

## Seasonal variations and species association of meroplankton in the Palk Bay and Gulf of Mannar along the east coast of India

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### Abstract

A study on the seasonal variations and species association of the meroplankton from the Palk Bay and the Gulf of Mannar biosphere reserve areas along the southeast coast of India during October 1993 and November 1995 was undertaken. The results indicated that the water quality differed between the two stations. The number of meroplankton reached maximum by October-December and gradually decreased during June to August. The average number of meroplankton was highest in Palk Bay. The meroplankton was constituted by the larval stages of commercial penaeids such as *Penaeus semisulcatus*, *P. indicus*, *P. monodon*, *P. merguensis*, *Metapenaeus monoceros*, *M. dobsoni* and *M. affinis*; zoea and megalopa of crabs, veliger larvae of gastropods and bivalves; and the fish larvae. The veliger larvae of gastropod and bivalves constituted 66% of the total meroplankton.

### Introduction

The Palk Bay (Lat. 9°40'N, Long. 79°20' E) and the Gulf of Mannar biosphere reserve (Lat. 8°35'-9°25' N, Long. 78°08'-79°30' E) situated along the southeast coast of India are separated by the Rameswaram Island. However, mixing of the waters between these two areas takes place through the Pamban Pass and also through the Adam's Bridge (Fig.1). The area has a rich and diverse group of flora and fauna. The Gulf of Mannar serves as a protective shelter for many larval forms of the marine organisms. Studies on the ecology of secondary producers from the east coast were made by Santhakumari

and Krishnamurthy, 1979; Thankaraj *et al.*, 1979; Chandran, 1982; Prabha Devi, 1986; and Subramanian, 1987. Information is available on the diel variation and relative abundance of planktonic larvae (Ayyakkannu, 1989), diversity of meroplankton in Palk Bay and Gulf of Mannar (Krishnamoorthy, 1997), diversity of zooplankton in the east coast of India (Maruthanayagam, 1998) and organization of meroplankton in Palk Bay and Gulf of Mannar (Krishnamoorthy, 1999). The present paper embodies the results of a study carried out on the seasonal variations and species association of the meroplankton from the Palk Bay and the Gulf of Mannar during 1993-95 (Fig. 1).

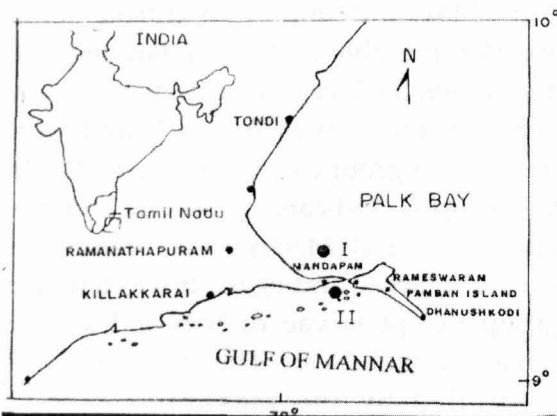


Fig 1. Map showing the sampling stations

## Material and methods

Regular fortnightly planktonic and *in-situ* water samples were collected over a period of two years from October 1993 to November 1995. Plankton samples were collected for 15 minutes (6-7 A.M.) by subsurface hauls using 50cm mouth diameter net made of bolting silk cloth (No. 14 and net mesh size 60  $\mu\text{m}$ ) operated by a slow moving mechanized trawling boat. The boat speed and direction were considered while calibrating the volume of water filtered in each samples. The mean depth of water was about 2.5 fathoms (5-6 meters). The collected net samples were carefully transferred to plankton bottles and preserved in 5% neutral formalin.

Total volume of plankton was determined by the displacement method. In this method the macroplankters were removed and the remaining plankton volume was determined. The total volume of plankton was made to a constant volume and 1ml sample was taken in Sedgewick rafter for counting under a

binocular microscope. The meroplankton from the preserved plankton samples were sorted out and pooled to get the monthly data. Cluster analysis was conducted using MS statistica package. MS-excel software was used for ANOVA test.

