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42. SEASONAL ABUNDANCE OF BIVALVE AND GASTROPOD LARVAE IN THE PLANKTON OFF TUTICORIN COAST

Pon SiraJmeetan and R. Marichamy
Central Marine Fisheries Researcti Institute, Cochin-682031.

ABSTRACT

Estimation and identification of tlie commercially important molluscsn larvae occurring in the planl(ton collected from inshore waters off Tutlcorin coast during 1976-1985 indicated their abundance in space and time. It is of practical significance to determina the fluctuations in the larval populat-ion and settlement of many of the bivalves iilce the pearl oyster. The occurrence of bivalve and gastropod larvae exhibit two distinct modes during February-April and September-December indicating the peal(spawning seasons of these groups. In certain years, anothsr prominent occur-rence of molluscan larvae was noticed during June-July. A maximum of 98.5% of bivalve larvae were recorded in February, 1976 and 91.8% of gastropod larvae during June, 1976. The distribut-ion pattern of molluscan larvae and that of other planktonic organisms and the relationship with hydrological factors are discussed. Several larval forms have been identified from the collections indicating the significence of Tutlcorin as an important molluscan resources zone.

INTRODUCTION

An accurate appraisal of the relative pro-ductivity of the area and the resultant variation in zooplankton stocks which directly support pelagic population might be possible through intensive hydrobiological studies. Such studies help in forecasting the situations developed in the environment that may affect the commer-cially important resources. Compared to the published information available on hydro-biology of the Gulf of Mannar (Chacko 1950; Prasad et a l 1952; Prasad 1954, 1956, 1958; Jayaraman 1954; Chacko and Malu Pillay 1962; Prasad and Nair 1960). Natarajan (1957) has described the larval development of some prosobranchs from the Palk Bay and Gulf of Mannar. Our knowledge of the plankton of Tutlcorin coast is limited to a few preliminary observations by Chidambaram et al (1951); Sambandamurthy (1962); Sudhakar and Chandrasekaran (1968). Recently, Marichamy and Pon Siraimeetan (1984) have described the distribution of zooplankton in this region in

relation to hydrological and meteorological features. The present paper attempts to describe the gross qualitative and quantitative variations of bivalve and gastropod larve distributed in the inshore waters with reference to environmental conditions and general inter-relationship of zooplankton based on the data collected during 1975-1985.

MATERIAL AND METHODS

The methods of collection of plankton samples, the area covered and the enumeration of the various components are the same as those described by Marichamy and Pen Siraimeetan (1984). Simultaneously, the hydrological factors were studied and the data collected on different sampling dates were pooled month-wise and the trend of seasonal variations were analysed on the basis of combined values of all the years of study. The fluctuations in the plankton are discussed in terms of monthly averages. Facilities enabled recording of some organisms upto generic level only. Measurements of different stages of molluscan larvae were taken using a micrometer scale and the features of larvae were compared with published information. Rainfall data were collected from the meteorological centre, Tuticorin Harbour Project.

ENVIRONMENTAL FEATURES

Among various hydrological parameters examined such as temperature, salinity, dissolved oxygen content, pH and nutrients, the data of highly influencing factors like rainfall, temperature and salinity alone were analysed and presented to examine their probable effect on the distribution of larve. The data collected on these aspects during 1975-85 were pooled monthwise since there was no difference in the trend of seasonal changes between the years. The results are presented in Table 1.

The surface water temperature closely followed the trends of atmospheric temperature and exhibited two peaks in a year. Sea temperature steadily increased from the winter low level and reached the maximum in May (30.5° C) and then declined upto August (27.2° C). The fall in surface temperature in coastal waters was due to the active south west wind. The secondary peak was observed during September-October and subsequently it declined. This observation is in confirmity with the earlier findings in Gulf of Mannar by Chacko (1950), and Marichamy and Pon Siraimeetan (1984). The values of salinity also exhibited a clear bimodal oscillation, more or less following the variations of temperature in the course of the year. Two maxima were recorded in April and October. The fall in salinity from November onwards was due to rainfall. However, in certain years the fall in salinity was not so prominent because of the failure of north east monsoon. The data on rainfall give a general picture for the region, but variations were noticed from year to year. Maximum record of 369.5 mm was noticed in November 1982, where as in the corresponding month of 1981 it was 34 mm. The average rainfall was generally high in northeast monsoon period, October-December. In November the average for the entire period was found to be 169 mm. Rainfall was noticed in April in certain years and average recorded was 34 mm.

