

MONSOONAL FLUCTUATIONS IN THE DISTRIBUTION OF THE HYDROMEDUSAE IN THE COCHIN BACKWATER, 1968-1969

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ABSTRACT

Plankton collections were made during the post-monsoon period (November, 1968) and during the pre-monsoon period (April, 1969). Two sets of samples representing day and night were taken from nine fixed stations from Barmouth to Aryad south (southern end of the backwater system). The relative abundance and monsoonal fluctuations of the hydromedusae in relation to salinity are discussed. The collection contains the following species belonging to eleven genera, namely *Euphysora abaxialis*, *Zanclaea costata*, *Podocoryne carnea*, *Tiaropsidium japonicum*, *Obelia* sp., *Phialidium hemisphericum*, *P. rangiroae*, *P. brunescence*, *Eucheilota menoni*, *Blackfordia virginica*, *Phialucium carolinae*, *P. taeniogonis*, *Eirene ceylonensis*, *E. menoni*, *Eutima hartlaubi*, *E. browne*, *E. neucealedonia*, *E. japonica*, and *E. commensalis*.

During the post-monsoon period, hydromedusae were apparently absent except at Barmouth and at Aroor (stations 1 and 2). Eight species were found and *Obelia* sp. formed the chief component for this season. Maximum density of hydromedusae recorded was only 12.9 specimens/m³ at Barmouth.

During the pre-monsoon period hydromedusae were present in all stations and a total of eighteen species were present. *Blackfordia virginica* (96.7 sp/m³), *Eutima commensalis* (68.9 sp/m³) and *Eirene ceylonensis* (35.3 sp/m³) were the dominant forms.

Comparison of the (numerical) density of hydromedusae with the salinity of the ambient water shows that there is a relationship between the abundance of a species and the salinity gradient, different species dominating different stations. In general, the very low saline period is not favourable for the hydromedusae of this region.

INTRODUCTION

EVEN though there are many papers on the systematics of the medusae of the Indian seas, there are comparatively few studies on the seasonal distribution of this group. Prasad (1954) recorded the seasonal occurrence of 16 species of Hydromedusae belonging to 15 genera in the coastal waters of the Gulf of Mannar and Palk Bay during 1949-53. Nair (1954) reported the seasonal distribution of hydromedusae from the Trivandrum coast during the years 1942-45. Ganapati and Nagabhushanam (1958) described the seasonal distribution of these organisms off the Visakhapatnam coast. Vannucci *et al.* (1970) studied the seasonal distribution of hydromedusae at two fixed stations, one at Fairway buoy and the other at Aroor in the Cochin Backwater for the year 1969.

The results obtained during the study of the seasonal distribution of hydromedusae of Cochin Backwater, collected from two localities, (Vannucci *et al.* 1970), indicated that a more extensive survey dealing with the monsoonal fluctuations of the hydromedusae of the area would be interesting.

The area surveyed covered the backwaters from Cochin southward to Alleppey. Cochin harbour is located at the outlet of a chain of backwaters which enter into the

central part of Kerala State and are connected with the Arabian sea. The region and details of the sampling are described by Chandrasekharan Nair and Tranter (1972). At the Barmouth there is mixing of seawater with the brackishwater of the backwater and the area is also under the influence of tide from the Arabian sea. The other stations are further from the sea with more stable conditions throughout the year except during the SW monsoon period. During the monsoon, as a result of precipitation and inflow of river water the entire region becomes an area of fresh water, and the effect of this is reflected on the composition of the fauna. This reversal of ecological conditions is related to unusual seasonal and biological cycles. This paper aims at studying the plankton along a salinity gradient before and after the monsoon, while in an earlier paper we compared the seasonal variation throughout one year at two stations, one inside and the other one outside of the backwater system.

