

Demersal fishery resources of monsoon months along central west coast of India

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An attempt is made to assess the potential demersal resources of the central west coast of India between lat. 13°N- 18°N, long 71°-74°E during the southwest monsoon (June-Sept) season, from the data collected from 1983-1993. The monsoon period fishery resources are identified as nemipterids from July to September in zone II (100-200 m) between lat. 13°N-17°N. Priacanthids are found in patches mainly between lat.14°-16°N. The reefcods are found distributed along lat. 14°-15°N in zone I and II during the end of August and September months and lat.14°-18°N in zone II during the end of September. The resources are concentrated in the region off Bhatkal and Vengurla respectively. Cephalopods are found concentrated between lat. 13°-15°N especially from 80 m-130 m from July to October from Mangalore to Bhatkal. Mackerels in the catches are found during June and July months along lat. 13°-14°N in zone I off Mangalore. Some resources which are known to concentrate during monsoon months therefore can be exploited judiciously.

The fishery resource along west coast during monsoon season remained largely unexploited until recently. Now with the operation of all weather vessels fishing has been a reality during monsoon season. The fish landing during monsoon is well documented, particularly along west coast¹⁻¹¹.

The demersal resources in 50-200 m depth during monsoon and early part of the postmonsoon season along Karnataka, Goa and south Maharashtra (lat. 13°-18° N) coast were studied (Fig. 1), and the distribution and abundance is discussed in this paper.

Materials and Methods

The data collected by two identical survey vessels *Matsya Vishwa* and *Matsya Shakti* (GRT 327.18 t, OAL 36.5 m, HP 825) from 1983 to 1993 are used for study. The gear used were 27 m fish trawl up to 100 m, and 47 m shrimp trawl beyond 100 m depth. The catch rates are computed separately for shallow water from 50-100 m depth (zone I) and deeper water between 100 m to 200 m depth (zone II). The sampling distribution for monsoon months (June, July, August and September) and early postmonsoon season is presented in Table 1.

Results and Discussion

The changes in overall catch rate during monsoon and postmonsoon is presented in Fig. 2. It may be seen that the resources during monsoon months are generally more in the zone I than zone II. There is decrease in catch rate in both the zones as monsoon advances. Decrease is sharp in the

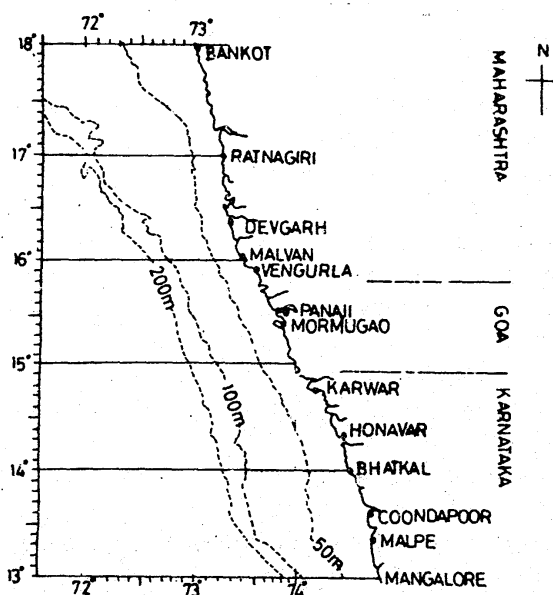


Fig. 1—Study area

Table 1—Sampling distribution				
Month	50-100 m		100-200 m	
	No. of hauls	Effort (hours)	No. of hauls	Effort (hours)
May	415	(625.53)	170	(256.42)
June	339	(518.36)	161	(243.12)
July	334	(502.31)	107	(163.22)
Aug	361	(543.20)	133	(202.18)
Sept	445	(670.18)	190	(288.28)
Oct	317	(477.13)	159	(242.02)
Nov	297	(448.54)	152	(228.46)

deeper water up to July which picks up as season advances to postmonsoon months of October and November. The catch rate in zone I which was higher than zone II up to August steadily decreased during monsoon to touch lowest rate during September followed by an increase of rather lowest magnitude than in zone II.

Some of the commercially important fishes like seer fishes, elasmobranchs and some carangids appeared in the monsoon catches. Elasmobranchs and carangids were found in appreciable quantities in July and August but occasionally. Pairs (male and female) of eels off Goa coast, and stray seer fishes off Karwar are also sometimes caught in the area of study during monsoon months. The catch was dominated by the fishes discussed below in the order of their abundance. The monthwise and zonewise catchrate of fishes has been presented in Table 2 and that of cephalopods in Table 3.

