

SEASONAL FLUCTUATION IN THE DISTRIBUTION OF EGGS AND
LARVAE OF FLAT FISHES (*PLEURONECTIFORMES* - PISCES)
IN THE COCHIN BACKWATER

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ABSTRACT

Attempts have been made to correlate the abundance of eggs and larvae of flat fishes belonging to families Cynoglossidae and Soleidae with the hydrographical parameters of the environment, particularly the salinity. The eggs and larvae were found to occur in the Cochin backwater during the pre-monsoon period but not during the south west monsoon period. During the south west monsoon period larvae belonging to very early stages were found at the marine end (Fairway Buoy). The continued or prolonged existence of very low salinity appears to restrict the distribution of flat fish larvae. In the post-monsoon period also the eggs and larvae were not found in regions of very low salinity. Larvae of *Cynoglossus puncticeps* (Richardson), *C. brevis* Gunther, *C. cynoglossus* (Ham. Buch), *C. lida* (Bleeker) and *Solea heinii* Steindachner were obtained in the collection taken from the estuary. From the data it is seen that each species has specific spawning period.

INTRODUCTION

The distribution of flat fish larvae in the Indian Ocean showed that most of them preferred low salinities (Lalithambikadevi, 1977). Balakrishnan and Lalithambikadevi (1974), have reported the occurrence of larvae of some flat fishes from Cochin backwater. In the present study an attempt has been made to study the distribution of larvae of flat fishes in the Cochin backwater in relation to hydrographical conditions prevailing there.

The Cochin backwater is connected with the Laccadive Sea (southern part of the Arabian Sea, Sewell, 1927) by a shipping channel of about 450 m wide. Some of the hydrographical characteristics of the Cochin Backwater have been described by Balakrishnan (1957); George and Kartha (1963); Sankaranarayanan and Qasim (1969); Devassy and Gopinathan (1970); Josanto (1971); Menon, Venugopal and Goswami (1971); Nair and Tranter (1971) and Shynamma and Balakrishnan (1973). Nair (1965) and Qasim *et al.* (1969), have recognised three seasons namely, pre-monsoon, monsoon and post-monsoon. During the pre-monsoon period (February to

May), the estuary is dominated by marine conditions. During the monsoon period (June to September), the salinity falls suddenly resulting in the conversion of a major portion of estuary into a fresh water reservoir. Typical brackish water conditions with large salinity fluctuations predominate during the post-monsoon period (October to January). According to Ramamritham and Jayaraman (1963), evaporation during hot months, upwelling, sinking and coastal piling up of water in the Arabian Sea also have a marked influence on the hydrographical conditions of the estuary.

MATERIAL AND METHODS

Fish eggs and larvae were obtained from plankton samples collected in two series by the Indian Ocean Biological Centre (IOBC) of the National Institute of Oceanography from Cochin backwaters. In the first series, fortnightly collections were made during day time for a period of one year during 1968 consisting of pre-monsoon (Feb-May), monsoon (June-September) and post-monsoon (Oct-Jan) from station 1 (Fairway Buoy, about 8.5 km away from the harbour entrance) and station 3 (Aroor,

