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Hydrographic features off northeast coast and Andaman - Nicobar Islands in relation to demersal finfish resources

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ABSTRACT

Temperature varied from 17.6 to 28.5°C, salinity values from 32.12 to 35.21 x 10^{-3} and dissolved oxygen from 0.8 to 4.41 ml/l. No identifiable relationship could be established between these three parameters and the total fish abundance, probably because the catch was made up of many species having different requirements. Higher abundance of trawl catches was from January to May when bottom water temperature was relatively low. The highest level of abundance of 2764 kg/hr in February 1989 was recorded when the parameters were 26°C, 33.6 x 10^{-3} and 2.71 ml/l; and the lowest level of 43.2 kg/hr in July 1988 was when the parameters were 25.3°C, 34.48 x 10^{-3} and 1.6 ml/l.

INTRODUCTION

Information available on the areawise, depthwise and seasonwise abundance of fish resources in the Exclusive Economic Zone of the northeast coast and Andaman - Nicobar islands is rather little (Sudarsan *et al.*, 1988). Also, very few attempts have been made to correlate such abundance with the prevailing environmental conditions in the area except the preliminary ones by Krishnamoorthi (1973), Sekharan *et al.* (1973) and Sudarsan (1977). The present paper attempts to correlate the spatial and seasonal fluctuations in the abundance of finfish resources with the hydrological conditions of the fishing area in the E E Z of the northeast coast and Andaman-Nicobar waters based on the data obtained during the cruises 45-58 of *FORV Sagar Sampada* (April 1988 - February 1989).

MATERIALS AND METHODS

Water samples were collected from standard hydrographic depths (0-500 m) using reversing Nansen bottles. Temperature was measured by reversing thermometers.

Salinity and dissolved oxygen were found out using standard analytical methods (Strickland & Parsons, 1968). Bottom trawling operations were undertaken using High Speed Demersal Trawls designed and fabricated by Central Institute of Fisheries Technology. Normally the gear was operated for a minimum one hour duration. The details with regard to shooting duration of fishing, hauling, quantity and quality of the catch were recorded. The specieswise and total catch rates during different months were analysed with respect to seawater temperature, salinity and dissolved oxygen.

RESULTS

Physico-chemical parameters off northeast coast

Temperature - The temperature distribution pattern given in Fig.1 shows high values over the continental shelf and adjoining offshore areas in May and June 1988 with surface temperatures ranging from 28° to 32°C. The surface temperature decreased to 28.3° to 29.5°C in September 1988. A secondary maximum in surface

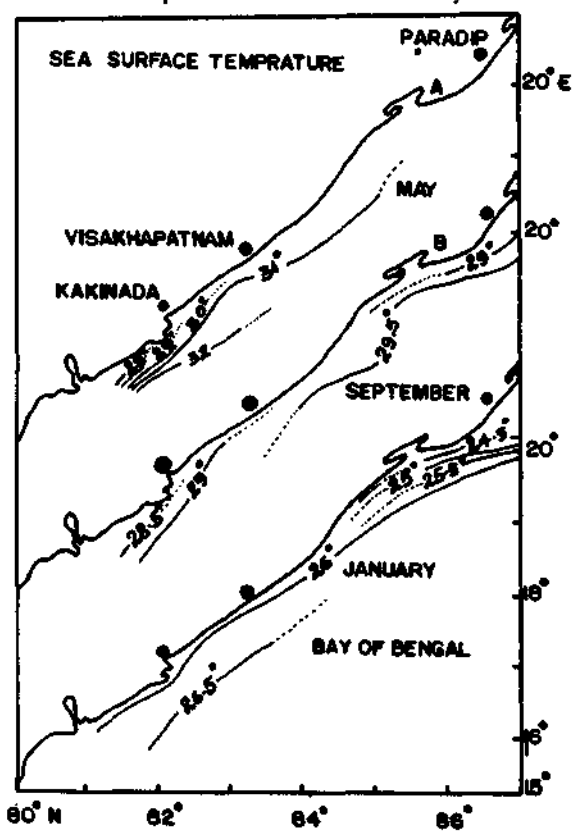

Fig. 1 - Seasonal distribution of sea surface temperature (°C) in the E E Z of the northeast coast of India