DISTRIBUTION OF BIVALVE LARVAE

Pubished information on the collection of egg masses of planktonic molluscan larvae in the study of breeding habits are known from the contributions of Hornell (1921), Gravely (1942), Annandale and Kemp (1916), Panikkar and Aiyar (1939), Panikkar and Tampi (1949) and Nataraj (1957). The bivalve larvae were separated from the plankton collections and

TABLE 1. *Seasonal variations of temperature, salinity and rainfall in Tuticorin coast*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature "C	25.8	27.2	29.7	31.4	30.5	29.7	29.2	27.2	28.8	28.9	27.9	27.4
Salinity %.	32.41	33.20	33.63	34.23	33.44	34.13	34.13	34.18	33.87	34.00	32.78	32.75
Rainfall mm	13.6	27.4	18.7	34.0	19.5	2.2	3.9	1.3	9.3	89.0	169.5	77.8

TABLE 2. ***The percentage composition of bivalve larvae in zooplankton during 1975-85***

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1975	6.5	75.0	2.6	0.9	0.3	3.6	5.6	0.9	1.2	0.9	2.4	0.5
1976	—	98 5	0.01	0.3	0.2	0.5	0.2	001	0.01	0.12	0.2	0.01
1977	0.1	0.3	98.4	0.5	0.02	—	—	0.03	0.02	—	0.1	0.6
1978	1,0	3.2	0.5	32,1	0.5	59.0	2.1	—	—	0.5	—	1.1
1979	193	3.2	13.1	19.7	41.0	—	3.2	14.8	—	205	1.3	0.8
1980	0.1	02	2.5	90.5	—	—	—	0.2	5.5	0.1	0.1	0.7
1981	—	—	2o.4	25.8	3.8	—	19.5	3.8	7.5	—	1.2	12.0
1982	1.0	2.0	18.1	4.0	—	2.0	1.0	28.2	—	34.2	80	1.5
1983	—	14.3	16.8	1.4	9.1	5.0	21.5	—	24.1	6,0	0.8	1.0
1984	0.2	0.1	0.1	2.1	4.0	1.6	3.4	44.6	2.5	24.1	15.8	1.4
1985	10.5	3.1	2.4	0.1	—	0.1	0.6	—	14.6	—	19.3	49.3

their percentage composition in general zooplankton are presented in Table 2. It may be seen that a very high percentage of bivalve larvae ranging from 75-98.5% was recorded in the period February - April during 1975-1980, although they occur alround the year. Maximum bivalve larvae of 59% was the predominent item in June 1978. A secondary peak in the occurrence was noticed during July in 1981 and 1983 whereas this secondary mode of larval occurrence was noticed in the month of October in 1979, 1982 and 1984.

The bivalves occurring in high percentages as well as in most of the samples collected round the year were examined further to see the larval stages and size, and were compared with the data in previous work. The details of this study are preseeted in Table 4. *Mactra mere.* ***Avicula vexillum, Modiolus*** **sp;** ***Crassostrea*** *madrasensis* and *Mactra* sp were noticed in umbo and spat stages. The larvae of the first two species were found in swarms in the collections during February-March season in most of the years revealing the spawning season of these bivalves. The larvae of *Mactra mere* were present throughout the year. The shelled larvae of *Avicula vexillum* resemble those of the pearl oyster *Pinctada fucata* and are known as 'false spat' (Hornell 1922). They were very common in the collections made during December-February and the average size was DVM 280 *IJ.* and APM 337 ^ in umbo stages and 1588-1648(1 respectively in spat stage. **The larva of** ***Crassostrea madrasensis*** **measured** at the average size of DVM 351 *v^* and APM 422 *V-* were common in the collections made during October. This species is known to breed

TABLE 4. ***Larvae of Bivalves***

Name of the species	Stage	Size of larvae Minimum DVM /i	Minimum APM *V-*	Maximum DVM (A	Maximum APM (A	Average DVM /i	Average APM *V-*
Mactra mere	Umbo	200	200	560	590	389.2	399.2
Avicula \iexillum	Umbo	250	290	310	370	280.	336.7
Modiolus **sp**	Spat	1025	1025	2525	2525	1775	1800
Crassostrea madrasensis	Plantigrade	350	420	352	424	351	422
Mactra **sp**	Umbo	230	270	300	280	265	275
Avicula vexillum	Spat	450	575	2950	2975	1588	1648

througout the year with 2 peaks in April-May and September-October and there are a good number of natural beds in the intertidal regions and creeks along Tuticorin coast.