## Results

### Seasonal variations

The maximum zooplankton biomass values were recorded during October - December and their minimum was noted during January - March. The average annual zooplankton biomass was 79 ml/ $\text{m}^3$  during first year and 73 ml/ $\text{m}^3$  for second year in the Palk Bay station and 70 ml/ $\text{m}^3$  and 73 ml/ $\text{m}^3$  during first and second year respectively in the Gulf of Mannar station. The numerical abundance of the component species varied during different seasons, however, a peak was observed in January-March. The larval forms of penaeid shrimps included *Penaeus semisulcatus* (7.2%), *P. monodon* (2.7%), *P. indicus* (3.6%), *P. merguensis* (1.6%), *M. affinis* (0.4%) and *M.dobsoni* (0.4%). The zoea (0.1%) and megalopa (0.2%) larvae of crabs were very poorly represented but occurred throughout the study period. Their peak was during October-December at both the stations. Though the number of eggs and fish larvae such as *Leiognathus* spp. (0.01%), *Hemirhamphus* spp. (0.018%) and clupeids (0.012%) were very low, the minimum number of eggs was recorded during April-May. The veliger larvae of gastropods and bivalves (66%) exhibited a bimodal abundance. The major peak was during October-December

ber and the secondary one during April-May at both stations. Besides, eggs (0.21%) of various organisms could also be observed. The period from October-December recorded 18.6% of meroplankton, followed by 11.6%, 8.9% and 12.9% during January -March, April-May and June-August respectively. The analysis of variance results indicated that there was significant variation between and among the species and seasons (Table 1).

### Species association

In Palk Bay, the high species diversity index of the meroplankton was obtained during autumn (Jun. - Aug.) and the low values were recorded during spring season (Jan. - Mar.) and in the Gulf of Mannar the species diversity was high during

April-May and minimum during January-March (Table 2). In Palk Bay the self-association of larval species was mainly grouped into two as A and B and were further sub-grouped into A<sub>1</sub>, A<sub>2</sub>, B<sub>1</sub>, B<sub>2</sub>. In the group A<sub>1</sub>, indicates the less abundance of *Penaeus* and *Metapenaeus* prawn larvae, crab larvae and eggs. It was a mixed group except larvae of fish and veliger larvae of molluscs. The A<sub>2</sub> group was controlled by the maximum *Penaeus* prawn larvae and the B<sub>2</sub> group included the abundantly available prawn larvae and veliger of molluscs and fish larvae (Fig.2).

In the Gulf of Mannar also, all the species clustered into two groups as A and B. The B group was further sub grouped into B<sub>1</sub> and B<sub>2</sub>, in turn B<sub>1</sub> group alone was sub grouped into B<sub>1a</sub> and B<sub>1b</sub>. The A

Table 1. The significance in between the species and months

Season (93-95)		P-Value		F-Value		Significance	
		93-95	94-95	93-94	94-95	93-94	94-95
(Oct.-Dec.)	Bm	0.1056	0.2668	2.795	1.3528	NS	NS
	Ws	8.3668	6.5378	172.47	172.880	*	*
(Jan.-Mar.)	Bm	0.0009	0.01334718	7.8675	4.66693	*	*
	Ws	6.6320	4.69799E43	262.149	147.9904	*	*
(Apr.-May)	Bm	0.37142	0.018401891	3.39444	4.294400	*	*
	Ws	2.80897E45	2.79792E46	178-264	193-8209	*	*
(Jun-Aug.)	Bm	0.674429	0.2263658	0.3966717	103.3844	NS	NS
	Ws	1.06753E40	8.56463E39	121.40621	1.525720	*	*
(Oct.-Dec.)	Bm	0.64421657	0.471218207	0.2179529	0.762135	NS	NS
	Ws	9.76427E29	3.18459E38	331.04535	98.51354	*	*
(Jan.-Mar.)	Bm	0.48985372	0.41398524	0.7228208	0.895961	NS	NS
	Ws	7.72142E31	1.90309E37	52.338061	92.23946	*	*
(Apr.-May)	Bm	0.102985702	0.0254765	2.3679865	3.921375	NS	NS
	Ws	1.0902E29	5.36578E36	47.350055	81.54108	*	*
(Jun-Aug.)	Bm	0.544633779	0.30701325	0.614283	1.206118	NS	NS
	Ws	2.70518E44	3.25712E53	164.18635	345.0367	*	*