temperature occurred between 29° and 31°C in October. The lowest surface temperature was observed in January 1989 with values ranging between 24.1° and 26.5°C. The vertical profile of temperature distribution along lat. 16°, 18° and 20° N zones for different months is presented in Fig.2. The stations in lat. 16°N sector recorded low values ranging from 15.4° to 28°C in the upper 250 m depth column in May 1988. The mixed layer observed up to 50 to 75 m depth zone during July at lat. 16° and 18° N was confined up to 20 m depth in September. The stations at lat. 20°N sector recorded a shallow thermocline and low subsurface layers in July. The mixed layer was found to extend below 50 m depth during October. From October to November the temperature pattern showed a decreasing trend ranging from 24.9° to 29.3°C at 50 m and from 22.3° to 27.3°C at 100 m. During January 1989 the subsurface layers recorded low temperatures of 15.6° and 17.3°C at 100 m depth in the transects at lat. 16° and 20°N respectively.

Salinity — The seasonal distribution of sea surface salinity is given in Fig.3. The surface salinity values were generally high in April 1988 ranging between 34.83 and 35.17 x 10^{-3}. During May and June 1988 the pattern showed a reduction and the values ranged from 31.95 to 33.62 x 10^{-3}. By July the salinity values showed another peak with values ranging between 33.21 and 34.64 x 10^{-3}. Salinity decreased to values between 20.05 and 24.20 x 10^{-3} during October. In January 1989 the surface values varied between 27.91 and 34.81 x 10^{-3}. The salinity values of the subsurface waters which were high in April 1988 showed a reduction during May and June 1988 with a

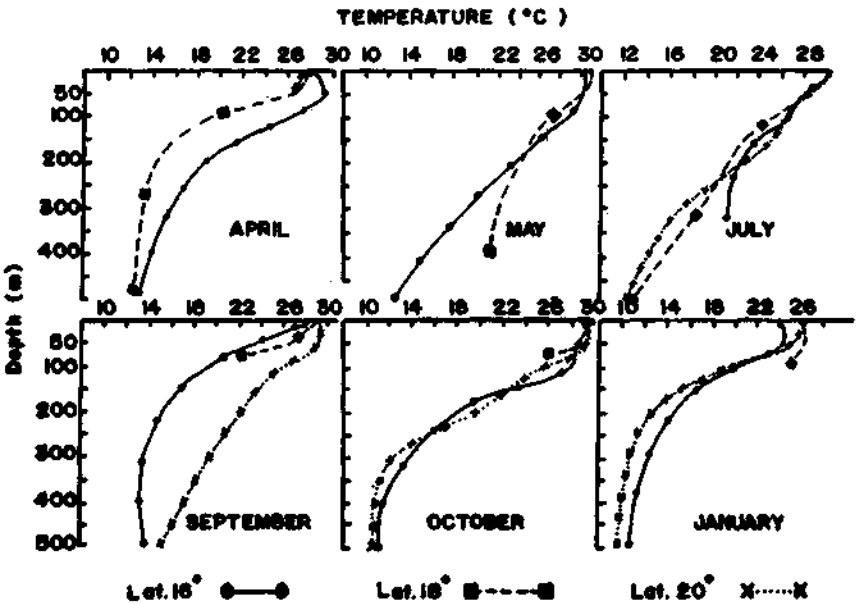

Fig.2 - Vertical profile of temperature distribution along lat. 16°, 18° and 20°N during different months in the E E Z of the northeast coast of India