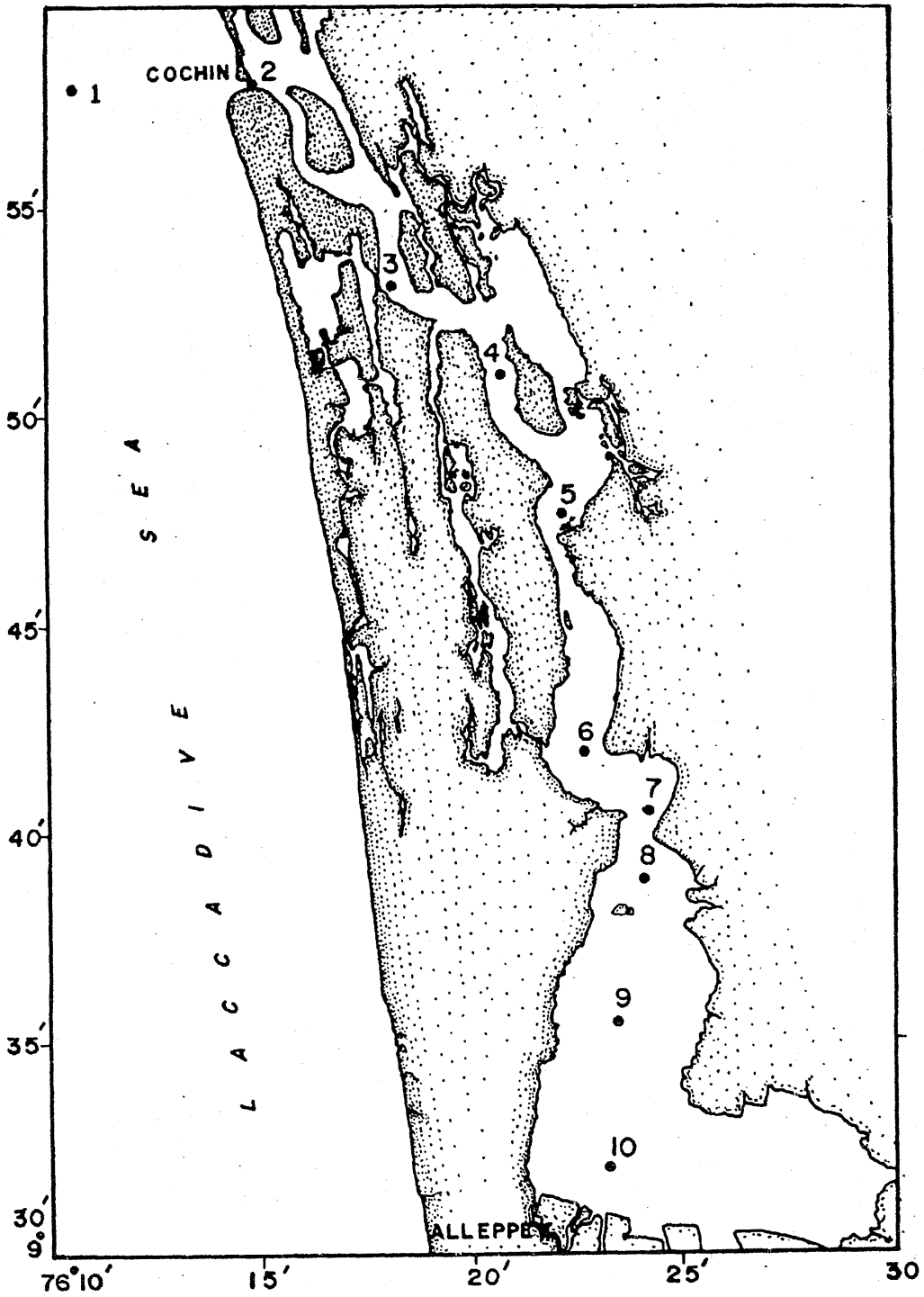


Fig. 1. Positions of stations investigated in Cochin Backwater.

about 14 km south of the harbour entrance (Fig. 1.). In the second series, collections were made from 9 stations, during November, 1968 and April, 1969 representing conditions of post-monsoon and pre-monsoon seasons respectively. The collections were begun in the morning from Station 2 (Barmouth, Cochin) and proceeded towards station 10 (Aryad South, head of the estuary); this order was reversed the following night. Only horizontal plankton samples were collected using an HT net (Tranter *et al.* 1972). The plankton samples were preserved in 4% formaldehyde buffered with 1% hexamine. Surface temperature and salinity were recorded using a salinity temperature bridge (Type:MC-5 by Electronic Switchgear London Ltd.) The eggs and larvae of flat fishes were sorted out from a known portion of the plankton and were identified. The number of eggs and larvae present in 100 m³ were calculated (Tables 1-4).

RESULTS

Salinity and temperature : In the first series, the salinity values varied between 11.6 and 33.0‰ at Station 1 and 0.4 and 32.8‰ at Station 3. Similarly, surface temperature ranged between 25.4 °C and 32.6 °C at Station I, and 26.2 °C and 32.8 °C at Station 3. (Tables 1 & 2)

In the second series, salinity decreased from 30.0‰ progressively to almost fresh water condition towards the head while in April, the salinity values were 34.4‰ at Station 2, and 25.2‰ at Station 10. Temperature ranged between 29.6 °C and 32.6 °C in November, and 31.8 °C and 34.1 °C in April (Table 3)

Eggs : In the first series eggs showing varying development stages were found at Station I during the pre-monsoon (February, March, May) and post-monsoon (October,

TABLE 1 : Temperature, salinity and number of flatfish eggs and larvae at Station 1.

(Series I)

Date 1968	Time (Hour)	Temperature °C	Salinity ‰	No. of eggs/ 100m ³	No. of larvae/ 100m ³
18 Jan	11.05	29.0	31.6	-	-
1 Feb.	08.52	29.8	31.5	210	-
15 Feb.	08.29	28.8	32.3	66	7
29 Feb.	08.15	30.8	32.1	172	10
14 March	08.16	30.6	31.5	141	14
28 March	08.37	30.2	32.0	5	5
25 April	08.26	31.8	32.0	-	1
9 May	08.45	29.8	33.0	-	1
23 May	09.04	29.9	32.8	7	2
6 June	09.08	29.2	21.5	-	4
9 August	08.32	29.0	16.8	-	7
12 Sept.	09.46	25.7	13.4	-	18
26 Sept.	08.59	28.4	11.6	-	-
11 Oct.	09.21	30.4	19.9	14	4
24 Oct.	09.32	32.5	29.5	741	12
8 Nov.	09.43	31.8	29.8	203	45
5 Dec.	09.40	29.8	31.0	-	-
19 Dec.	09.49	29.4	30.0	-	-