Rani fish (Nemipterus sp.)—Nemipterids were concentrated mainly in zone II and catch rate reduced steadily to negligible quantity during July and August followed by an increase in the postmonsoon season. In the zone I the catch rate was lower than in zone II before the onset of monsoon. However, it increased slightly during the monsoon months up to August thus coinciding with decrease in the catch rate in zone II. Such shoreward migration of nemipterids have been ascribed to upwelling¹².

Most of the nemipterids were from deeper waters of lat. 13°-15°N. The increase in postmonsoon catches in deeper waters was largely observed in lat. 14° and 15°N. The shallow water migration was discernible in lat. 13°-15°N and to some extent in lat. 17° N. During postmonsoon

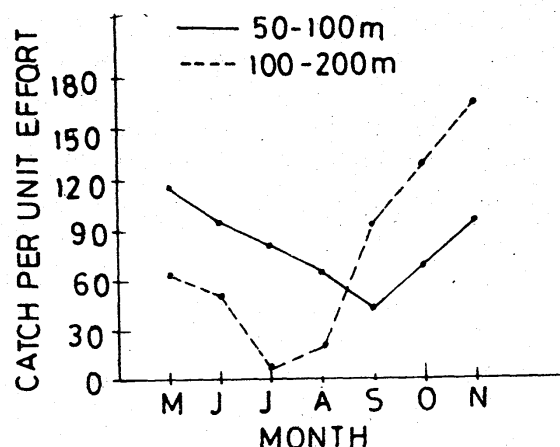


Fig. 2—Overall catch rates in the study area:

season catch rate in zone I remained quite low except along lat. 16° N and 13° N.

Ribbon fish (Trichiurus sp.)—This resource is mainly concentrated below 100 m depth region i.e. zone I. As monsoon advances, the ribbon fish abundance decreases (except July) up to September. In the zone II they were found throughout the area of study but in smaller quantities. In zone I off Mormugao and Vengurla this resource registered up to 43.75 kg/hr. Whereas in zone I off Bhatkal the abundance was 32.42 kg/hr and off Ratnagiri was 38.26 kg/hr especially during monsoon months.

Bull's eye (Priacanthus sp.)—This species was found in deep waters. Not much change in abundance was observed during monsoon months in shallow water (zone I). But in zone II the changes are quite pronounced. The resources steadily increased during postmonsoon months in zone II with increased concentration, this trend is seen almost throughout the study areas. High catch rate during postmonsoon months was more pronounced along Goa coast and at lat. 17°N.

Cat fish (Arius sp.)—Cat fish resource was abundant in shallow region during onset of monsoon. It decreased as monsoon advanced and started appearing during postmonsoon months. This trend was pronounced throughout the area with small regional changes. Cat fish in zone II is almost absent north of Bhatkal. In the shallow regions off Goa, Malpe, Kundapur and Ratnagiri, catch rate was high just before the onset of monsoon. Concentration of cat fish decreased almost to negligible quantity during June, July and

Table 2—Catch per unit effort of different demersal fishery resources during monsoon season for various locations and months