DISTRIBUTION OF GASTROPOD LARVAE

The percentage composition of gastropod larvae in zooplankton collections are presented in Table 3. It can be seen that gastropod larvae occur in high percentage, 56-82%, during February - April, indicating the spawning season of this group of molluscs. A secondary peak in the occurence was noticed in December. A swarm of gastropod larvae numbering 92,256 in a 10 mts surface haul, accounted for 92% in the collection made in June 1976. tn the rest of the months, gastropod larvae were noticed but in negligible percentages.

The gastropod larvae were present almost through-out the year as well as in good percentages. They were identified and the details of size of the larvae measured, are given in Table 5. *Murex virgineus, Oliva* sp, *Turritella acutangula, Turriteiia* sp., *Nerita aibicilla Pota - mides cirigulatus (Cerithidea fluviatilis)* were the common forms present in most of the collect-ions. Larvae of *lVlurex virgineus* was present in the collections round *the* year with peak in March. Natarajan (1957) observed that the breeding season of this species was during

TABLE 3. *The percentage composition of gastropod larvae in zooplaniiton during 1975-85.*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1975	8.2	61.1	4.0	1.0	0.8	8.6	5.0	1.3	2.2	3.0	4.0	0.8
1976	—	4.4	0.7	1.1	0.3	91.6	0.3	0.2	0.5	0.2	0.6	0.1
1977	0.9	6.0	81.5	3.9	0.1	0.4	0.2	1.4	1.5	—	0.5	3.6
1978	2.8	1.1	3.4	56.1	—	6.8	19.5	—	2.2	2.8	—	5.7
1979	22.0	10.2	12.6	4.2	6.0	—	3.9	34.3	—	3.6	1.2	2,0
1980	1.4	6.9	11.5	59.7	—	0.5	—	0.5	5.7	29	3.3	7.6
1981	—	—	12.6	6.9	11.1	—	4.1	7.6	13.3	—	0.9	43.5
1982	3.0	2.3	11.1	4.1	5.8	2.6	0.6	18.1	—	16.3	33.8	2.3
1983	2.7	11.0	43.4	0.1	0.5	1.0	0.7	—	3.0	27.2	5-3	5.1
1984	1.9	4.9	3.0	2.9	2.5	37.2	1.5	18.4	3.5	2.7	7.9	13.6
1985	18.2	9.4	55.4	0.2	0.1	—	1.8	0.4	5.7	—	1.9	6.9

TABLE 5. *Larvae of gastropods*

Serial No.	Date	Station No.	Depth mt	Name of the specias	Stage	Minimum DVM^	Minimum APM(X	Maximum DVM(Jl	Maximum APMjA	Average DVM (i	Average APMfx
1	30.3.77	6C	20	*iVIurex virgineus*	Advanced veliger	375	225	2125	1525	746.9	493.8
2	//	<»	//	*Oliva* sp	,'	2500	1050	2500	1050	2500	1050
3	11.4.80	4C	24	*Turritella acutangula*	//	350	225	700	325	557.5	292.5
4	/ t	it	tr	*Turritella* sp	/ /	425	200	475	275	450	237.5
5	19.11.82	58	12	*Nerita aibicilla*	veliger	275	225	875	625	543.8	437.5
6	31.3.83	60	20	*Cerithidea fluviatilis*	//	275	200	475	350	427.8	309.7

November-March and May-July and also stated the likelihood of continuous breeding round the year. The descriptions given for the various stages of larval development are comparable with the larvae examined in the present study. The average size of the larvae was DVM 747 *fi* and APM 494 t^. *Oliva* sp in slightly advanced stage was also recorded in March. *Potam/'des cingulatus {Certithidea fluviatilis)* larvae were next in importance in abundance round the year with peaks in March and June The larvae measured 275-475 in DVM and 200-350 ^ in APM. Sadasivan (1949) has made detailed studies on the rate of growth, duration of breeding period etc. from Madras. Natarajan (1957) has recorded the spawn masses of this species during January-September and the present observations indicate that the spawning season of this species in Tuticorin coast is also the same as in Mandapam area. The maximum concentration of gastropod larvae noticed in April 1980 was due to the presence of *Turritella acutangula* and *Turritella* sp, and the larvae with average size of DVM 557 *v-* and DVM 450 ^ respectively were examined. *Epitonlum scalare* were found in a few samples. The larvae of *Nerlta albicilla* measuring 544 [A in DVM, were noticed round the year, with a peak in November indicating the spawning season. Natarajan (1957) has given the descriptions for the newly hatched veliger of this species and the features of the larvae of present collections are in confirmity with the descriptions.