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MATERIAL AND METHODS

The work was initiated under the direction of D. J. Tranter, UNESCO Curator, Indian Ocean Biological Centre, in November 1968. Plankton collections were taken after the monsoon (November 1968) and before the monsoon (April, 1969). Two sets of collections were made from nine fixed stations from Barmouth (St. 1) towards the head of the estuary, Aroor (St. 2), Vaduthala (St. 3), Kulasekharan (St. 4), Pallipuram (St. 5), Thaneer North (St. 6), Thaneer South (St. 7), Aryad North (St. 8), and Aryad South (St. 9) during each period. During the post-monsoon one set was collected on the way to Aryad South from 11.45 hrs. to 18.50 hrs. and the second set was collected during the return cruise between 21.39 hrs. and 05.47 hrs. In the same manner for pre-monsoon period one set was collected on the way to Aryad south from 10.40 to 17.13 hrs. and the return cruise between 20.03 and 03.49 hrs. All the collections were surface hauls. So, for each period there are two sets of collections representing day and night. Collections were taken with a net of mouth area 0.25m^2 and mesh size of 0.2 mm (Heron-Tranter net, unpublished) set with a flow meter. Plankton was fixed immediately in 4% formaldehyde buffered with 1% hexamine. The details of stations and hydrographical conditions are described by Chandrasekharan Nair and Tranter (1972). During this study the species were identified and an effort has been made to note the developmental stages and also the sexes.

RESULTS

Standing stock

The results indicate that the hydromedusae are absent in this backwater after the south west monsoon except at Barmouth and Aroor (Fig. 1). The maximum density of the population of medusae noticed at that season was only 12.9m^{-3} at Barmouth. However, during the pre-monsoon collection (April, 1969) hydromedusae were found at all stations, during this season the maximum density found was 183.6m^{-3} (Fig. 2). This maximum was found in a night collection taken from

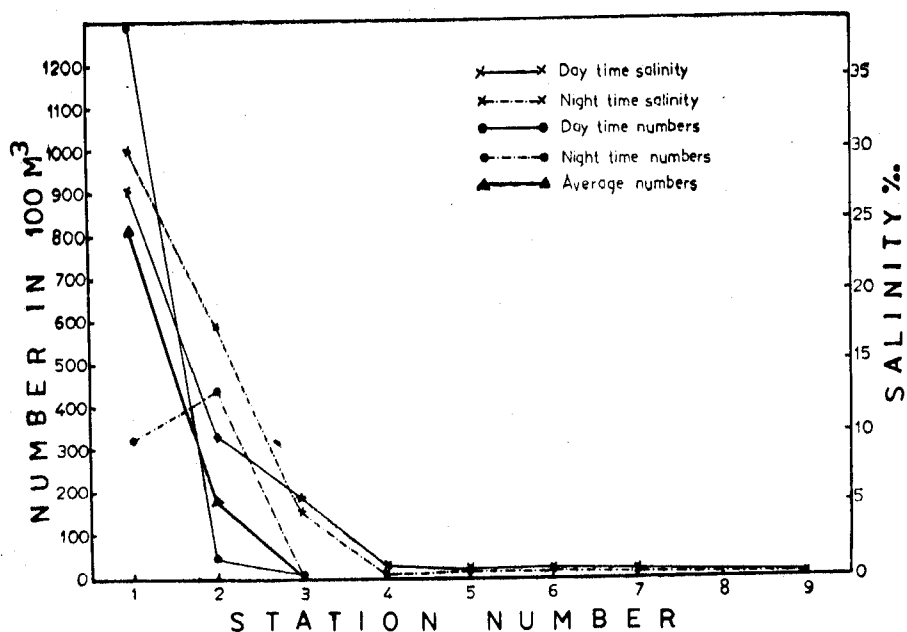


FIG. 1. Distribution of Hydromedusae expressed as number of specimens/m³ (population density) from Barmouth to Aryad South (St. 1 to 9) in relation to salinity during November 1968.

