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OBSERVATIONS ON THE LARVAL INGRESS OF THE MILKFISH, *CHANOS CHANOS* (FORSKÅL) INTO THE PULICAT LAKE

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ABSTRACT

Seasonal abundance of the larvae of the milkfish, *Chanos chanos* (Forskål) in the Pulicat Lake has been studied with reference to the lunar phase, the time of the day and the tide during 1966-68 and correlated with surface salinity, surface temperature and rainfall.

The ingress of the milkfish larvae into the Pulicat Lake takes place continuously from February/March to October with two peaks. Quantitatively the peak in August/September is more important than the one in April. The probability of each fish spawning independently of others in the population is perhaps responsible for the continuous larval occurrence over a prolonged period. A positive correlation of larval abundance with surface temperature in the range of 26.5 to 30.3°C and an inverse correlation with rainfall has been established. Surface salinity values during peak periods of larval abundance have been found to be 34.3 and 34.4‰. Larval index of a particular year appears to indicate the success of the commercial fishery of the fish in the subsequent year.

INTRODUCTION

Chanos chanos (Forskål), popularly known as the milkfish, is much sought after for culture in some Far Eastern countries, by virtue of its quick adaptability to and survival in brackishwater ponds. For the successful culture of this fish, quantitative studies on the availability of its fry are essential. As the available information on the occurrence of the fry of *Chanos* (Ganapati *et al.*, 1950 ; Menon *et al.*, 1959 ; Chacko *et al.*, 1953 ; Chacko and Mahadevan, 1956 ; Saanin, 1954 ; Thiemmedth, 1954 and Panikkar *et al.*, 1962) is meagre, quantitative studies were undertaken for the proper evaluation of the seed resources of the Coramandel coast at Pulicat village, near Madras. In the present contribution the ingress of *Chanos* larvae into the Pulicat Lake, a brackishwater lagoon on the east coast of India, with respect to lunar phase, tide, month and time of the day, has been presented and correlated with surface salinity, surface temperature and rainfall.

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Material and Methods

In the course of the study 246 collections were made with a Midnapore type shooting net (Jhingran, 1965) at the lake mouth from April 1966 to December 1968 covering all four tides of a day on full moon and new moon days. On a few occasions due to inclement weather collections were made on a day prior to or succeeding the full moon and new moon day as the case may be. Water samples to determine physico-chemical factors were also collected at this time and prevailing weather conditions noted. The fishes in the samples were identified upto species wherever possible, and the total count of each species, and the associated organisms in the collections were also noted. The concentration of *Chanos* fry in the samples worked out as their percentage in the total number of fish was used to draw conclusions on the diurnal, tidal and lunar periodicities. For calculating the seasonal variations in the ingress of the fry, the average number per each operation of the net at high tide was taken into account. As the sampling was confined to the spring tides, the observations made on the lunar periodicity relate only to a comparative study of the moon phases covered. As there was no rain gauge at or near the place of collection, the rainfall data collected by the Revenue Department of Tamil Nadu at Ponneri, about 25 km away from the collection centre, were used for correlating the larval abundance with rainfall.

Observations

Tidal Periodicity

The percentage of *Chanos* fry was worked out for high and low tides separately for each month for 1966, 1967 and 1968 (Table 1). Except for a few instances the percentage of the fry in general was higher at high tide than at low tide.

The length at which the *Chanos* fry entered the lake, which serves as a nursery ground for them, varied between 11 and 15 mm. At this size the fry appears to passively drift with the tide. Most of the fry that entered with the tide settle down in the fringe areas away from the main current and the rest are washed back into the sea by the receding tide. Therefore, for calculating the seasonal abundance of the larvae, the number at high tide alone was taken into consideration.

Lunar periodicity

It is well known that the tidal effect is stronger at spring tides (on full moon and new moon days) than at neap tides. To understand their effect on the larval ingress two collections at neap tide were made—one on 22nd April 1968 and another on 6th May 1968. On the former occasion the average number of larvae per one operation of the shooting net was 24.5 which was a lower figure than 82.5 for new moon day (27-4-68) and 32.5 for full moon day (12-4-68). On the second occasion the average number of larvae was only 4.5 being much less than 24.5 on new moon day (26-5-68) and 29.0 on full moon day (12-5-68). From these it would seem that *Chanos* fry in other phases of the lunar cycle (neap tides) were poorer than those made on full moon and new moon days (spring tides).