Months Fishes	Area Lat.	May	June	July	August	September	October	November
1. Rani fish	13°N**	15.0/9.91	37.10/36.33	18.93/0.12	76.75/0.82	21.91/31.95	31.19/3.95	8.5/74.61
	14°N	5.83/140.2	0.62/ND	1.29/ND	Nil/Nil	6.56/198.6	Nil/90.55	33.66/20.0
	15°N	65.88/95.0	17.58/7.76	61.04/1.19	4.88/4.88	4.06/46.54	6.52/77.0	28.44/52.75
	16°N	3.24/Nil	ND/ND	ND/ND	40.5/ND	71.5/ND	0.05/3.5	Nil/Nil
	17°N	15.53/11.97	22.53/Nil	2.99/0.2	1.64/Nil	0.33/4.12	7.2/Nil	5.50/4.5
	OA	26.45/51.93	25.58/25.91	28.28/0.39	37.16/2.64	10.35/32.54	17.87/89.12	13.68/53.88
		0.98/1.17	0.97/Nil	21.18/0.08	2.52/1.21	Nil/1.14	Nil/1.40	0.02/2.60
2. Ribbon fish	13°N	10.22/0.66	32.47/ND	5.48/ND	Nil/Nil	3.8/Nil	Nil/7.0	Nil/Nil
	14°N	47.15/1.18	43.75/Nil	42.66/Nil	0.42/Nil	0.01/0.41	8.76/0.09	21.68/0.56
	15°N	7.87/Nil	ND/ND	ND/ND	Nil/ND	Nil/ND	Nil/Nil	59.40/Nil
	16°N	38.53/1.90	15.21/Nil	38.76/Nil	19.43/0.78	0.04/0.01	7.30/Nil	1.2/1.04
	17°N	4.48/7.57	6.99/22.98	4.79/5.62	10.44/21.53	15.90/30.47	25.30/46.74	16.20/74.70
	OA	7.58/7.65	10.04/27.30	10.83/3.68	6.90/5.25	9.7/31.94	7.59/11.08	7.66/12.95
		0.04/7.38	Nil/ND	Nil/ND	0.09/0.5	37.06/11.08	4.28/33.2	33.53/Nil
3. Bulls eyes	13°N	7.63/8.98	0.36/14.93	3.92/11.07	29.6/36.42	16.93/85.82	5.89/49.98	4.42/147.13
	14°N	0.14/25.0	ND/ND	ND/ND	Nil/ND	49.9/ND	14.74/8.8	2.0/Nil
	15°N	4.61/1.88	0.41/2.14	2.18/8.4	3.15/28.15	13.90/54.0	34.85/104.5	2.08/71.22
	16°N	4.48/7.57	6.99/22.98	4.79/5.62	10.44/21.53	15.90/30.47	25.30/46.74	16.20/74.70
	17°N	71.92/Nil	36.06/Nil	2.95/Nil	Nil/Nil	0.18/Nil	Nil/Nil	35.16/7.68
	OA	5.16/Nil	0.04/ND	19.35/ND	0.13/ND	Nil/Nil	Nil/Nil	4.55/Nil
		90.0/Nil	97.32/Nil	2.25/Nil	0.98/Nil	0.12/Nil	20.37/Nil	80.0/Nil
4. Cat fish	13°N	12.59/Nil	Nil/ND	Nil/ND	3.06/ND	Nil/ND	Nil/Nil	22.08/Nil
	14°N	9.99/Nil	21.13/Nil	1.95/Nil	0.15/Nil	Nil/Nil	3.6/Nil	3.41/Nil
	15°N	46.17/0.003	36.01/Nil	7.88/Nil	0.12/Nil	0.17/Nil	6.30/46.15	46.15/3.64
	16°N	9.0/8.30	7.19/7.0	6.5/0.42	16.93/2.59	6.49/15.31	2.22/1.27	13.11/12.19
	17°N	Nil/4.33	Nil/Nil	Nil/Nil	Nil/Nil	Nil/0.33	Nil/0.27	Nil/Nil
	OA	4.97/13.85	3.93/1.58	1.04/1.25	0.44/2.32	0.46/3.60	0.06/3.52	0.24/3.2
		0.23/Nil	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil	Nil/26.6	Nil/Nil
5. Lizard fish	13°N**	0.92/6.11	Nil/Nil	0.63/1.4	0.07/Nil	0.43/4.9	0.05/Nil	Nil/2.75
	14°N	15.12/1.7	6.87/0.02	18.9/0.03	0.14/Nil	0.28/0.09	3.34/0.06	13.5/18.66
	15°N							
	16°N							
	17°N							
	OA							

Contd

Table 2—Catch per unit effort of different demersal fishery resources during monsoon season for various locations and months—Contd