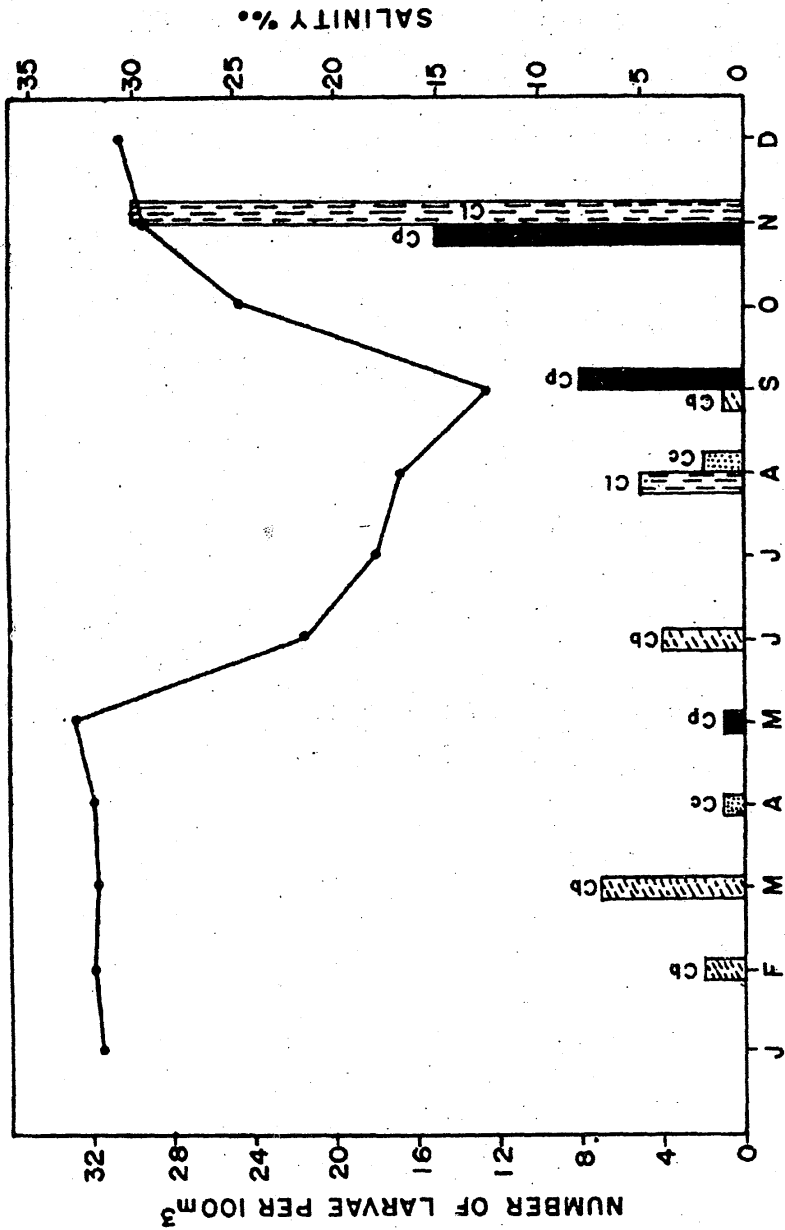


Fig. 2. Seasonal fluctuation of flat fish larvae at Station I (Fairway Buoy) in relation to salinity.

Abbreviation for figs 2-6.

C.b. - *Cynoglossus brevis*, C.c. - *Cynoglossus cynoglossus*, C.l. - *Cynoglossus lida*, C.p.-*Cynoglossus puncticeps*, S. - *Solea heinii*, P.M. - Pre-monsoon, M. - Monsoon, Pt.M.-Post-monsoon, D.-Day, N. - Night

November) periods, with a maximum number in October. They were absent during the monsoon period (Table 1). At Station 3, the eggs were unhealthy and few in number and were found only during January and March (Table 2)

In the second series, eggs were found only at Station 2, during night, in November (Table 3). In April, the eggs were present during night at Station 4 to 9 with a maximum number at station 9 (Table 4). They were found in the plankton during day time at Stations 7 and 8, but were unhealthy. The eggs were absent at Stations 2, 3 and 10. The number of eggs in April was 15 times more than that of November.

Larvae : In the first series, larvae were present in all seasons at Station 1, but not in all months (Table 1). All the larvae were in the very early stage of development. At Station 3, larvae of different stages were found in pre-monsoon

period (3 stray specimens, 2 in early June and other in January; Fig. 3). Interspines were discernible in some of the larvae collected during the pre-monsoon period, indicating an advanced stage of development.

In the second series, larvae occurred at Stations 3, 4 and 5 in November, when salinity values varied between 0.1 and 17.5‰ the maximum being recorded at Station 4 during the day time (Table 3). The distribution of larvae decreased towards the head of the estuary (Fig. 4). Only 6 larvae were obtained from Station 5 where salinity was 0.7‰. Beyond station 5 the larvae were absent, even though the salinity was not very different from that of Station 5.