The percentage of *Chanos* fry in the collections in each month for the full moon and new moon days is given in table 2 for the years 1966-68. It can be seen from the combined data that in the first half of the year (February to June) collections in the new moon period were richer than those of the full moon period, while

TABLE 1. *Percentage* of Chanos *fry at high and low tides in different months**

Year	*Tide*	*Feb.*	*Mar.*	*April*	*May*	*June*	*July*	*August*	*Sep.*	*October*
1966	HT	..	..	37.04	7.99	1.02	..	1.44	0.15	..
	LT	..	..	81.55	..	37.26	2.83	17.60	..	..
1967	HT	..	8.61	11.03	1.70	0.33	1.43	9.03	17.08	0.15
	LT	..	7.33	4.33	0.76	..	..	20.00	..	..
1968	HT	1.04	36.30	21.16	2.00	0.34	1.13	5.08	3.04	0.14
	LT	..	7.98	0.50	0.63	0.12	..	0.40	..	..
All years combined	HT	0.42	11.41	40.15	2.31	0.38	1.05	4.41	7.27	0.07
	LT	..	7.43	8.26	0.50	2.73	1.65	5.74	..	..

*Absent in the months January, November and December. HT=High Tide ; LT=Low Tide.

TABLE 2. *Percentage of* Chanos *fry during full moon and new moon periods*

Year	*Moon phase*	*Feb.*	*March*	*April*	*May*	*June*	*July*	*August*	*Sept.*	*Oct.*
1966	Full moon	..	..	N.C.	A	5.30	0.90	2.83	A	A
	New moon	..	..	42.5	8.10	1.80	A	1.10	0.2	A
1967	Full moon	A	9.80	6.50	9.90	A	0.90	11.70	0.5	1.70
	New moon	A	A	11.4	1.0	2.8	2.7	0.5	17.8	A
1968	Full moon	0.60	5.30	22.50	9.90	..	1.80	5.80	1.60	0.10
	New moon	0.80	32.20	16.60	0.90	2.80	0.6	1.90	3.20	A
All years combined	Full moon	0.13	9.60	8.19	4.40	0.14	1.33	5.84	0.92	0.23
	New moon	0.17	12.13	18.46	18.75	1.42	0.82	1.39	7.47	A

N.C.=Not collected ; A=*Chanos* absent.
Absent in the months January, November and December.

in the second half (July to October) the reverse was the phenomenon, with the exception of September.

When data for individual years were examined, some irregularities were noticed. For example, in June 1966 the catch during the full moon period showed numerical superiority over that of the new moon period. Similarly in September of the same year, the new moon period catch was more, while *Chanos* fry were totally absent during the full moon period. In March and May 1967 and in July and September in the same year, some irregularities were noted. In 1968, April, May and September were abnormal instances.

Diurnal periodicity

The percentage of *Chanos* fry in the total number of fish in each month for day and night during 1966 through 1968 (Table 3) showed that but for some anomalous instances, the percentage of the fry was generally more during day time than at night. However, when the data for the three years were combined, it was observed that the percentage of *Chanos* fry was more during night in the months of March and April.

The observed diurnal differences in the occurrence of *Chanos* fry were tested for statistical significance by chi-square test (Table 3). Since March and the first half of April were not covered in 1966, no statistical test was made for the 1966 data. The years 1967 and 1968 showed highly significant difference between day and night catches.

Seasonal abundance

In working out the seasonal abundance (Table 4) the average number of the fry per each operation of the shooting net at high tide only was taken into account for reasons already mentioned.

There were two peaks of abundance, one in April and another in August/September. Of these two peaks, the latter seems to be of greater importance. Generally there was a continuity in the occurrence of *Chanos* fry from February/March to October.