DISCUSSION

The richness of molluscan fauna in Gulf of Mannar has been recognized by several earlier workers. Natarajan (1957) had identified 33 species of prosobranchs and studied their early larval history from Mandapam area. Seasonal variations in the surface temperature and salinity show similarity in general trends. A bimodal cycle in the distribution of these major factors was noticed. Two maxima were observed during April-May and September-October and the minima during August and January. The same trend has been noticed by a number of earlier workers from this region (Malu piliay, 1962; Freda Chandrasekaran and Sudhakar 1968; Marichamy and Ron Siraimeetan 1984). Thorson (1940) opined that in the reproduction of prosobranchs of all oceans there is a tendency for the pelagic development to be totally suspended in the deep sea and is restricted to shelf fauna and that starting from the Arctic and Antractic where the pelagic development is suppressed there is a gradual increase of the same towards the trophic shelves where it is the highest. Panikkar and Aiyar(1939) and Paul (1942) have observed different types of both continuous and discontinuous breeding in marine and brackish water animals of Madras area. Natarajan (1957), Marichamy and Pon Siraimeetan (1984) observed the same trend of breeding habits from the Gull of Mannar. No direct effect of temperature and salinity on breeding activity was found since most of the molluscan groups breed intermittently in an extended period. However, Rao (1951) observed the influence of salinity and temperature on the intensity of breeding in *Ostrea (= Crassostrea) madrasensis.* The monthly averages of the diurnal variations in the minimum and maximum temperature were observed to have a direct influence to the gonadal development, spawning and setting of edible oyster spat (Rajapandian and Rajan 1983). The maintenance of larval population in a given region depends upon a balance of dynamic factors, the drift of the water and its interaction with the environment as well as upon the rate of reproduction and mortality of population under the environmental conditions (Prasad, 1954). Alagarswami andChellam (1976) observed a seasonal trend in the setting of the *Avicula vexlllum* during April-June and *Crassotrea* sp during May-June. The occurence of the above two bivalve larvae in the plankton collected from this zone was noticed more or less in the same period confirming the spawning seasons of the species. Similarly, they have observed the occurrence *Modiolus* sp in large numbers during July and in the present observation, the larvae ot this species was recorded in June. The determination of breeding seasons of the gastropods examined in the present study is in agreement with the findings of Nataraj (1957). In general, the occurrence of bivalve and gastropod larvae exhibit two distinct modes during February-April and September-December

indicating the peak spawning seasons. Copepods and Lucifers were noticed in negligible percentages when molluscan larvae were predominent in the collections.

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REFERENCES

ALAGARSWAMI, K. AND A. CHELLAM 1976. On fouling and boring organisms and mortality of pearl oysters in the farm at Veppalodai, Gulf of Mannar. *Indian J. Fish.,* 23(182): 10-22.

ANNANDALE. N. AND KEMP. S 1916. "Family ostreidae", *Mem. Indi. Mus. Calcutta.* 5 : 328-66.

CHACKO, P. I 1950. Marine plankton from waters around the Krusadi Island Proc. Indian Acad. Sci., 31 : 162-74.

CHACKO, P.I. AND MALU PILLAY. 1957. Importance of hydrographical investigations in the Gulf of Mannar in relation to its fisheries *Ind. Com. Jour.-* 12 : 194-197.

CHACKO, P.I. AND A. D. I. RAJENDRAN. 1959, Maritime meterology and hydrography of Tuticorin Bay, Gulf of Mannar, 1950-1954. *Madras Fisheries Department, Fisheries Station Reports and Year Book,* 1954 55 : 175-193.

CHANDRASEKARAN, F. AND K. SUDHAKAR. 1968. Observations on the hydrography and Planktology oF peral Banks of Gulf of Mannr. *Madras Jour. Fish.,* 1:28-33.

CHIDAMBARAM, K, A. D, ISSAC. RAJENDRAN AND A. P, VALSAN. 1951. Certain observations on the hydrography and biology of the pearl bak, Tholayram Paar, off Tuticorin in the Gulf of Mannar in April 1949. *J Madras, Univ.,* B21 : 48-74.

