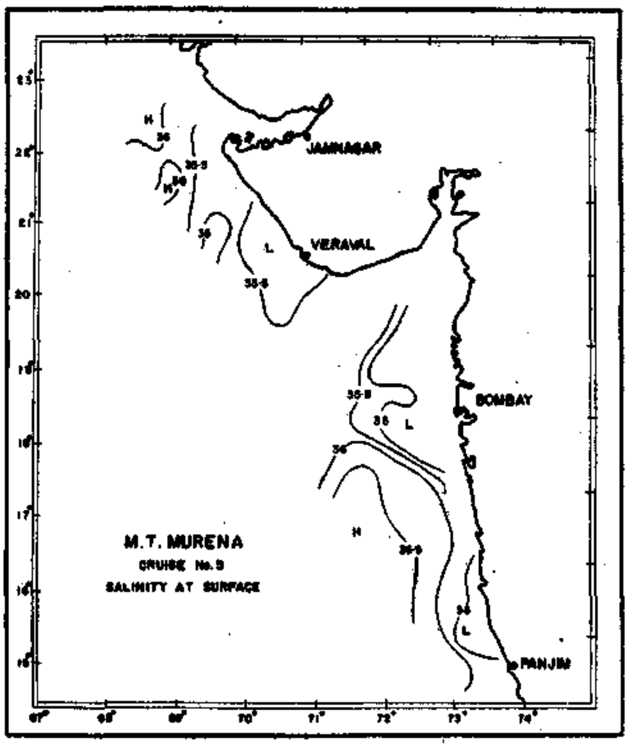


Fig. 46. Distribution of surface salinity (‰) values during Cruise V.

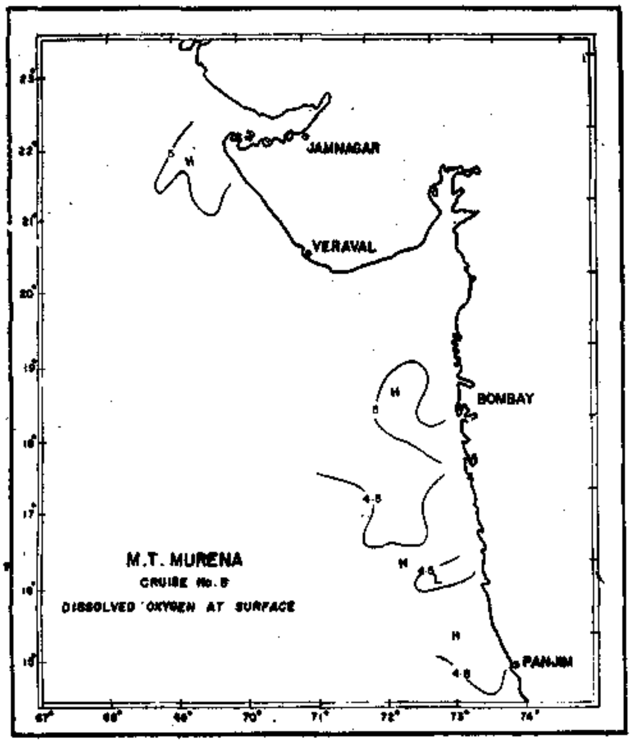


Fig. 47. Distribution of surface dissolved oxygen (ml O_2/l) values during Cruise V.