Effect of salinity, rainfall and temperature

During April and August when peak incursions of *Chanos* fry occurred, the salinity of surface waters at the lake-mouth during 1968 was 34.3‰ and 34.4‰, while the salinity range during the period of occurrence of the fry was between 33.4‰ and 35.6‰. *Chanos* fry did not occur during November to January, when the salinity varied from 29.6‰ to 27.3‰. Higher salinities of 35.6‰, 34.6‰ and 35.3‰ in May, June and July respectively were associated with smaller number of fry.

The average number of *Chanos* fry per haul at high tide in each month during 1966, 1967 and 1968 was correlated with rainfall (Table 5). During the two peaks in April and August/September there was either no rainfall or low rainfall, the maximum rainfall occurring during October-December. The period October-December had an average rainfall in 309, 263.8 and 176.7 mm per month during 1966, 1967 and 1968 respectively, whereas the fry season March-September had 122.2, 74.9 and 66.0 mm of average rainfall per month in the above years, showing an inverse correlation between the occurrence of *Chanos* fry and rainfall.

TABLE 3. *Percentage of* Chanos *fry at day and night*

Year	*Time*	*Feb.*	*Mar.*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Total no. of fry in the year*	*Chi-square*
1966	Day	..	..	45.19	11.64	1.32	..	0.82	..	..		
	Night	..	..	40.05	..	2.89	0.75	1.69	0.15	..	1480	342.4**
1967	Day	..	6.11	4.61	1.80	0.54	7.64	21.45	47.01	0.75	630	
	Night	..	10.74	11.59	0.95	0.22	0.59	0.89	1.53	..	1133	350.5**
1968	Day	1.92	35.11	37.84	8.87	0.39	4.23	7.33	3.31	..	400	
	Night	0.42	13.95	17.35	0.26	0.25	0.41	0.55	2.92	0.14		
All years combined	Day	0.17	9.05	12.27	4.68	1.19	4.33	8.04	36.48	0.31		
	Night	0.12	11.37	15.61	0.31	0.56	0.52	1.13	1.02	0.04		

**Highly significant.

TABLE 4. *Seasonal variation in the larval ingress of* Chanos* (*average number of fry per haul*)

Year	*Feb.*	*March*	*April*	*May*	*June*	*July*	*August*	*Sept.*	*Oct.*
1966	..	..	135.00	12.30	6.70	..	23.5	3.7	..
1967	..	69.0	95.80	12.50	5.30	4.80	37.80	280.50	1.00
1968	0.50	24.50	57.50	25.80	18.50	8.80	219.80	21.50	1.30
All years combined	0.30	43.60	88.30	16.80	10.50	4.20	92.70	110.8	1.50

*Absent in January, November and December.

The relationship between the occurrence of *Chanos* fry and surface water temperature during 1968 during day and night is indicated in Fig. 1. It can be observed that there was a positive correlation in the temperature range of 28.3°C to 30.3°C

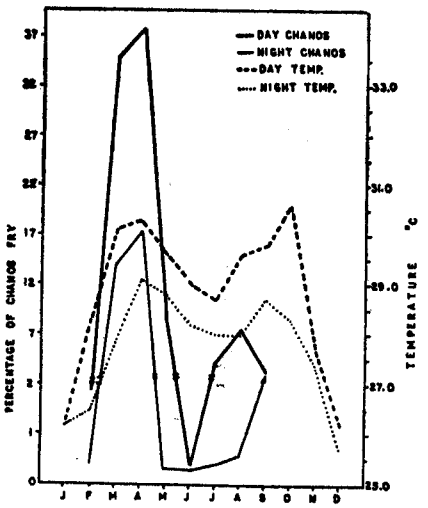

FIG. 1. The correlation between abundance of *Chanos* fry and surface water temperature at day and night.

during day and 26.5°C to 29.1°C during night time. The peak occurrence of *Chanos* fry in April when temperatures were relatively higher and the absence of fry during the months when the temperature was low is interesting.

Variations in larval indices in different years

In Table 6 the larval indices for 1966, 1967 and 1968 are presented. It will be seen that the larval index was minimum in 1966 and maximum in 1957. At this period the location of the lake mouth, its width and depth had undergone considerable change as a result of silting and erosion of the sand bar, resulting in variations in the inflow of sea water into the lake, on which depends the ingress of larval fish. The changes in the larval indices for different years, despite the physiographical changes at the lake mouth, may reflect the spawning success of *Chanos* on the Coramandel coast in different years.