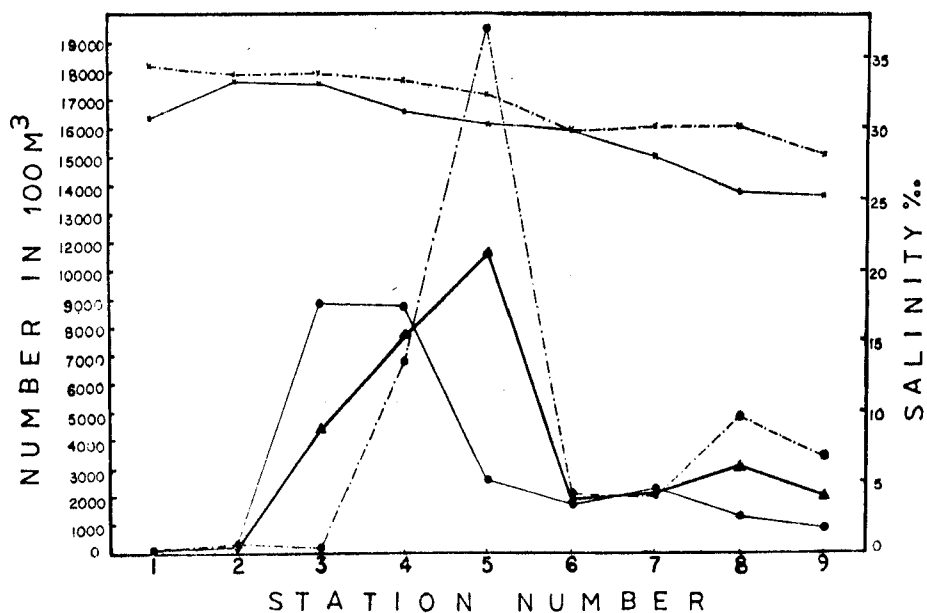


FIG. 2. Distribution of Hydromedusae from Barmouth to Aryad South in relation to salinity during April 1969. Conventions as in Fig. 1.

Pallipuram (St. 5). A peak in the day collection was also found at Vaduthala (St. 3) the density being 88/m³.

The total number of medusae/m³ of water was found to be roughly 30 times greater during the pre-monsoon period than during the post-monsoon in the surface layer. The difference is entirely accounted for by the dense population present in the inner part of the system that is totally absent during the monsoon. However, at the two outermost stations, the standing stock of medusae was roughly four times larger in numbers during the post-monsoon, which was due to a swarm of locally liberated *Obelia* spp. caught by the net. The large number of medusae found in the backwater system confirms earlier results (Vannucci, *et al.* 1970) and indicates a very high secondary production in those waters since medusae are all exclusively carnivores.

Species present

Nineteen species of hydromedusae belonging to eleven genera are represented in the collections (Table 2).

Species taken during post monsoon period

During this period, only eight species are represented, and they are *Podocoryne carnea*, *Obelia* spp., *Phialidium brunescens*, *Eucheilota menoni*, *Eirene menoni*, *Eutima neucealedonia*, *E. japonica* and *E. commensalis*. Table 1 represents the pattern of distribution of these species.

Obelia spp. was found at Barmouth and Aroor, with a maximum density of 12/m³ at Barmouth. *Podocoryne carnea* was found only at Barmouth from both day and night collections, the density being 0.78/m³ and 1.6/m³ respectively. *Phialidium brunescens* and *Eucheilota menoni* were represented only in the night collection made at Barmouth each with a density of 0.09/m³. *Eurene menoni* was found from the day collection of Barmouth with a density of 0.2/m³. *Eutima neucealedonia* and *E. japonica* were found only in the night collection at Aroor, with a density of 1.6 and 0.36/m³, respectively. *Eutima commensalis* was present at Barmouth and Aroor. The maximum density recorded is 2.3/m³.