In April, the larvae were present at all stations (Table 4). At Station 9, 1000 larvae/100m³ consisting of very early to metamorphosed stages were found at night, but

TABLE 2 : *Temperature, Salinity and number of flat fish eggs and larvae at Station - 3*

(Series - 1)

Date (1968)	Time (Hour)	Temperature °C	Salinity ‰	No. of eggs/ 100 m ³	No. of larvae/ 100 m ³
18 Jan.	13.25	30.5	27.2	144	1
1 Feb.	12.13	31.0	28.9	-	-
15 Feb.	11.28	31.4	29.0	-	-
29 Feb.	14.33	32.6	29.0	-	-
14 March	14.42	31.4	29.0	-	-
28 March	11.45	31.6	29.8	14	35
25 April	11.24	31.8	32.8	-	-
9 May	11.59	31.9	32.4	-	-
23 May	12.03	32.2	30.0	-	8
6 June	11.06	31.2	27.2	-	2
20 June	08.15	29.5	22.9	-	-
4 July	10.32	27.8	0.6	-	-
2 Sept.	15.52	31.0	5.0	-	-
12 Sept.	11.58	28.6	1.0	-	-
26 Sept.	11.14	30.3	4.6	-	-
11 Oct.	11.35	32.6	3.0	-	-
24 Oct.	12.30	32.8	2.8	-	-
9 Nov.	13.28	31.8	29.2	-	-
5 Dec.	12.13	31.8	29.2	-	-
19 Dec.	11.57	30.4	28.2	-	-

TABLE-3 : Temperature, salinity and number of flat fish eggs and larvae at Stations 2-10 during November (Pre-monsoon Period)

(Series - 2)

Station No.	Station position	Time(hour)		Temperature °C		Salinity ‰		No. of egg/100m ³		No. of larvae/100m ³	
		D	N	D	N	D	N	D	N	D	N
2.	Barmouth	11.45	05.45	30.9	29.6	27.2	30.0	-	702	-	-
3.	Aroor	13.06	04.27	32.4	29.9	9.7	17.5	-	-	-	8
4.	Vaduthala	14.05	03.33	32.6	30.2	5.6	4.5	-	-	92	73
5.	Kulasekharam	15.12	01.13	32.6	30.8	0.7	0.1	-	-	6	2
6.	Pallipuram	16.00	00.15	32.4	30.4	0.1	0.2	-	-	-	-
7.	Thannermukham North	16.26	23.28	32.0	30.6	0.6	0.4	-	-	-	-
8.	Thannermukham South	17.02	22.43	32.0	30.8	0.4	0.2	-	-	-	-
9.	Aryad North +										
10.	Aryad South	18.40	21.39	31.0	30.7	0.3	-	-	-	-	-