Larval index and commercial fishery

In Table 6 the larval indices and the landings of *Chanos* were given for the period 1966-68. It will be seen that the trend of the larval index in a year was similar to the trend of commercial landings in the subsequent year. Thus, a low index in 1966 appeared to have resulted in a relatively poor fishery in 1967 and a high index in 1967 appeared to have resulted in a gain in the fishery in 1968. Within the limited scope of the data, it seems, the larval index might be used to predict the fishery in the subsequent year. However, studies over a long range are necessary to substantiate the trend noticed above.

TABLE 5. *Correlation between incursion (average number per haul) of* Chanos *fry and total rain fall*

Year	*Parameters*	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
1966	*Chanos* fry ingress	—	—	—	135.0	12.3	6.7	—	23.5	3.7	—	—	—
	Rain fall (mm)	16.0	—	—	—	106.0	37.0	133.3	173.4	405.6	355.5	503.5	68.0
1967	*Chanos* fry ingress	—	—	69.0	95.8	12.5	5.3	4.8	37.8	280.5	1.0	—	—
	Rain fall (mm)	56.0	—	76.0	—	5.0	86.0	72.5	253.0	32.0	127.0	271.0	393.4
1968	*Chanos* fry ingress	—	0.5	24.5	57.5	25.8	18.5	8.8	219.8	21.5	1.3	—	—
	Rain fall (mm)	—	—	—	145.0	9.0	80.0	79.0	31.0	118.2	88.0	223.0	219.0

TABLE 6. *Larval indices and landing figures of* Chanos *for different years*

Year	*Total no. of fry at High tide*	*Total no. of operations at High tide*	*Average number per operation*	*Landings (in* Kg)
1966	444	24	18.5	11,818
1967	1957	41	47.7	6,534
1968	1512	46	32.9	7,495

DISCUSSION

The existence of two peaks of larval ingress in *Chanos chanos* at Pulicat and the importance of the August/September peak are in conformity with the observations made by Delsman (1926), Saanin (1954) and Thiemmedh (1954). A secondary peak in October-November was reported for the Coramandel coast by Ganapati *et al.* (1950) and Chacko *et al.* (1953). Occasional occurrence of *Chanos* fry in Chinnapalem creek in November has also been reported by Panikkar *et al.* (1952).

The continuous occurrence of the fry from February/March to October seems to throw light on the breeding habits of the fish. Tampi (1957) gave the spawning season of *Chanos* as from February to May and from the existence of a single peak of mature eggs, concluded that there was a single spawning. Further he opined that the occurrence of fry in October-November might be due to another population breeding in October to December. However, the continuous occurrence of the fry at Pulicat may be due to the individual fish spawning independently of others in the population.

Observations on the lunar periodicity indicated that *Chanos* fry were more abundant at spring tides than at neap tides; and richer during the new moon period than during full moon period from February to June, and from July to October (except in September) the reverse was the case. Their greater abundance during the new moon period was also reported by Chacko and Mahadevan (1956).

In general, the fry were more at day than at night time. However, the combined data for all the years indicate that fry were more at night than at day in March and April.

There was a positive correlation between surface temperature and *Chanos* fry in the temperature range of 26.5°C to 30.3°C. However, *Chanos* is known to tolerate temperatures upto 40°C (Schuster, 1958). The optimum salinity for the occurrence of fry appeared to be 34.3‰—34.4‰. However, Sunier (as quoted by Schuster, 1958) observed that *Chanos* behaves normally in waters with a salinity of even 84.6‰. The inverse correlation between rainfall and abundance of the fry noticed in the present study agrees with the observations of Thiemmedh (1954). Peaks in the occurrence of the fry were preceded by rainfall as earlier noted by Malupillay and Chacko (1959).

A close similarity existed between the trends of larval index and the fish landings, indicating that the larval index of a year may be useful in the prediction of the commercial fishery in the subsequent year.

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