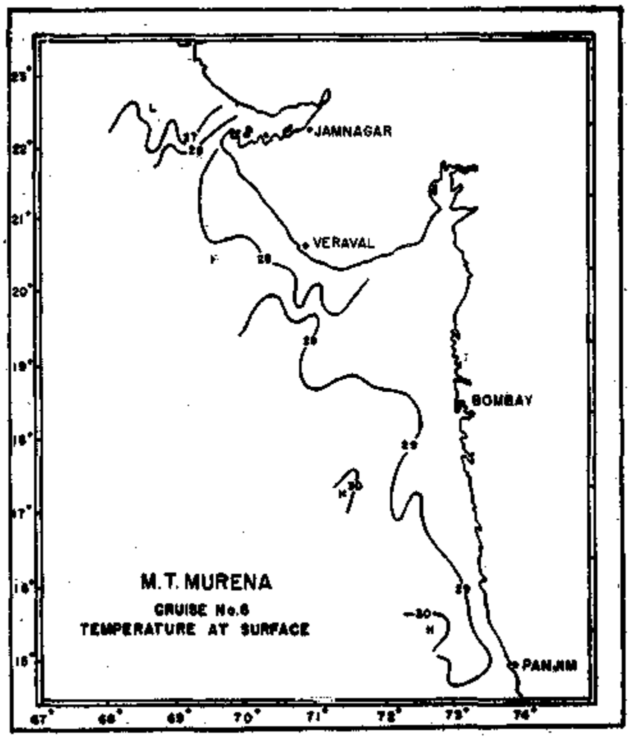


Fig. 48. Distribution of surface temperature (°C) values during Cruise VI.

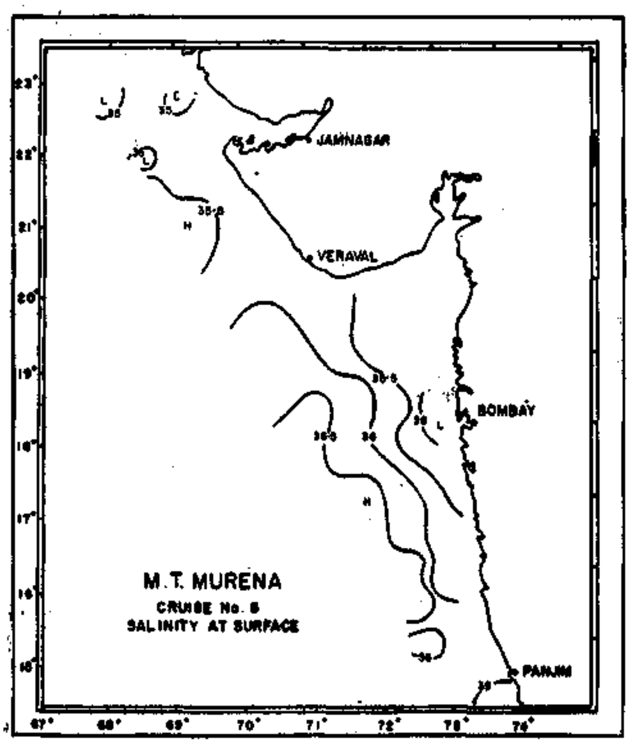


Fig. 49. Distribution of surface salinity (‰) values during Cruise VI.

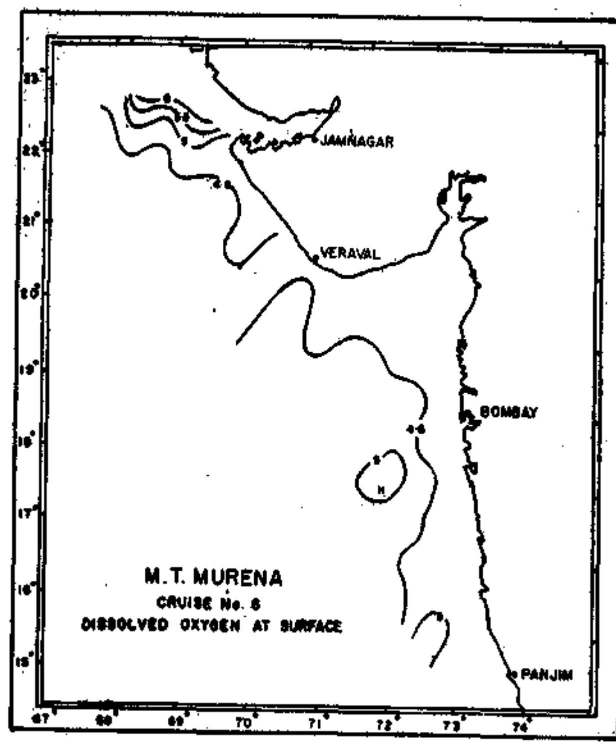


Fig. 50. Distribution of surface dissolved oxygen (Ml O°_2/l) values during Cruise VI.