+ Data not available D = Day N = Night

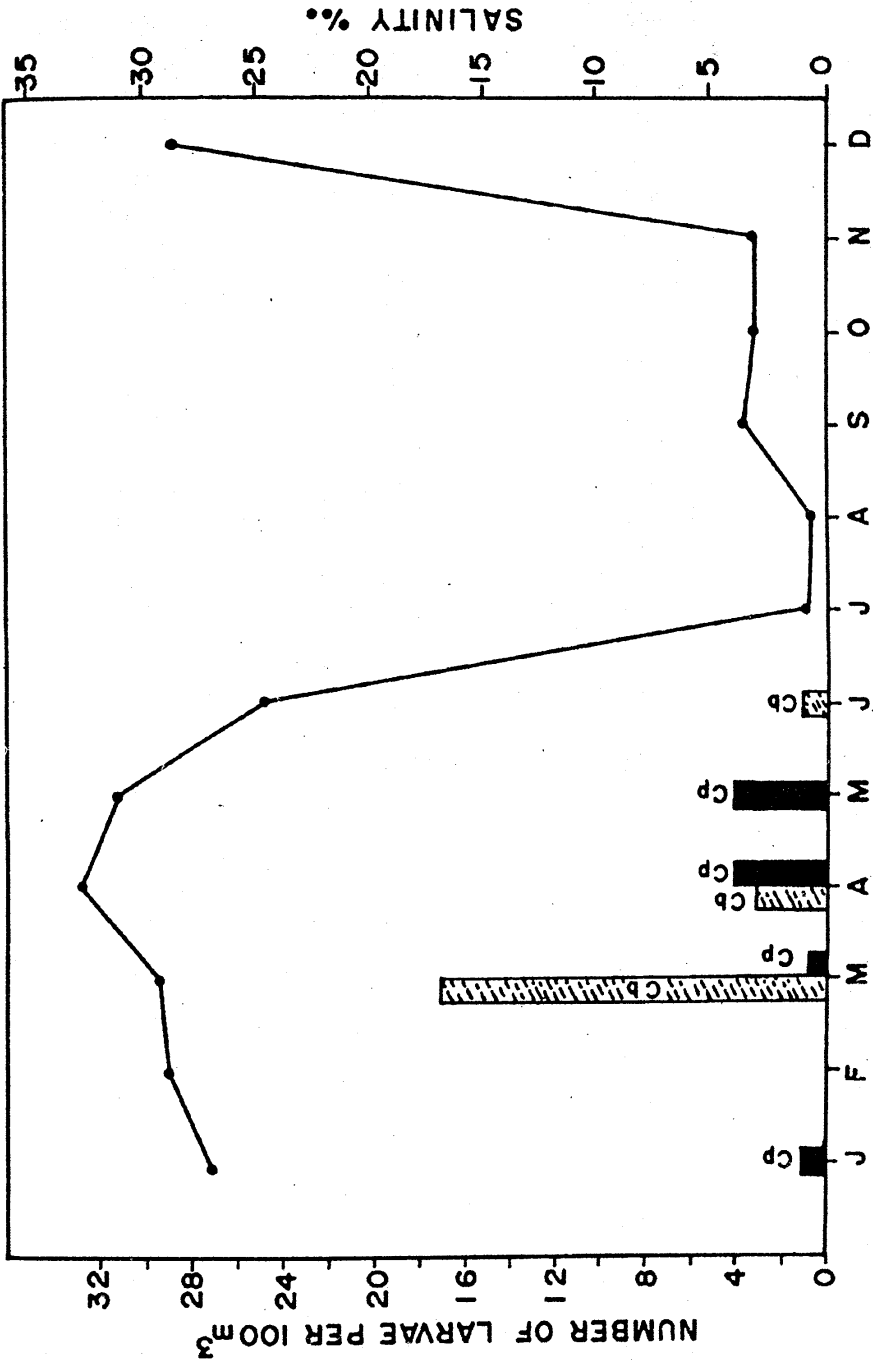


Fig.3. Seasonal fluctuation of flat fish larvae at Station 3 (Aroor) in relation to salinity.

TABLE 4 : *Temperature, salinity and number of flat fish eggs and larvae at Station 2-10 during April (Pre-monsoon Period)*

(Series - 2)

Station position No.	Time(hour)		Temperature °C		Salinity ‰		No. of egg/100m ³		No. of larvae/100m ³		
	D	N	D	N	D	N	D	N	D	N	
2	Barmouth	10.40	03.46	33.0	31.8	30.7	34.4	-	-	4	-
3	Aroor	11.58	02.03	32.8	32.3	33.3	33.7	-	-	75	-
4	Vaduthala	12.51	01.19	33.5	32.4	33.1	33.7	-	13	48	7
5	Kulasekharam	13.52	23.49	33.3	33.2	31.5	32.2	-	71	-	86
6	Pallipuram	14.39	22.48	33.2	32.3	30.2	29.6	-	1423	-	38
7	Thannerujham North	15.12	22.20	33.8	33.0	29.7	30.0	47	297	33	78
8	Thannerkukham South	15.29	22.02	33.8	33.0	29.7	30.0	423	595	92	24
9	Aryad North	16.33	20.45	34.1	33.2	27.9	28.0	-	7388	15	1000
10	Aryad South	17.10	20.03	33.9	33.8	25.4	25.2	-	-	29	15

D = Day N = Night

during the day, only 15 larvae/100 m³ were present. In general, larvae were most abundant during April than in November. The number of larvae collected at night was four times higher than that during day time in April.

In the first series, larvae of *Cynoglossus brevis* (Gunther), *C. puncticeps* (Richardson), *C. lida* (Bleeker) and *C. cynoglossus* (Hamilton Buchanan) were present of which the last two species were rare. While all the four species occurred at Station I, only the first two species were found at Station 3 (Figs 2 and 3).

Larvae of *Cynoglossus brevis* were present in the pre-monsoon and monsoon periods at Station I and in the pre-monsoon and early monsoon periods at Station 3. The maximum number of larvae occurred in March at Station 3, except for three fairly advanced stages of larvae collected in April from Station 3 all the rest belonged to very early stages of development.

At Station I, *Cynoglossus puncticeps* larvae was found in May, September and November representing all three seasons. The salinity values during these months at the station were 33.0‰, 13.4‰ and 29.8‰ respectively. At Station 3 the larvae were present in January, March, April and May collections. At Stations I, the maximum number of larvae was obtained in November. None of them had interspines in their fin complement. At Station 3 in many of them interspines were clearly visible showing an advanced stage of development.

Cynoglossus lida larvae were confined to station I during monsoon and post-monsoon periods (August and November), when the salinity values were 16.8‰ and 29.8‰ respectively. All the larvae were in very early stages of development.

A few early larvae of *Cynoglossus cynoglossus* were found at Station I during the pre-monsoon and monsoon periods (April and August). None had developed interspines in their fin complements. The second series of collections contained larvae of *Cynoglossus*

cynoglossus. *C. puncticeps*, *C. lida*, *C. brevis* and *Solea heinii* (Fig. 4 and 5) of these *C. cynoglossus* formed the predominant species in April, occurring at all stations except at Station 4 suggesting a wide range of distribution. At Station 9, an exceptionally large number of larvae representing almost all stages were obtained in the night collections but were only very few during day. In November, larvae of this species were, however, absent.