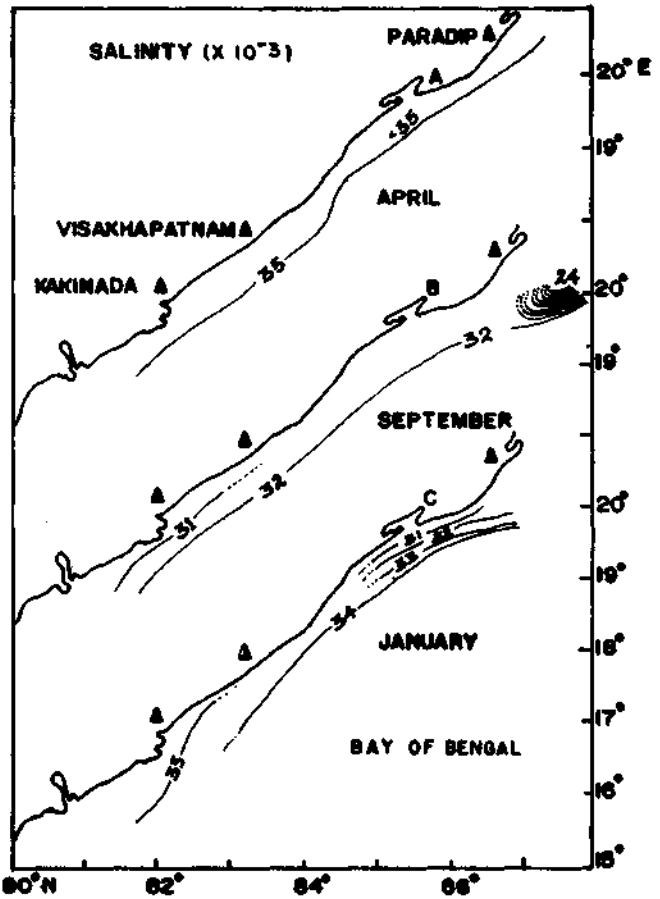

Fig. 3 - Seasonal distribution of sea surface salinity (x 10^{-3}) in the E E Z of the northeast coast of India

minimum of 31.61 x 10^{-3} at 20 m depth and a maximum of 34.80 x 10^{-3} at 450 m depth (Fig.4). Relatively lower values prevailed at lat. 16°-17°N sector than at lat. 20°N. Salinity decreased during September with values between 31.54 and 34.47 x 10^{-3} at 50 m and between 32.30 and 34.73 x 10^{-3} at 400 m depth. In general salinity values during October 1988 were low from the surface to 30 m depth, while below there was an increase compared to the previous month. In January 1989 salinity has marginally increased up to 200 m depth.

Dissolved oxygen — Generally high values ranging from 4.98 to 5.17 ml/l were recorded at the surface over the entire shelf region in April 1988. During May and June the values were high at lat. 16°N while it was relatively low at lat. 17°-18°N sector. There was a decrease in surface values during July. Surface values were lower in September 1988 ranging from 2.43 to 3.90 ml/l at lat. 16°N when compared to

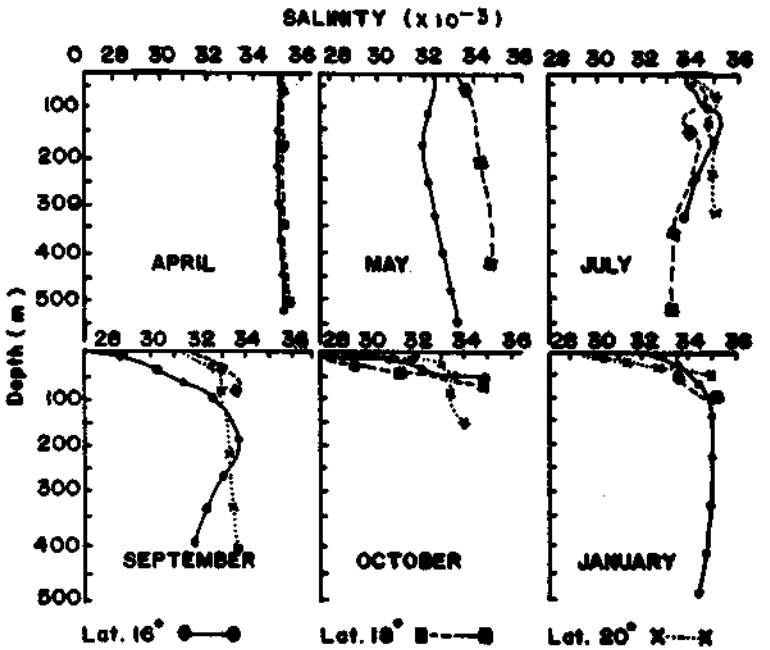

Fig. 4 - Vertical profile of salinity (x 10^{-3}) along lat. 16°, 18° and 20°N for different months in the E E Z of the northeast coast of India.

northern areas where high values of 3.90 to 4.80 ml/l prevailed. In October 1988 and January 1989 the surface values were relatively higher. The vertical profile of dissolved oxygen (Fig.5) showed that in shallow stations the 1 ml/l oxygen layer which is usually found at deeper areas occurred at depths between 30 and 50 m at lat. 16°N and between 50 and 75 m at lat. 18°N during September 1988. In October this layer was found at depths below 100 m in the 18.20°N sector. During November low oxygen content was recorded at depth below 100 m in the shelf and 1 ml/l layer occurred below 150 m depth at lat. 20°N sector.