monsoon season and 133 during the post-monsoon season. The plankton biomass was estimated by the displacement method. For detailed studies an aliquot of the total sample was analysed and the major groups were enumerated. With the data thus obtained a comparative study of the groups of zooplankters obtained in different seasons has been made and the results are given below.

The zooplankters were categorised into 23 groups, which were present in all the three seasons in varying proportions. Groups like echinoderm larvae, brachiopod larvae and cephalopod larvae, which were represented by extremely negligible numbers in one season or the other, were not taken for detailed study.

In the 48 pre-monsoon samples 22,56,094 individual zooplankters belonging to 23 different groups were present. The bulk was constituted by the copepods (20,99,226). The total number of zooplankters was less during the southwest monsoon season. The 49 samples gave a total count of 3,84,763 plankters, of which the copepods made up only 2,77,225. During the post-monsoon season there was a slight improvement over the monsoon season, the 133 samples yielding 14,37,243 organisms, of which 11,39,084 were copepods.

Relative Abundance of Zooplankters in Different Seasons

a. *Pre-monsoon*

Of the total zooplankton obtained, 93.047% was constituted by copepods which was the largest single group. Next in abundance in this season came the ostracods which formed 2.4% only. Chaetognaths with 2% stood close to the ostracods. Excepting copepods, ostracods and chaetognaths all the other 20 groups were meagrely represented.

The relative abundance of the copepods varied greatly in individual samples. In two samples, for instance taken from 15° 15′ N-73° 14′E, ostracods dominated over the copepods. In one sample, when 4,310 ostracods were present only 3,630 copepods occurred. Similarly in a second sample 5,210 ostracods and 4,340 copepods were present. In another sample taken at 16° 31′ N-73° 00′E, even though the copepods were the dominant group with 1,480 individuals, the ostracods with 1,060 specimens was close behind it. In one sample taken at 19° 59′ N-70° 29′E, the copepods were totally absent. However, this was a poor sample from the point of view of the number of groups and their numbers. The major group was chaetognath, constituted by 150 organisms.

Fish eggs were the least represented group and formed only 0.002% in the total zooplankton. The fish larvae were more (0.064%).

b. *Southwest Monsoon*

During the monsoon season too the copepods remained the most dominant group though relatively less in number than in the pre-monsoon period. Their percentage contribution in the total zooplankton was 72. The chaetognaths with 11.6% came next in abundance. This was followed by appendicularians (3.3%) and decapod larvae (2.8%). Other groups of zooplankters which had more than 1% share in the total zooplankton of the monsoon season were, ostracods (1.5%), polychaetes (1.3%), *Lucifer* (1.3%), salps (1.1)% and doliolids (1.1%). All the other groups were but meagrely represented (Table 17). Lamellibranchs, heteropods, Mysidacea, and Euphausiacea, were the less represented groups in this season.

Copepods were more abundant in all stations except in station 13, sampled on 20-6-'77, where the ostracods dominated by a small margin. In station 113, sampled on 16-8-'77, *Lucifer* had out-numbered the copepods by a few hundreds. In two other stations though copepods were the numerically abundant group they were closely rallied by some other groups. Thus at station 14, sampled on 20-6-'77, when 1410 copepods were present, the next abundant group, the ostracods, were represented by 1060 specimens. Similarly at station 121, sampled on 20-8-'77, the number of copepods was 2,768 followed by 2,168 chaetognaths. At station 27, sampled on 1-7-'77, the copepods were completely absent, the sample being mostly of salps (760 numbers). Only five groups of zooplantkon, including fish eggs and larvae, made up this sample and the total number of zooplankters was 865 only.