Cynoglossus puncticeps larvae in different stages of development occurred during April. They were more numerous during day than night. As regards abundance, *Cynoglossus puncticeps* larvae ranked next to *C. cynoglossus*, although their distribution was restricted to stations 3, 4, 5 and 7. In November only advanced stages were found at Station 3 during night.

Cynoglossus brevis larvae were present only at Station 8 during April in the plankton collected at night.

Various stages of *Cynoglossus lida* larvae were obtained more during the day than night, at Stations 4 and 5 in November.

Solea heinii larvae were found to occur at Station 4, at night, in November, but the number was very few.

DISCUSSION

Fluctuation in the salinity of the Cochin backwater is affected by the volume of fresh water discharged during the monsoon, and sea water incursion during high tide. This plays a vital role in the development and distribution of organisms in the backwater.

Eggs collected from different stations showed progressive development as the time of collection advanced. From rearing experiments (Lalithambikadevi, 1972) it has been found that flat fishes of this locality (studied so far) spawned during the early part of night and hatched within 14 hours.

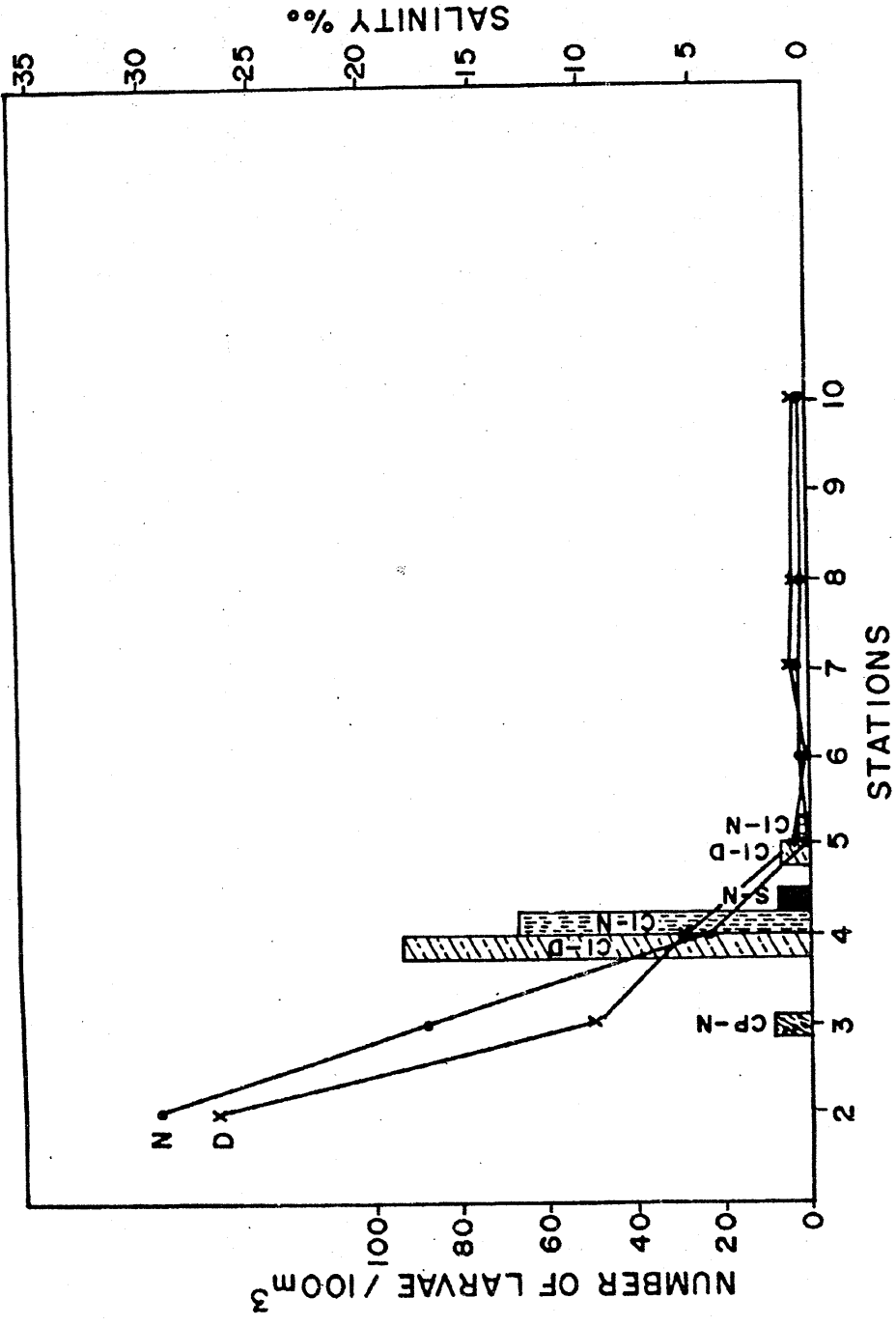


Fig.4. The distribution of flat fish larvae in the estuary during post-monsoon period.