\*P=1.0; NS = Not Significant Bm = Between months, Ws = Within species

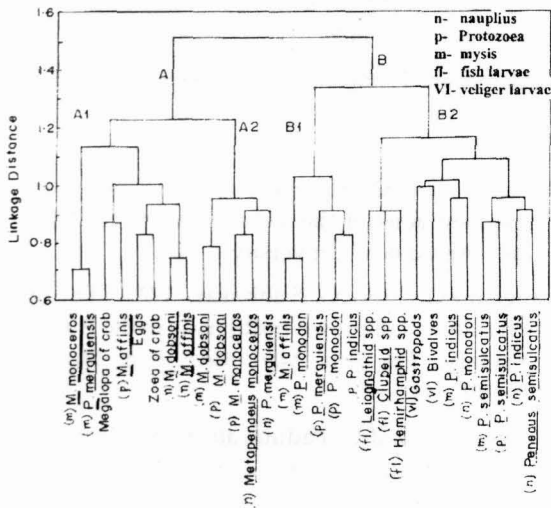


Fig. 2. Dendrogram of meroplankton assemblages in station-I

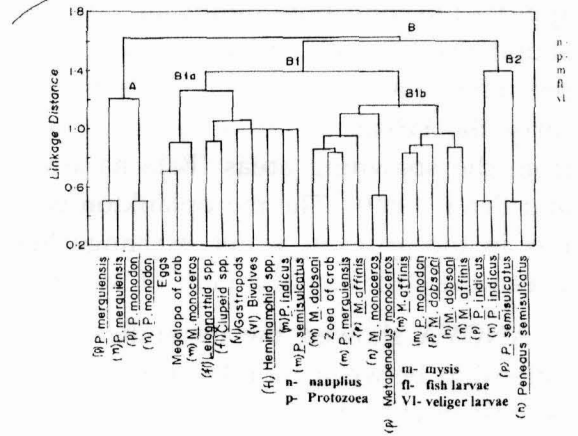


Fig. 3. Dendrogram of meroplankton assemblages in station-II

group was characterised by the poor abundance of larvae of *Penaeus* spp. and *Metapenaeus* spp., eggs, fish larvae, along with megalopa of crabs and veliger larvae of molluscs. It was a mixed group. The larvae of *Metapenaeus* spp. and the zoea of crabs constituted the sub group B<sub>1b</sub> and the B<sub>2</sub> was dominated by larvae of penaeid prawns (Fig.3).

**Discussion**

**Species composition**

The larvae of penaeid prawns were recorded throughout the collection period

from both the stations with peak abundance during October-December and a secondary one during April-June. Subramanian (1987), Mary Manisseri (1986), Subramanian (1992), Krishnamoorthy and Subramanian (1997) and Sambandam (1994) have reported that the breeding and recruitment of prawns take place more or less round the year but with a peak during October-December along the southeast coast of India. The abundance of meroplankton in these places revealed that the adult species might have chosen the areas for breeding and as a nursery ground for young ones. The

Table 2. Ranges of species diversity during seasons

Year	Palk Bay			Gulf of Mannar		
	Minimum	Maximum	Range	Minimum	Maximum	Range
1993-94	Jan.-Mar.	Jun.-Aug.	1.75-1.93	Jan. - Mar.	Apr. - May	1.6-2.18
1994-95	Jan.-Mar.	Jun.-Aug.	1.75-1.94	Jan. - Mar.	Arp. - May	1.7-2.1

Units: bites / individual

water current pattern of the sea also appeared to contribute significantly to the abundance of eggs and fish larvae. The prevailing equatorial current pattern may carry the larvae to far off places away from the spawning areas (Balachandran and Peter, 1989). The meroplankton was less in the areas of water exchange between the Palk Bay and Gulf of Mannar.