Though not forming a substantial part of the plankton in this season fish eggs were more abundant than in the pre-monsoon period. Fish larvae were comparatively more than in the earlier season.

c. *Post-monsoon*

Copepods (79,257 numbers) formed the dominant group in this season also, though far less in abundance than in the pre-monsoon period. The chaetognaths, as in the monsoon period, formed only 7.99% and came next to copepods in abundance. The third place was taken up by ostracods which was the second abundant group during the pre-monsoon period. The cladocerans were also relatively more (2.2%) in this season and this was the period of maximum occurrence of this group. Decapod larvae and appendicularians made up more than 1% in the plankton.

Of the 133 samples examined during the post-monsoon season all except five samples were dominated by the copepods. Of these five, in one sample collected from 15°16′N 73°34′E, the cladocerans (22,400) dominated over the copepods (10,400). At 23°00′N 67°50′E the chaetognaths with a total number of 2,258 edged over copepods which had 2,024 individuals in the sample. In the third sample collected at 22°28′N 68°11′E 4,780 decapods were present while the copepod number was as low as 2,250. The dominant group in the sample taken at 28°18′N 70°30′E was formed by the polychaetes which had 4,170 individuals against 2,530 of copepods. In the fifth sample the ostracods (2,530) were slightly more abundant than the copepods (2,500).

In this season the fish eggs contributed 0.148 %while the fish larvae had a lesser share of 0.132 %.

Remarks

The copepods were more abundant in the pre-monsoon season, while ostracods, chaetognaths and appendicularians in varying strength in the three seasons, took up the next three positions.

There were some groups which were relatively more abundant in the monsoon and post-monsoon seasons than during the pre-monsoon season. These included decapod larvae which formed 2.806 % and 0.766 % and polychaetes 1.278 % and 0.488 % in the respective seasons.

Of all the groups the least represented in all the three seasons were the planktonic molluscs such as lamellibranchs followed by heteropods, though pteropods were relatively more abundant than the other molluscs.

Although the salps and doliolids did not make a substantial portion of the total plankton in any of the seasons their dominance in certain samples caused decreased availability of other planktonic groups. This could be due to the highly predatory nature of salps and doliolids.

Mysidacea, Euphausiacea and heteropods were the three groups which were least represented in the monsoon samples.

TABLE 20. *Relative Abundance (in percentage) of Zooplankton in the Three Seasons*

	Zooplankton groups	Pre-Monsoon	Monsoon	Post-monsoon
1.	Foraminifera	0.590	0.996	0.754
2.	Siphonophora	0.316	0.749	0.595
3.	Medusae	0.077	0.596	0.203
4.	Cladocera	0.112	0.021	2.239
5.	Ostracoda	2.401	1.455	3.098
6.	Copepoda	93.047	72.044	79.257
7.	Amphipoda	0.087	0.738	0.245
8.	Mysidacea	0.045	0.004	0.044
9.	Euphausiacea	0.106	0.036	0.058
10.	Decapod larvae	0.208	2.806	1.275
11.	Stomatopod larvae	0.025	0.096	0.054
12.	*Lucifer*	0.121	1.264	0.766
13.	Chaetognatha	2.010	11.592	7.794
14.	Polychaeta	0.043	1.278	0.488
15.	Lamellibranchiata	0.005	0.002	0.003
16.	Gastropoda	0.022	0.119	0.033
17.	Pteropods	0.040	0.313	0.512
18.	Heteropods	0.007	0.003	0.026
19.	Salps	0.380	1.093	0.483
20.	Doliolids	0.045	1.055	0.061
21.	Appendicularians	0.250	3.280	1.075
22.	Fish eggs	0.002	0.199	0.148
23.	Fish larvae	0.064	0.252	0.136

IX

SUMMARY

1. The area of survey, extending from 15° to 24°N latitude and lying between 55 and 360 metres depth covers 30,067 sq. nautical miles.