TABLE 1. Numbers of hydromedusae in Plankton tows in Cochin Backwater 1968, November (Post-Monsoon)

Species	Station No. 1		Station No. 2	
<i>Podocoryne carnea</i>	28	70	0	0
<i>Obelia</i> spp.	430	40	6	0
<i>Phialidium brunescens</i>	0	4	0	0
<i>Eucheilota menoni</i>	0	4	0	0
<i>Eirene menoni</i>	8	0	0	0
<i>Eutima neucealedonia</i>	0	0	0	126
<i>Eutima japonica</i>	0	0	0	28
<i>Eutima commensalis</i>	0	18	8	180
Unidentifiable medusae	0	4	0	6
Total number	466	140	14	340
Grand Total	606		354	

Medusae were absent in all the other stations.

Species taken during pre-monsoon period

Except *Podocoryne carnea* all the other species were represented during this season. The distribution pattern of the species occurring during this season is represented in Table 2.

Euphysora abaxialis was found at Aryad south (St. 9) in night collection, with density of 0.05/m³. *Zanclaea costata* and *Tiaropsidium japonicum* were found in the day collection at Aryad-north (St. 8) each with a density of 0.07/m³. *Obelia* spp. was represented from stations 1, 2, 3 and 5, the maximum density being 0.6/m³ at Aroor (St. 2). *Phialidium hemisphericum* and *P. rangiroae* were found only at Aryad-north and Barmouth with the density of 0.06/m³ and 0.7/m³ respectively. *Phialidium brunescens* was represented at all the stations with a maximum density of 6.5/m³. *Eucheilota menoni* was found at all stations except Thanneermukkam-north (St. 6), the maximum density of 2.0/m³ at Aryad-north (St. 8). *Blackfordia virginica* is one of the commonest species of this backwater. It was absent at Barmouth and Aroor but was represented at all the other stations, with a maximum density of 96.7/m³ in the night collection at Pallipuram (St. 5). *Phialucium caroliniae* and *P. taeniogonia* were found only at Aryad-north (St. 8) with a density of 0.5/m³ and 1.9/m³ respectively. *Eirene ceylonensis* was represented at all stations except at Barmouth with a maximum density of 35/m³ at Kulasekharam (St. 4). *Eirene menoni* found at stations 4, 5, 6, 7, 8 and 9. The maximum density was 1.5/m³ at Aryad south (St. 9). *Eutima hartlaubi* was found in the night collection of Pallipuram (St. 5) only, with a density of 0.3/m³. *Eutima brownei* was found at Kulasekharam (St. 4), having a density of 0.11/m³. *E. neucealedonia* was found at all stations except at Barmouth, Aroor and Vaduthala with a maximum density of 5.1/m³ at Pallipuram (St. 5). *Eutima japonica* was represented only at Thanneermukkam-south and Aryad-north (St. 7 & 8). *Eutima commensalis* was found at all stations with a maximum density of 69/m³ at Vaduthala. During this period, some unidentifiable specimens were also encountered.

The distribution of *Blackfordia virginica* in relation to salinity during the pre-monsoon period is represented in Fig. 3. A high peak is noticed at Pallipuram where the salinity is 32.2‰ and the haul was taken at night time. For *Eutima commensalis* the distribution is portrayed in Fig. 4, the peak is noticed at Vaduthala (St. 3) in the day collection having the salinity of 33.1‰. In Fig. 5 the distribution of *Eirene ceylonensis* is given and the maximum is in the day collection at Kulasekharam (St. 4) with a salinity of 31.5‰.

The population of *Eutima commensalis* was divided into six developmental stages (Santhakumari, 1970). The peak for *Eutima commensalis* noticed at Vaduthala, is chiefly due to stages I and II. At Aroor and Barmouth this species is found only in very few numbers.