Physico-chemical features of the Andaman-Nicobar islands

Temperature — The sea surface temperature varied between 29.8 and 30.5°C in April 1988. During June the temperature values ranged between 28.4° and 29.2°C, which declined to between 27.1 and 28°C during November-December 1988. During April 1988 a thermocline occurred at depths of more than 50 m in the northern latitudes; during June the thermocline was observed between 75 and 100 m depth. During November and December the thermocline was found to occur below 100 m in the southern regions while in the northern areas it was observed below 50 m depth.

Salinity — During April 1988 surface salinity varied between 30.58 and 34.65 x 10^{-3} with comparatively higher values towards southern latitudes. In June salinity

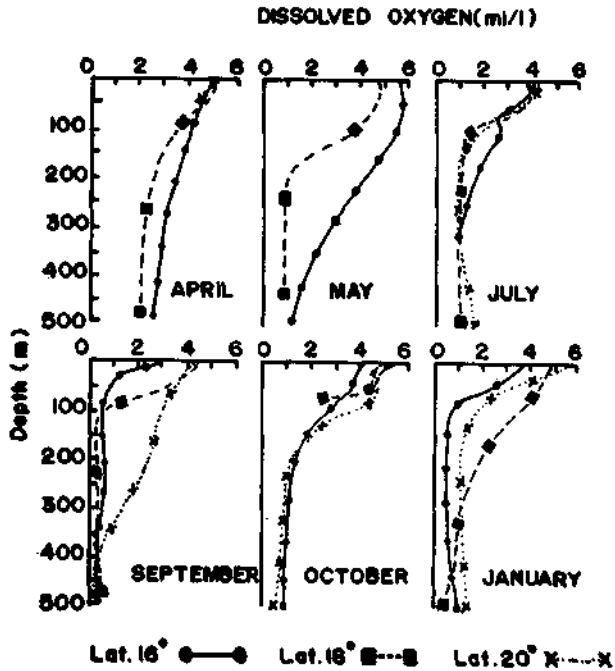

Fig. 5 - Vertical profile of dissolved oxygen along lat. 16°, 18° and 20°N during different months in the E E Z of the northeast coast of India

varied between 31.78 and 35 x 10^{-3}, without much regional variation. During November and December the values were between 32.04 and 33.67 x 10^{-3}. A salinity maximum of 35 x 10^{-3} was found at 200 m with slightly lower values in surface areas in April 1988. During August the maximum values of salinity occurred between 300 and 500 m depth in the areas north of lat. 12°30'N and between 200 and 500 m in the area south of it.

Dissolved oxygen — In April 1988 the dissolved oxygen values were below 4 ml/l in the upper 100 m column. During June the surface waters were well oxygenated with 5 ml/l. In November and December 1988 the values were more or less uniform from surface to 50 m depth. In April 1988 dissolved oxygen values below 1 ml/l were observed at 200 m depth in the northern sector between lat. 10° 30' and 14°30'N. During June values of 1 ml/l were found at 500 m. In August low values of 1 ml/l occurred at depths between 150 and 200 m at lat. 11°30'N and between 200 and 400 m between lat. 7° and 8°N.

Species abundance

The abundance of major categories of finfish obtained in demersal trawling in relation to hydrographic conditions of the bottom waters is given in Table 1. In the northeast coast the peak month of finfish abundance in the shallower areas of the shelf

Table 1 - Abundance of demersal finfish in the bottom trawl catches during April 1988 - February 1989 in relation to hydrographic conditions

Months	Hydrographic parameters			Name of species/groups* (catch rate in kg/hr)								Total catch rate (kg/hr)
	Temp. (°C)	Sal. ($\times 10^{-3}$)	Diss. O_2 (ml/l)	1	2	3	4	5	6	7	8	
Northeast coast of India												
April '88	26.1	35.21	4.41	60.1	0.1	1.6	41.3	21.9	0.2	-	32.0	157.2
May	17.6	32.12	0.8	169.0	10.5	683.5	-	-	14.2	-	122.3	999.5
June	27.3	33.95	1.65	0.7	52.8	16.8	3.4	5.0	1.2	-	114.1	194.0
July	25.3	34.48	1.60	0.1	0.1	17.2	0.1	6.2	6.0	-	13.5	43.2
Sept	27.9	33.40	3.10	0.5	4.4	0.6	21.3	6.9	0.3	-	115.0	149.0
Oct	28.5	34.39	2.79	0.2	0.4	13.5	2.3	3.5	-	203.7	24.0	247.6
Nov	28.2	34.75	2.89	7.1	14.2	16.4	12.3	20.5	2.7	9.1	141.2	223.5
Jan '89	24.8	33.90	3.70	9.5	-	3.5	44.7	7.6	236.5	26.9	118.9	447.6
Feb	26.0	33.60	2.71	13.6	0.7	58.0	48.0	235.0	1186.1	13.0	1209.6	2764.0
Andaman-Nicobar Islands												
April - May '88	28.4	32.93	2.44	1.0	5.0	-	-	-	12.9	39.0	241.6	299.0
June	17.8	34.73	2.50	2.5	-	2.0	-	-	-	-	13.5	18.0
Aug	-	33.23	3.78	0.2	0.3	-	-	-	-	-	0.5	1.0
Sept	-	-	-	-	-	-	-	-	-	-	-	-
Dec	24.2	33.89	-	-	-	0.4	-	-	-	12.8	136.8	150.0
Jan '89	25.9	34.47	-	0.6	0.7	0.1	-	-	-	27.0	15.6	44.0