2. A major portion of the shelf region fished was soft ground, comprising sand, mud, silt and clay. The deeper strata of zones II, VI, IX and X, the inshore strata of zones IV and VI and the middle strata of zones IV and V showed hard bottom with coral or rock.

3. A total of 247 bottom hauls and 542 pelagic hauls were made during the entire survey.

4. A total of 259 species of fishes, crustaceans and cephalopods was recorded in the course of the survey. For purposes of this investigation, they were grouped into 29 major groups.

5. M.T. MURENA made 247 bottom hauls and landed a total catch of 73,073 kg of fish expending an effort of 397.55 hr and yielding a catch rate of 183.81 kg/hr. Of the three depth-zones, the maximum catch of 43,207 kg and catch rate of 201.76 kg/hr came from 55-90 m, and, generally, a declining trend with increasing depths was noticed.

6. Pelagic trawling brought in 4,30,760 kg of fish for a fishing effort of 1071.34 hr at an overall catch rate of 402.08 kg/hr. The shallower areas of 55-90 m depth range gave the higher catch and rate figures by pelagic trawl also, though the middle depths of 91-125 m, particularly off Okha, yielded particularly high catch rates, mainly because of the catches of the horse-mackerel. The elasmobranchs were more abundantly caught from the 55-90 m depth than from other ranges.

7. The sharks were represented by 12 species. They were fairly abundant in the depth ranges of 55-90 m and 91-125 m.

8. Rays were more abundant in pelagic trawling than in bottom trawling. A progressive decrease in the catch rates from 55-90 m to 126-300 m depth-ranges was noticed.

9. The depth range of 55-90 m yielded good catch of skates in both the gears.

10. The maximum catch rates of *Congresox talabonoides* were obtained from pelagic trawling in the depth range of 55-90 m.

11. The cat-fish was better represented in catches by the pelagic trawl than in bottom trawling. The southern strata were richer than the northern.

12. Pelagic trawling yielded better catch rates of clupeids.

13. The scopelid group (which includes Bombay-duck) accounted for very poor catches.

14. For *Pomadasys hasta* the catch rates obtained by bottom trawling were better. Most of the catch came from the depth range 55-90 m.

15. In bottom trawling good catch rates of *Lutianus* spp. were obtained in the 55-90 and 91-125 m depth ranges; whereas the catch came exclusively from the shallower depths in pelagic trawling.

16. *Mene maculata* was exclusively taken during pelagic trawling. Most of the catch was obtained from the 50-90 m depths.

17. The species *Nemipterus japonicus* was better represented in bottom trawl catches than in pelagic trawl. Catch rates increased with increasing depths and the highest catch rate was recorded in the 126-360 m depth range.

18. The serranids were mostly obtained by bottom trawling. Though they were caught in all depths, good concentrations were found in the 55-90 and 91-125 m depth ranges.

19. Perches and perch-like fishes were taken mostly in Cruises I and V from the depth range 55-90 m.

20. Pelagic trawling yielded better catches of *Protonibea diacanthus* ('Ghol'); the highest catch and catch rates were recorded from 55-90 m both by bottom trawling and pelagic trawling.

21. Yet another sciaenid, *Otolithoides brunneus* ('Koth'), was caught more during bottom trawling than in pelagic trawling. However, by both the gears good concentrations were noticed in the depth range 55-90 m.

22. The lesser sciaenids ('Dhoma') provided a sizeable catch mainly by bottom trawling.

23. Polynemids were recorded both in bottom trawl and pelagic trawl catches. The entire catch by pelagic trawl and the major part of the catch by bottom trawl came from 55-90 m depth range.

24. Next in importance to *Megalaspis cordyla*, the contribution of *Trichiurus* spp. was very significant both in bottom trawling and pelagic trawling, the bulk of the catch coming from depth range 55-90 m.

25. The discovery of a large resource of *Megalaspis cordyla* in the northern stratum 29 during February-April was the major contribution of the work of M.T. MURENA, since such large concentrations were not recorded earlier.