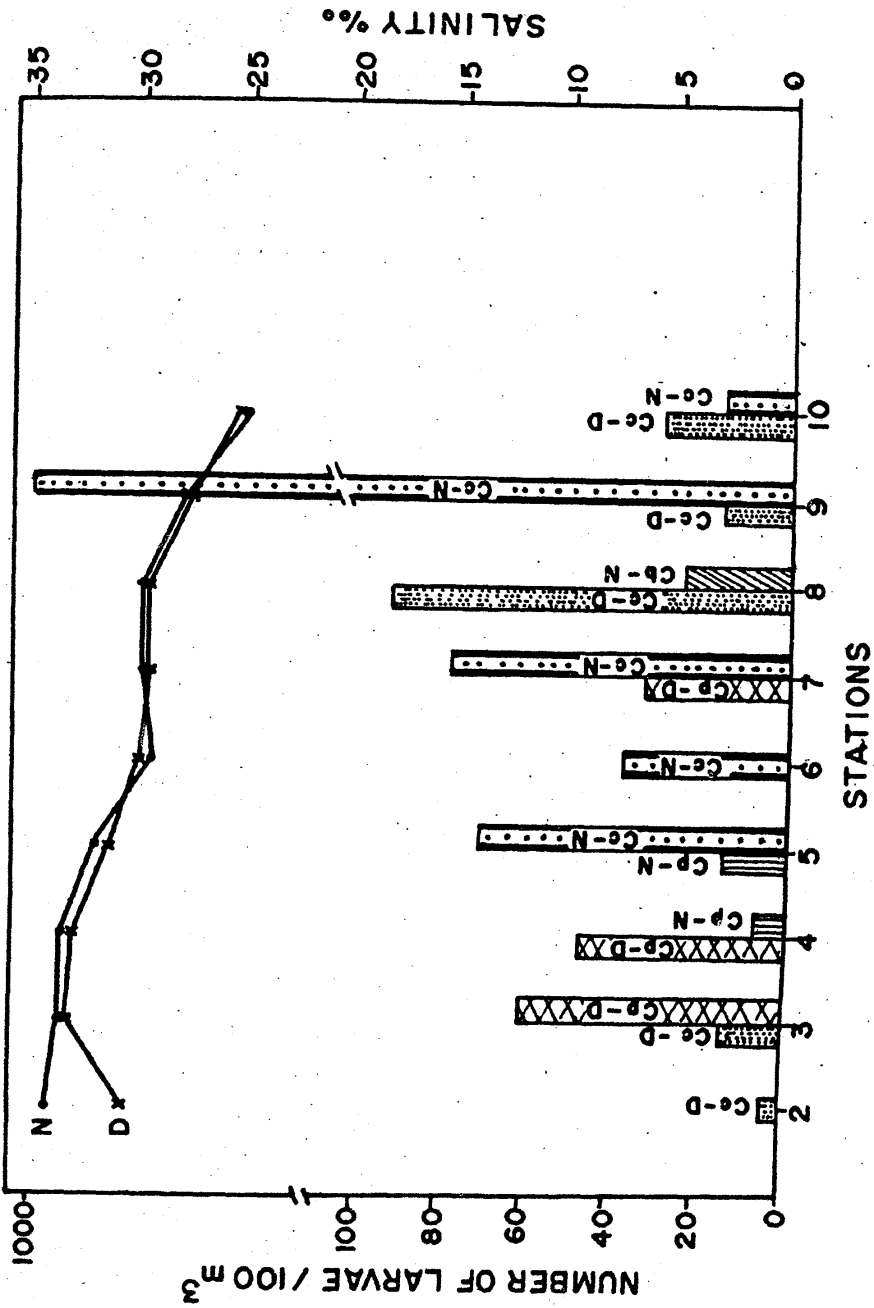


Fig. 5. The distribution of flat fish larvae in the estuary during pre-monsoon period.