Analysis of the species into the two sexes showed a dominance of males in the case of *Blackfordia virginica*, *Eutima commensalis* and *Eirene ceylonensis* and this agrees with the observation of Vannucci *et al.* (1970)

DISCUSSION

As the result of the south west monsoon and influence of river discharge the salinity fluctuated from 0.3‰ to 34.4‰ during the period, 1968-69. Thus a hydrographical condition caused drastic changes in the environment and con-

TABLE 2. Numbers of hydromedusae in Plankton tows in Cochin Backwater 1969, April (Pre-monsoon)

	St. No. 1		St. No. 2		St. No. 3		St. No. 4		St. No. 5		St. No. 6		St. No. 7		St. No. 8		St. No. 9		
	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	
<i>Euphysora abaxialis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
<i>Zanclaea costata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Tiaropsidium japonicum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Obelia</i> spp.	6	14	54	8	50	8	0	0	0	5	0	0	0	0	2	0	0	0	0
<i>Phialidium hemisphericum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Phialidium rangiroae</i>	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
<i>Phialidium brunescens</i>	14	42	24	42	0	8	0	22	6	0	0	5	6	15	6	196	8	4	4
<i>Euheilota menoni</i>	16	4	0	2	0	6	0	20	0	25	0	0	24	15	10	62	10	2	2
<i>Blackfordia virginica</i>	0	0	0	0	385	2	1328	534	18	3095	6	10	6	15	32	124	14	404	0
<i>Phialucium carolinae</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	6	0	0	0
<i>Phialucium taeniogonia</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	58	0	0	0
<i>Eirene ceylonensis</i>	0	0	6	0	540	12	1270	118	232	175	216	55	208	40	18	688	74	58	0
<i>Eirene menoni</i>	0	0	0	0	0	0	0	8	0	25	18	20	0	10	2	24	58	46	0
<i>Eutima hartlaubi</i>	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0
<i>Eutima brownei</i>	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
<i>Eutima neucaledonia</i>	0	0	0	0	0	0	44	4	206	40	38	0	16	5	0	22	4	28	0
<i>Eutima japonica</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0
<i>Eutima commensalis</i>	6	2	2	2	3585	2	472	242	576	2415	452	155	316	120	228	230	172	124	0
Unidentifiable medusae	8	0	0	2	15	0	0	0	0	85	0	20	0	55	0	8	0	2	0
Total number	84	62	86	56	4575	38	3118	948	1038	5875	730	265	584	275	336	1436	340	670	2
Grand Total	146		142		4613		4066		6913		995		859		1772		1010		

sequently, the organisms living in this backwater fluctuated with the seasons, while the range of temperature variation is of 4°C only.

The distribution of hydromedusae in time shows that they were absent during post monsoon period (November) except at Barmouth and Aroor where the salinity ranged from 30.0‰ to 9.7‰ during the season. This suggests that for the endemic species low salinity is not favourable for the liberation of medusae from the hydroid. From Aroor, towards the head of the estuary, the salinity of the backwater decreased and fell to 0.1‰ at Pallipuram and Kulasekharam (St. 4 & 5).

During the pre monsoon period (April) hydromedusae are well represented qualitatively and quantitatively; *Blackfordia virginica*, *Eutima commensalis* and *Eirene ceylonensis* being the most common and abundant species.

From the available data, a direct relationship can be noticed between the density of hydromedusae and the salinity of the water during the post monsoon period (Fig. 1). Such a correlation was not evident during the pre monsoon (Fig. 2) where the total abundance appears to be strongly influenced by the presence of dense swarms of different species, at different stations. Thus maximum abundance was found at St. 3, where salinity averaged 31.1‰ and high density was due to high frequency of *Blackfordia virginica* during the night and *Eutima commensalis* during the day. There seemed to be a tendency for a secondary peak of abundance at St. 8 where salinity averaged 28‰ and again this was due to the presence of a swarm of *Eirene ceylonensis* found during the night.