GRAVELY, F. H. 1942. Shells and other animal remains found on the Madras beach. 11 Snails, etc, (Mollusca, Gastropoda) *Bull. Mad, Govt. Mus. (Nat hist)* 5 (2) : 1-110.

HORNELL, J. 1922. The Indian pearl fishery of the Gulf of Mannar and Palk Bay. *Madras Fish. Bull.* 16 : 1-188.

HORNELL, J. 1921. The common molluscs of south India Report IV of 1921, *Madras Fisheries Bull.* (1922), 14: 97-210.

JAYARAMAN, R. 1954. Seasonal Variations in salinity dissolved oxygen and nutrient salts in the inshore waters of the Gulf of Mannar and Palk Bay near Mandapam (S. India) *Indian J. Fish.,* 1 : 345-364.

MARICHAMY, R. AND PON SIRAIMEETAN. 1984. Hydrelogical studies in the coastal waters of Tuticorin, Gulf of *Mannar J. Mar. biol. Ass. India,* 1979, 21 (1&2): 67-76.

MALU PILLAY, C. 1962. A survey of the maritime meteorology and physico-chemical conditions of the Indian Pearl Banks off Tuticorin in the Gulf of Mannar from December 1958 to May 1959. *Madras Jour. Fish.,* 1 : 77-95.

NATARAJAN, A. V. 1957. Studies on the egg masses and larval development of some prosobranchs from the Gulf of Mannar and the Palk Bay. *Proc Indian Acad. Sci.,* 46 (3) Sec. B 170-228.

PANIKKAR, N. K. AND R. G. AIYAR 1939. Observations on breeding in brackish-water animals of Madras. *Proc. Indian Acad. Sci.,* 9B: 343-364.

PANIKKAR, B. K. AND P. R. S. TAMPI 1949. The egg mass of a Dollid gastropod mollusc from Krusadai Island. *J. Bombay Nat. Hist. Soc,* 48 (3) : 598-99.

PAUL, M. D. 1942. Studies on the growth and breeding of certains edentary organisms in the Madras Harbour. *Proc Indian Acad.Sci..* 15: 1-42.

PRASAD, R. R 1954. The characteristics of planl<ton at an inshore station in the Gulf of Mannar near Mandapam. *Indian J. Fish.,* 1 : 1-36.

PRASDAD, R. R. 1956. Further studies on the plankton of the inshore waters off Mandapam. *Indian J Fish.,* 3(1) : 1-42.

PRASAD, R.R.I958. Plankton calendars of the inshore waters at Mandapam with note on the productivity of the area *Indian J. Fish* , 5(1) : 170-188.

PRASAD, R.R. BAPAT, S. V. AND TAMPI, P.R.S. 1952. Observations on the distribution of plankton at six inshore stations in the Gulf of Mannar *J. Zool Soc India,* 4: 141-151.

PRASAD, R R AND P.V.R. NAIR 1960. Observations on the distribution and occurrence of diatoms in the inshore waters of the Gulf of Mannar and Palk Bay. *Indian J. Fish., 7{\) :A9-68.*

RAO, K.V. 1951. Observations on the probable effects of salinity on spawning, development and settling of the India backwate oyster, *Ostrea madrasensis* Preston *Proc. Indian Acad.Sci.,* 33B: 231-256.

RAO, K. V. 1956. Seasonal gonadal changes in the adult backywater oyster *Crassostrea madrasensis (Preston)* from Ennur near Madras. *Proc. Indian Acad. Sci.,* 44: 332-356.

RAJAPANDIAN, M. E AND C. T. RAJAN 1933. Studies on maturity stages and spawning periodicity of *Crassostraa madrasensis* (Preston) at Tuticorin Bay. *Proc. Symp coastal Aquaculture 2:* 475-478.

SAMB^NDAMURTHY, N. 1962. Surface plankton of the pearl bank Tholayiram paar off Tuticorin *IVladras J. Fish.,* 1: 74-75.

SUDHAKAR, K. AND F. CHANDRASEKARAN 1968 A note on the veiiger larvae in plankton collected from Tholayiram paar. *Madras J. Fish.,* 14: 38-41.

SADASIVAN, V. 1949. The rate of growth of *Cerithidea angulatus* Gmelin (Gastropoda, Pectinitra chia). *Proc. 35th Ind' Sci Congr* Abstract, p. 198.

THORSON, G. 1940. Studies on the egg masses and larval development of Gastropoda from the Iranian Gulf. *Danish Scientific Inveatigations in Iran,* pt II: 159-238,