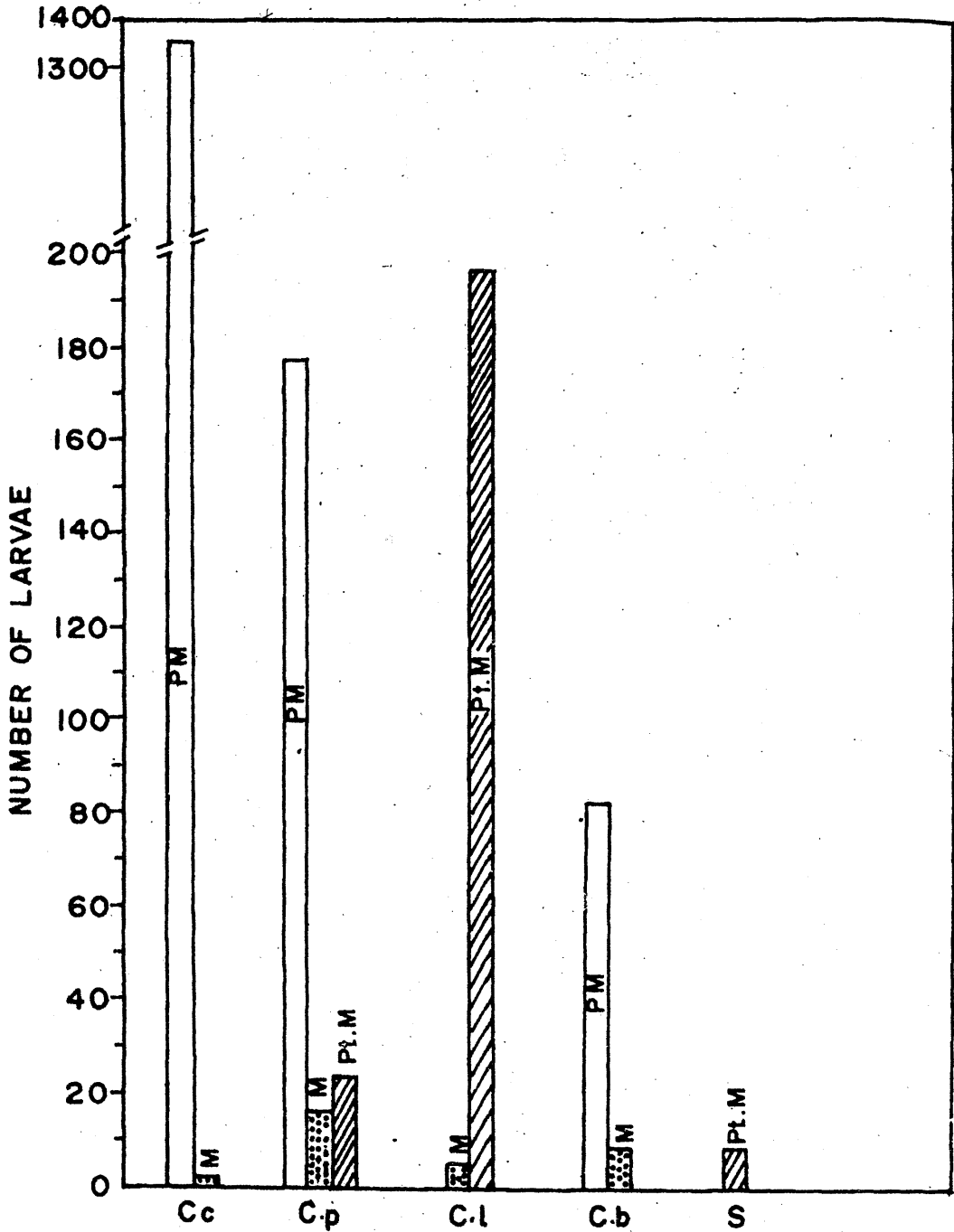


Fig.6. Relative abundance of flat fish larvae during pre-monsoon, monsoon and post-monsoon periods.

In the post-monsoon period, large number of eggs were present at Station 2 but not at Station 3-10. The salinity at Station 2 was 30.0‰ and at other stations it varied from 17.8‰ to 0.1‰. The eggs may remain floating at a level where the density of water is higher than that of the eggs. The presence of oil globules may assist them to remain afloat. But, beyond a certain concentration, the eggs may sink to deeper levels. Balakrishnan and Lalithambikadevi (Unpublished) have observed that eggs were absent in surface plankton when salinity varied between 0.1‰ to 15.0‰, but present at the same station and at the same time in plankton taken from 5 to 10 m. The bottom salinity was 26.7‰ and at 5m it was 15.0‰. It is, therefore, to be expected that surface plankton collected from Station 3-10 may not contain eggs.

Although the larvae of the flat fishes belonging to the families Cynoglossidae and Soleidae studied so far appear to be euryhaline, they cannot tolerate fresh water conditions for long durations. This might account for their absence at Station 3 during the monsoon period and beyond Station 5 during the postmonsoon period. Their presence at all stations during the pre-monsoon period lend support to this view. The complete absence of advanced stages of larvae at Station 1, and their presence at Station situated within the estuary during the pre-monsoon and post-monsoon periods indicate that the estuarine conditions are more favourable for growth and distribution of these species of larvae than the marine conditions. Rao *et al.* (1975) also noticed optimum conditions in which most of the estuarine species flourish somewhat away from the mouth to the middle reaches. This area represents a more stable environment when compared to the mouth which is subjected to disturbances due to tidal mixings.

From the results it is seen that each species of flat fish has a particular spawning season (Fig.6). In *Cynoglossus cynoglossus* and *C. brevis* maximum spawning occurs in the pre-monsoon period, rare during monsoon and absent in post-monsoon while in the case of *C. lida*,

maximum spawning occurs in post-monsoon, is rare in the monsoon and absent in pre-monsoon. *Solea heinii* prefer the post-monsoon for breeding. *C.puncticeps* breeds during all seasons, with a maximum intensity in the pre-monsoon period. These inferences are based on the presence of different stages of larvae in the plankton collection.

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