26. Among the carangids that grow to a large size, the only species recorded in the catch was *Carangoides chrysophrys*. Both bottom trawling and pelagic trawling yielded good catches of this species from the middle depth ranges (91-125 m).

27. 'Other carangids' were caught more by pelagic trawl than by bottom trawl. The bulk of the catch was from the shallower depths of 55-90 m.

28. Large catches of *Pampus argenteus* were obtained from the depth range 55-90 m by both types of trawling. A declining trend in deeper waters was noticed.

29. *Apolectus niger* is also a single-species fishery, and its contribution far more than of *P. argenteus*. Pelagic trawling is more effective than bottom trawling for this species and the depth range 55-90 m was more productive.

30. The scombroids made poor contributions in the catches of M. T. MURENA, though relatively better catches of this group were obtained from pelagic trawling than from bottom trawling. The shallow range of 55-90 m as more productive for both types of trawling.

31. The contribution of the tunnies both in bottom trawl and pelagic trawl catches was very meagre. Pelagic trawling yielded relatively better catch rates. As in the previous group, the shallower areas were more productive.

32. Flat fishes were scarse in the catches of M.T. MURENA. They were recorded exclusively from the shallow depths of 55-90 m in bottom trawling.

33. Prawns, crabs and lobsters had but token representation in the catches of M.T. MURENA.

34. Amongst cephalopods recorded in the catches, three species *Sepia aculeata, S. pharaonis* and *Loligo duvaucelii* were met with frequently. Major catches were obtained in the depth range 55-90 m both by bottom trawling and pelagic trawling.

35. Based on biological observations on selected groups an account is given of the size groups, and probable age (from study of scales and otoliths) of the important categories.

36. From an analysis of data on maturation and spawning of 38 species the month-wise, strata-wise and depth-wise percentage distribution of different maturity stages is given. Based on the occurrence of spent and running individuals, the probable spawning season and grounds for some of the species studied are indicated. The distribution of males and females with reference to month, depth and stratum is furnished. Ova-diameter studies were carried out in respect of *Apolectus niger* and *Trichturus lepturies* to determine the spawning periodicity in these species. Notes on the food of *Megalaspis cordyla* and *Rastrelliger kanagurta* are also given.

37. Based on data obtained from bottom trawling operations in the depth zone 55-360 m, for an area of 1,34,566 sq. km the total estimated resource has been estimated as 2,46,819 metric tonnes on the basis of densities at 1.89 m.t/sq. km or 19 kg/ha and the potentially sustainable yield at 60% was 1,48,091 metric tonnes Compared with similar estimated figures for other areas along the west coast, this marks the present one as relatively poor

X

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XI

ANNEXURE A

CODES USED FOR FILLING THE PROFORMAE

BOTTOM TYPES	Gravel	1
	Sand	2
	Silt (Mud)	3
	Clay	4
	Shell	5
	Coral (Rock)	6
TIME OF SHOOTING	2400-0359	1
	0400-0759	2
	0800-1159	3
	1200-1559	4
	1600-1959	5
	2000-2359	6
GEAR TYPE	Bottom trawl 33/37	1
	Pelagic rope trawl 64 × 11 × 59/92	2
	Pelagic trawl 59 × 88 × 53/66	3
PERFORMANCE	No damage, haul representative	0
	Slight damage, haul representative	1
	Serious damage or malfunction, haul not representative	2
	Possible damage or malfunction but insufficient information—catch data may not be representative.	3
Duration of haul	130 min	13
	95 ,,	9
	120 ,,	12

ANNEXURE B

Hydro Master Card, Code 01
Hydro Depth Card, Code 03

Year: Name of the country: Name of Ship:

Country	Ship	Station No	Lat °	Lat	Long °	Long	N S E W	Date Yr	Date Mo	Date Day	Station time (IST)	Depth to bottom m	Pressure of Hg. mm	Max. Obs. dep. m	Mix. layer dep.	Wind Dir	Wind SP m/sec	Temperature Dry bulb °C	Temperature Wet bulb °C	Weather	Cloud amount	State of sea	Ice		Code No.