*Species/groups: 1) *Nemipterus* spp, 2) *Saurida* spp, 3) *Priacanthus* spp, 4) *Upeneus* spp, 5) Catfish, 6) *Psenes indicus*, 7) Perches, 8) Others

were April, November 1988 and January-February 1989 when the bottom water temperature was relatively low at the respective trawling depths. The peak abundance of threadfin bream *Nemipterus* in the inner continental shelf of up to 80 m was in April 1988, January and February 1989, when the bottom waters were characterised by lower temperature. The outer continental shelf recorded the maximum catch rate in May. The catch rate of goat fishes *Upeneus* also showed an almsot identical pattern in abundance. The peak abundance of *Priacanthus* was in May 1988 in 150 - 200 m depth when the bottom waters were characterised by high salinity, low temperature and low oxygen. In the shallow shelf the maximum catch rates of *Psenes indicus* were in January and February. In the Andaman-Nicobar seas the highest catch rate of 299 kg/hr was noticed in May 1988 when the bottom water temperature was relatively higher, the catch consisting mainly of elasmobranchs, silver bellies and perches.

DISCUSSION

The studies undertaken by Sekharan *et al.* (1973) on the exploratory trawling of the continental shelf along the north- western part of the Bay of Bengal have revealed no indication of a drift in the abundance of the demersal fishes to offshore grounds in February - April, probably because the upwelling observed in this area was too weak to exert any influence on a wide scale (Jayaraman, 1965). The best catch rates of all categories of fish in the offshore grounds were observed during July - September in all zones, probably due to the effect of a shallow thermocline in the western side of the Bay of Bengal (Prasad, 1952), suggesting that there may be upwelling in the Bay during July - August. Sekharan *et al.* (1973) however noticed demersal fish abundance along lat. 17°N zone to be the highest during April - June and suggested a time lag of 1 - 2 months between the period of maximum plankton production (March - April) and the highest abundance of demersal fishes, provided the two are related. Krishnamoorthi (1973) has observed that off Andhra-Orissa coasts the peak period of abundance of *N. japonicus* was from January to April coinciding with the northern current system. In the present investigation this group has maximum catch rates during April- May.

Nishida & Sivasubramaniam (1986) observed that temperature and salinity do not vary much during a year in deeper waters and opined that deepsea demersals do not move or migrate extensively but probably remain in areas where environmental conditions are constant. They have also stated that lizard fishes generally inhabit shallow waters of 100-150 m and prefer relatively high temperatures of 19° - 27°C with optimum of 20°-22°C and salinity of 34-34.4 x 10^{-3} with optimum of 34.2 - 34.4 x 10^{-3}. The minimum, maximum and optimum dissolved oxygen ranges reported were 0.2, 2.5 and 0.5 - 1.0 ml/l respectively. *Priacanthus* occurs in low and high temperature ranges of 14- 27°C with optimum of 14°- 22°C, high salinity ranges of 34 - 35.8 x 10^{-3} with optimum of 34.2 - 34.6 x 10^{-3} and low dissolved oxygen range of 0. 2 - 2.5 ml/l with optimum of 1.0 - 1.5 ml/l. In the present studies, the peak abundance of *Priacanthus* was seen in relatively deeper waters of 150 - 200 m, low temperature of 17.6°C and dissolved oxygen of 0.8 ml/l values. The catch rates of lizard fish *Saurida*

were relatively higher in comparatively shallow waters of up to 150 m characterised by a temperature of 27.3°C and dissolved oxygen of 1.65 ml/l.

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