Months Fishes	Area Lat.	May	June	July	August	September	October	November
6. Perches	13°N	4.76/0.09	0.52/Nil	0.80/Nil	0.99/0.25	0.71/3.31	0.78/5.62	0.42/3.30
	14°N	0.66/7.37	Nil/ND	Nil/ND	Nil/Nil	40.02/36.43	1.0/11.41	4.66/Nil
	15°N	2.17/1.08	0.79/0.66	3.29/0.96	0.15/1.77	27.53/0.55	5.78/0.34	1.74/0.04
	16°N	Nil/Nil	ND/ND	ND/ND	Nil/ND	Nil/ND	Nil/2.66	3.4/16.6
	17°N	7.0/1.16	0.78/2.85	7.0/Nil	0.47/4.2	1.98/3.56	17.95/13.45	9.78/73.54
7. Mackerel	OA	4.28/1.13	0.06/0.33	3.47/0.23	0.62/1.34	11.16/4.92	11.33/3.91	3.17/12.8
	13°N	14.96/Nil	4.36/Nil	5.34/Nil	Nil/Nil	Nil/Nil	Nil/Nil	4.0/Nil
	14°N	3.70/Nil	19.0/ND	Nil/ND	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil
	15°N	1.15/Nil	0.18/Nil	3.31/Nil	0.01/Nil	Nil/Nil	1.23/Nil	1.19/Nil
	16°N	0.04/Nil	ND/ND	ND/ND	Nil/ND	Nil/ND	Nil/Nil	0.26/Nil
	17°N	0.48/Nil	0.05/Nil	Nil/Nil	0.12/Nil	Nil/Nil	Nil/Nil	0.14/Nil
	OA	5.49/Nil	3.38/Nil	1.14/Nil	0.03/Nil	Nil/Nil	0.23/Nil	2.17/Nil

*Zone I/Zone II, ND=No Data, OA=Overall, **=Area between lat 13°N and 14°N

Table 3—Catch per unit effort of Cephalopod resources during monsoon season for various locations and months

Months Fishes	Area Lat.	May *	June	July	August	September	October	November
1. Cuttle fish	13°N**	2.3/0.08	3.10/0.75	1.46/Nil	19.35/2.63	12.08/23.86	1.0/7.17	3.40/3.28
	14°N	Nil/Nil	Nil/ND	Nil/ND	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil
	15°N	1.69/0.27	1.16/0.65	2.44/1.5	0.98/1.76	1.84/2.25	Nil/65.90	8.99/30.45
	16°N	0.36/Nil	ND/ND	ND/ND	Nil/ND	Nil/ND	Nil/Nil	0.1/Nil
	17°N	0.47/Nil	0.10/Nil	0.01/5.0	0.65/Nil	0.61/0.18	0.11/0.39	3.10/21.52
2. Squid	OA	1.37/0.17	1.73/0.67	1.35/0.51	9.11/1.95	4.51/10.84	0.52/28.50	4.48/16.62
	13°N	0.55/0.02	0.06/0.10	3.59/Nil	0.77/0.48	0.15/16.91	0.01/18.80	0.87/2.66
	14°N	13.70/13.32	Nil/ND	Nil/ND	Nil/Nil	6.76/69.43	Nil/37.44	1.46/1.0
	15°N	0.43/Nil	0.37/0.82	Nil/Nil	0.81/Nil	0.20/0.85	0.14/0.48	2.70/0.61
	16°N	0.99/Nil	ND/ND	ND/ND	Nil/ND	1.25/ND	Nil/12.22	Nil/Nil
	17°N	0.80/0.69	0.02/Nil	1.15/Nil	0.01/Nil	Nil/Nil	0.72/Nil	0.82/2.34
	OA	1.23/1.20	0.14/0.28	1.70/Nil	0.36/0.20	0.54/13.2	0.06/8.90	1.15/1.80

*Zone I/Zone II, ND=No Data, OA=Overall, **=Area between lat 13°N and 14°N

first part of postmonsoon season, i.e. October-November. In the zone II it had scanty distribution during monsoon and postmonsoon. Migration of cat fish towards south during the southwest monsoon period from Karnataka¹³ may be one of the reason why the catch rate is low during postmonsoon months along Karnataka coast. The availability, abundance and yield of cat fish is however very much influenced by monsoon along the west coast⁷.

Cephalopods—Migration and distribution of cephalopod species is attributed to temperature, which can in turn be helpful for commercial exploitation¹⁴. They also appear to be opportunistic animals capable of rapidly expanding their population and occupy the niche left by depletion of other animals¹⁵.

Cuttle fish (*Sepia* sp.)—This resource was found mainly in zone II. During monsoon months, they were less in deeper waters and their presence is felt in shallow water as monsoon advances. In the zone II also the catch increases as monsoon advances but very high catch rate was observed during the postmonsoon months.

Catches found during monsoon were in zone I between Mangalore to Kundapur and Goa but in small quantities. August onwards, the catch increased in zone I and during September in the zone II along lat. 13°N which remains so for a short period. Along Goa coast also high catches were recorded in zone II during October which later shift to shallower waters as season advanced. Catch rate in deep water of lat. 17°N was comparatively low during monsoon months.