			Obs time.	Obs. depth.	Temp.	Sal		Mean	$D.10^5$	Oxygen ml/l	Oxygen %		Sal method	Extra Info-	

Available extra information should be sent in on separate sheet

Punched by (Date)

Remarks:

Normally not filled in.

Checked by (date)

ANNEXURE C

DEMERSAL AND PELAGIC CATCH FORM

Sheet no ...

	CRUISE NO.	STATION NUMBER	Date YEAR	MONTH	DAY	SUBSTRATE NUMBER	Position LATITUDE	LONGITUDE	TIME OF SHOOTING	B.T. STATION NUMBER	HYDROLOGY STATION NUMBER	PLANKTON STATION NUMBER	SALININITY
3	4	7	9	11	13	15	19	23	24	27	30	33	36

OXYGEN	TEMPERATURE	THERMOCLINE DEPTH	BOTTOM TYPE	HAUL NUMBER	MAX. BOTTOM DEPTH	MIN. BOTTOM DEPTH	MEAN FISHING DEPTH	WARP OUT	GEAR TYPE	PERFORMANCE	DURATION OF HAUL	WEIGHT OF CATCH
39	42	44	45	48	51	54	57	60	61	62	64	69

SPECIES	WEIGHT OF SPECIES	CARD TYPE	REMARKS	SPECIES	WEIGHT OF SPECIES	CARD TYPE	REMARKS
74	79	80		74	79	80	

ANNEXURE D

DATA FORM FOR COLLECTING LENGTH FREQUENCY INFORMATION

SPECIES........................ CRUISE.........................

LENGTH IN CM. STATION.........................

Lnth		Lnth		Lnth		Lnth	
5		32		59		86	
6		33		60		87	
7		34		61		88	
8		35		62		89	
9		36		63		90	
10		37		64		91	
11		38		65		92	
12		39		66		93	
13		40		67		94	
14		41		68		95	
15		42		69		96	
16		43		70		97	
17		44		71		98	
18		45		72		99	
19		46		73		100	
20		47		74		101-105	
21		48		75		106-110	
22		49		76		111-115	
23		50		77		116-120	
24		51		78		121-125	
25		52		79		126-130	
26		53		80		131-135	
27		54		81		136-140	
28		55		82		141-145	
29		56		83		146-150	
30		57		84		151-155	
31		58		85		156-160	

ANNEXURE E

Lenght Frequency Form. Sheet no. ....

			DATE				POSITION							
	CRUISE NO.	HAUL NUMBER	YEAR	MONTH	DAY	PROJECT	LATITU-DE	LONGI-TUDE	MEAN BOTTOM DEPTH	MEAN FISHING DEPTH	SHOOT TIME	EFFORT	SPECIES	
3	4	7	9	11	13	14	18	22	25	28	29	31	- 36	37

LEN-GHT	Number of fish	MALES					FEMALES					TOTALS				IDEN. NOT	C. T.	REMARKS
		I	III -V	VI	VII -II	To-tal	I	III -V	VI	VII -II	To-tal	I	III -V	VI	VII -II			
40	43	45	47	49	51	54	56	58	60	62	65	68	71	74	77	79	80	

ANNEXURE F

Age Frequency Form Sheet no ....

			DATE				POSITION							
	CRUISE NO.	HAUL NUMBER	YEAR	MONTH	DAY	PROJECT	LATI-TUDE	LONGI-TUDE	MEAN BOTTOM DEPTH	MEAN FISHING DEPTH	SHOOT TIME	EFFORT	SPECIES	
3	4	7	9	11	13	14	18	22	25	28	29	31	36	37

LEN-GHT	AGE /Number of fish/											TOTAL	C. T.	REMARKS
	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10	10>			
40	43	46	49	52	55	58	61	64	67	70	73	75	79	80	