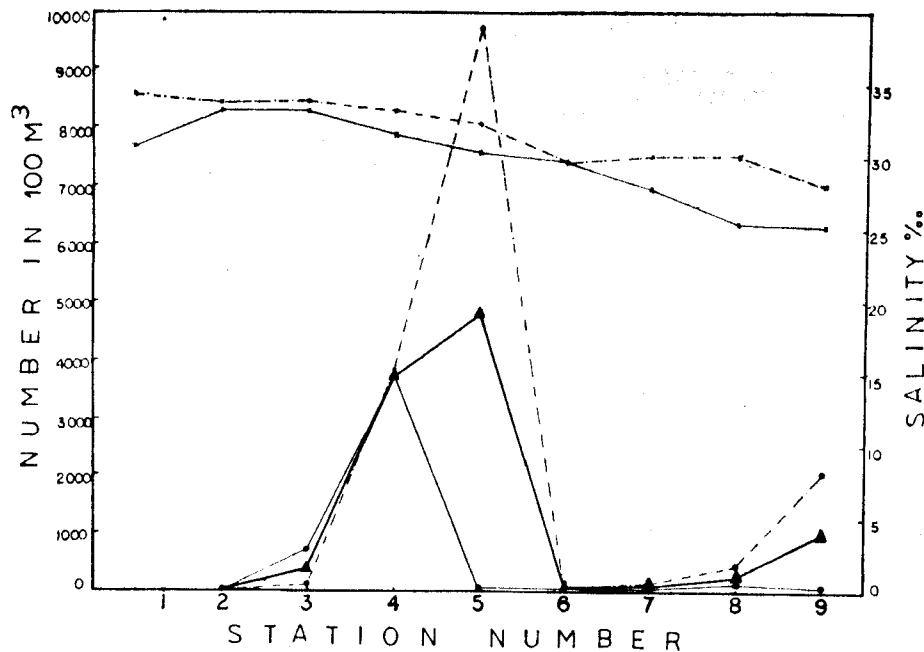


FIG. 3. Distribution of *Blackfordia virginica* from Barmouth to Aryad South in relation to salinity during April 1969. Conventions as in Fig. 1.

The distribution in space of the three more abundant species shows that they have a major peak and tend to have a secondary peak. Thus *Eutima commensalis*

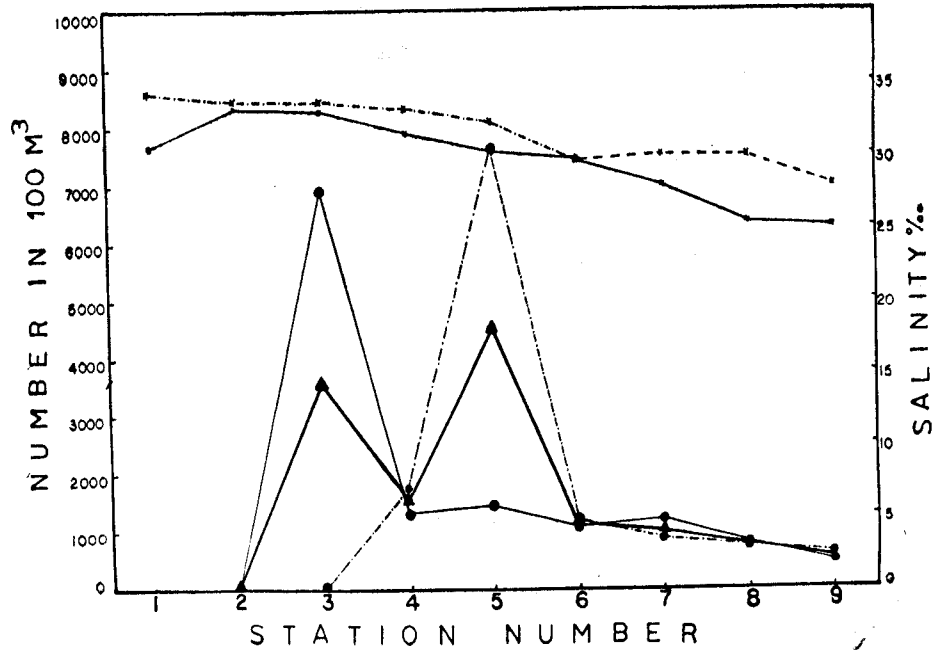


FIG. 4. Distribution of *Eutima commensalis* from Barmouth to Aryad South in relation to salinity during April 1969. Conventions as in Fig. 1.