Squid (*Loligo* sp.)—Squid resource was found in zone I during monsoon season in small quantities which reduced further during postmonsoon season when catch rate increases in the zone II.

South of lat. 14° N, squid resource found more in zone I during mid July which was found to migrate deeper regions as season advances. Occurrence of large quantity squid¹⁶ during September-October in deeper water is attributed to increased seawater temperature. Higher catch rate of squids was also evident during postmonsoon especially off Goa and Malvan. High catch rate of squids in zone II especially along Karnataka coast is presently being exploited by Indian trawlers.

Lizard fish (*Saurida* sp.)—Distribution of lizard fish was almost identical in both the depth zones showing some seasonal fluctuations. The catch rate was more in zone II during premonsoon months and is lowered down in both zones as the monsoon advanced. They started appearing in zone I by August especially to the south of Bhatkal. These fishes appeared in zone II by the month of September along Karnataka and Goa coasts. Increased catch rates of lizard fishes during postmonsoon months mainly in deeper water has also been reported.⁹ But as the fishing season approached, the catch rate did not differ much between the zones showing scattering of the resources into the shallow waters. The deeper zones north of lat. 14°N continued to yield higher catch rates.

Perch (*Epinephelus* sp.)—Perches during monsoon season were found mainly in shallower waters. Catch rates were low in zone II during monsoon. In both the depth zones, the resources started appearing in larger quantities during postmonsoon season but more in zone I. During monsoon perches are found mostly along lat. 17°N, 15° N and 13° N. During postmonsoon months the catch rate increased for a month especially in lat. 14° N and 15° N and during September-October in lat. 17° N in zone II indicating a northward deep water migration of the resource.

Mackerel (*Rastrelliger* sp.)—The demersal catches of mackerel are from below 100 m depth. Their catch rate reduced as the monsoon advances and begins to appear in the same depth after monsoon. Demersal catches of mackerel are mainly caught from lat. 13° to 15°N found during pre and postmonsoon months in shallow water off Kundapur, Malpe and Bhatkal region. Large catches are hauled off Karwar up to 150-200 kg during June in shallow waters. Most of the mackerel catches are from shallow water during monsoon period¹¹ especially in large quantities along Goa and Karwar.

Changes in resource distribution pattern

The entire study period was divided into first half (1983-88) and second half (1989-93) in order to see changes if any in the catch rates in the two depth zones (Table 4) during the monsoon.

The rani fish shows a large change in their abundance. However during monsoon months the

Table 4—Catch per unit effort of different demersal fishery resources during first half (1983-88) and second half (1989-93) of the study period for various months

Months Fishes	Area Lat.	May *	June	July	August	September	October	November
1. Rani fish	Zone I	29.30/5.77	28.30/2.94	30.16/6.0	37.59/31.78	11.74/0.88	15.73/0.03	14.68/7.76
	Zone II	46.69/84.34	25.96/24.3	0.39/Nil	2.71/Nil	22.30/109.35	36.88/28.13	43.29/204.93
2. Ribbon fish	Zone I	20.0/72.69	18.49/23.39	34.24/2.41	7.19/0.18	0.01/1.86	5.01/Nil	3.79/37.37
	Zone II	1.71/0.34	Nil/Nil	0.06/Nil	0.15/Nil	0.63/0.41	0.52/4.34	1.6/Nil
3. Bulls eye	Zone I	4.28/5.98	7.83/Nil	5.17/Nil	11.04/0.03	10.75/Nil	20.31/67.6	7.03/70.52
	Zone II	7.61/7.28	23.30/15.2	5.64/Nil	22.07/Nil	33.31/Nil	50.24/12.2	80.15/Nil
4. Cat fish	Zone I	50.47/15.0	37.17/34.0	4.31/53.67	0.40/Nil	0.20/Nil	5.55/Nil	52.66/8.38
	Zone II	0.004/Nil	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil	3.89/Nil
5. Cuttle fish	Zone I	1.51/0.35	1.93/0.01	1.46/Nil	9.63/Nil	5.17/Nil	0.46/Nil	4.55/4.04
	Zone II	0.16/Nil	0.59/2.5	0.52/Nil	2.0/Nil	12.32/Nil	31.86/2.79	14.36/49.46
6. Squid	Zone I	0.66/5.39	0.15/0.03	1.83/Nil	0.38/Nil	0.23/2.76	0.59/0.15	1.28/0.38
	Zone II	0.12/8.0	0.07/5.2	Nil/Nil	0.21/Nil	1.10/103.70	6.91/24.89	1.91/67.0
7. Lizard fish	Zone I	5.14/1.11	4.79/0.17	3.28/Nil	8.30/Nil	2.64/0.04	0.88/Nil	6.68/2.68
	Zone II	10.65/2.68	5.23/4.5	0.65/Nil	2.25/Nil	11.64/0.35	2.02/4.31	7.52/Nil
8. Perches	Zone I	4.84/0.26	0.68/Nil	3.75/Nil	0.66/Nil	10.0/19.48	1.25/54.91	2.93/4.63
	Zone II	0.56/4.71	0.25/2.2	0.23/Nil	1.38/Nil	2.10/26.02	2.81/12.68	13.51/3.2
9. Mackerel	Zone I	5.45/6.0	2.07/14.0	1.19/Nil	0.04/Nil	Nil/Nil	0.20/0.12	0.25/Nil
	Zone II	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil	Nil/Nil
10. All fishes	Zone I	116.61/111.7	95.63/74.5	82.16/62.0	66.79/32.18	38.14/25.01	49.08/122.70	89.55/132.9
	Zone II	56.87/104.68	50.23/49.4	6.83/Nil	28.55/Nil	71.88/239.5	129.32/115.79	86.57/325.3

*1983-88/89-93

pattern remains same with slight decrease in shallow waters. There seems to be no much change in the pattern of abundance of ribbon fish. Deep water ribbon fishes were distributed in similar pattern with slight increase during postmonsoon months and shallower water ribbon fishes were slightly more denser in later half.

There is a large change in the pattern of Bull's eye distribution. Though premonsoon month pattern remains same, the zone II is no longer abundant with Bull's eye which seems to have shifted to zone I. The catch rate during postmonsoon period increased starting from September (67.0-70.0 kg/hr.) in zone I but there is no big change in catch rate in zone II as in the first half. Cat fishes in zone II were recorded only during the first half of study period. During the second half increase of monsoon cat fish is noticed in Zone I but there is a general decrease in their abundance.

Over the period cuttle fish catch rates in shallower region have come down with an increased catch rate in deeper water from October to November. The cuttle fish of first half was perhaps reflecting the stock exploited at a very low level.

Changes in catch rate of squids over the period is prominent. There is an increase in catch rate in deep water during postmonsoon months of second half. There is an increase in catch rate of perch in both the zones during postmonsoon months with peak rates in zone II during September and zone I in October. During second half lizard fishes were found to be almost absent in both depth zones during monsoon period perhaps due to increase in exploitation level. The mackerels which were found throughout the monsoon season are found mainly in June with negligible catches in other monsoon months.

The temperature, salinity, dissolved oxygen and transparency of columnar waters show direct effect on pelagic fishery^{17,15}. Positive correlation between bottom waters temperature, and dissolved oxygen and trawl catch has been observed^{19,20}. Even the benthic biomass has a direct relation with bottom trawl catch²¹. Monsoon plays a vital role in triggering environmental factors such as temperature, salinity, dissolved oxygen and nutrient generation which in turn is responsible for

production of zoo- and phytoplankton²². In a study along Mangalore region it was observed that, during September, cold oxygen-poor bottom water moved to the fishing grounds from the deeper water²³. Therefore the change in the catches during monsoon and postmonsoon months along the study area is mainly due to change in the environmental factors. The depletion in catches in the demersal region as the monsoon advances is due to change of water mass in the bottom due to upwelling^{23,24}. The depleted oxygen affects the distribution of pelagic and demersal species²⁵. Aggregation during postmonsoon in the case of squid off Malpe and Mangalore is due to increase in temperature which triggers spawning activities¹⁶. Peak spawning of *Nemipterus japonicus* and *N. mesoprion* coincided with post- and premonsoon period along west coast²⁵. Availability, abundance and yield of cat fish is very much influenced by monsoon along west coast and spawning season of all the species is found to be during the end of monsoon⁷. Abundance of nemipterids and squids in deeper waters during monsoon and postmonsoon period, cat fishes during postmonsoon months needs to be, therefore, judiciously exploited following proper resource management technique. Management of fishery to be considered not only based on biology of resources² but also sociological and developmental objectives and priorities as well. However, exploitation of any resources especially those aggregating during monsoon need to be done cautiously with proper control on the type of fishes harvested.

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