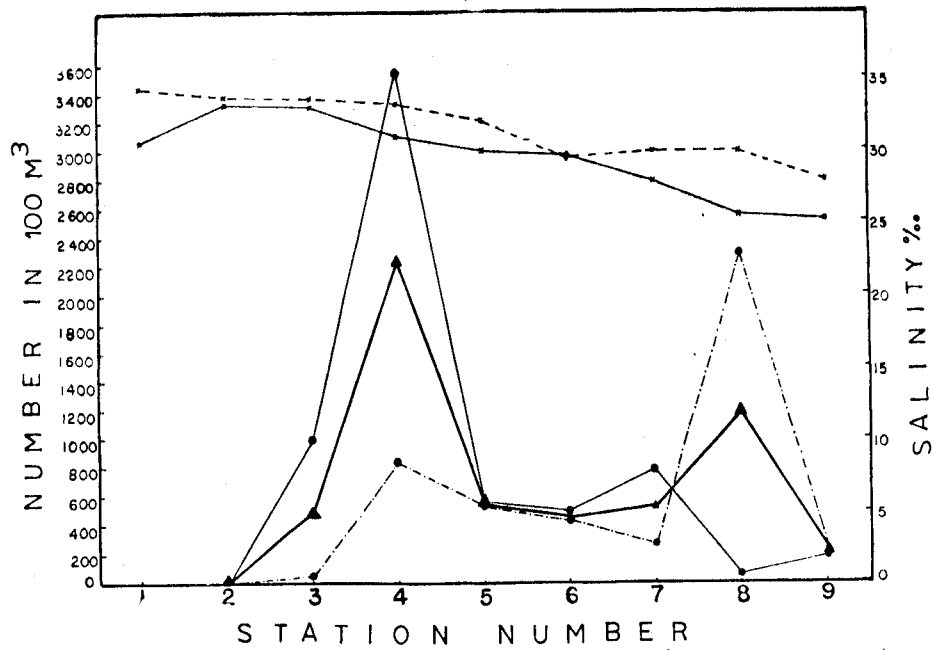


FIG. 5. Distribution of *Eirene ceylonensis* from Barmouth to Aryad South in relation to salinity during April 1969. Conventions as in Fig. 1.

has a peak at St. 5 (night) and a secondary one at St. 3 (day light, Fig. 4). *Blackfordia virginica* has a peak at St. 5 and an upward trend at St. 9 (both are night samples, Fig. 3); and also a secondary peak at St. 4 (day). *Eirene ceylonensis* also shows two peaks, a major one at St. 4 (day light) and a secondary one at St. 8 (night sample). Each of the three species shows a peak at a different station, except for St. 5 where two species were found in major numbers, namely *Blackfordia virginica* by night and *Eutima commensalis* by day; the latter, however, was found mainly in its younger and smaller stage I and II that will have different food habits than the large adults. The data suggest that each species acquires numerical dominance over a certain portion of the system (Figs. 3-5) that may be correlated to their salinity preferences or to suitable food availability or some other ecological parameter.

In general, very low salinity is not favourable for the life and activity of hydromedusae in this region. This is evident from the fact that during monsoon period the hydromedusae are entirely absent in the area.

As far as known, the species to be found in the backwaters in the post-monsoon season are endemic to the area and not to be found in the coastal waters nor in the offshore upwelled watermass. The restocking of the waters with such species after the monsoon is a problem that we believe may have been solved by the following mechanism; the hydroids will encapsulate and develop some form of resting stage during the very low saline period and will grow, become active and bud off new medusae when salinity will have again reached the appropriate level. This is actually known to occur with *E. commensalis* (Santhakumari & Nair, 1969; Santhakumari, 1970).

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