ANOVA showed the insignificant relationship between months during June-August and October-December in the Palk Bay. It revealed that these periods have a good bearing over the populations. But the period January-March and April-May have shown significant relationship. This variation could be attributed to spawning activities of various organisms.

The larvae of penaeid prawns linked themselves and formed a cluster group. The unique representation of larval forms in both stations might be due to the semi-enclosed nature of the area. Larvae of *Penaeus* spp., *Metapenaeus* spp. and crabs also formed a cluster. The interrelationship noticed between the larval forms might be due to the sharing of food. The fish larvae formed a single group, mostly due to their sub-surface feeding habit and identical abundance. The species diversity index values was higher in the Gulf of Mannar than the Palk Bay (Krishnamoorthy, 1999). From these it was discernible that Gulf of Mannar is more fertile and productive.

## References

- Ayyakkannu, K. 1989. Diel variations and relative abundance of planktonic larvae in Coleroon estuarine complex, south east coast of India. *J. mar. biol. Ass. India*, **31** : 276-286.
- Balachandran, T. and K.J. Peter. 1989. Variation in meroplankton along 78°E' meridian, *Ibid.* **31**:195-201.
- Chandran, R. 1982. Hydrobiological studies in the gradient zone of the Vellar Estuary *Ph.D Thesis*. Annamalai University : 4-21.
- Evangeline, G. and G. Sudhakar. 1973. On the recruitment of prawn post-larvae in the Adayar Estuary. *Pro. Semi. Mari. Mech. Fish.*, Madras, pp 39 - 41.
- Goswami, S.C. and G. Padmavati. 1996. Zooplankton production composition and diversity in the coastal waters of Goa. *Indian J. Mar. Sci.*, **25** : 91-97.
- Krishnamoorthy, P. 1997. Biodiversity of meroplankton in Palk Bay and Gulf of Mannar Biosphere Reserve areas along the east coast of India. *Ph.D Thesis*, Bharathidasan University, pp1-45.
- 1999. Organisation of commercially supporting meroplankton in Palk Bay and Gulf of Mannar biosphere reserve areas, south east coast of India, *Indian J. Mar. Sci.*, **28** : 211-215.
- and P. Subramanian. 1997. Meroplankton production in the Gulf of Mannar and Palk Bay on the southeast coast of India. *J. mar. biol. Ass. India*, **39** : 44-48.
- Maruthanayagam, C. 1998. Biodiversity of Zooplankton in Palk Bay and Gulf of Mannar Biosphere Reserve areas, *Ph.D Thesis*, Bharathidasan University, pp1-56
- Mary Manisseri, K. 1986. On the fishery of *Penaeus semisulcatus* and its distribution in relation to depth along Tinnevely coast, southern India. *Indian J. Fish.*, **5-7**: 59-69.
- Nair, P.V.R, and V.K. Pillai. 1983. Productivity of the Indian seas, *J. mar biol Ass India*, **25**: 41-50.
- Prabha Devi, L. 1986. Hydro-biological studies in tidal zone of the Coleroon estuary, *Ph.D Thesis*, Annamalai University, pp 1-21

- Sambandam, K.P. 1994. A Comparative study of prawn seed resources of estuaries in Ramnad Dt., Tamil Nadu. *J. mar. biol. Ass. India*, **36**: 57-62.
- Santhakumari, P and K. Krishnamurthy. 1975. Species distribution in aquatic environments. *Indian J. Mar. Sci.*, **3**: 135-138.
- Subramanian, P. 1987. Spawner recruitment distribution of *Penaeus indicus* in Parangipetai coastal ecosystem. *J. mar. biol. Ass. India*, **29**: 23-26.
- Subramanian, P. 1992. Organisation of Natural communities of juvenile penaeid prawns. I. Distribution and relative abundance. *Intl. J. Ecol. Envi. Sci.*, **18**: 227-235.
- Thangaraj, G. S., V. Sivakumar, R. Chandran, R. Santhanam, B. Sri Krishnadoss and K. Ramamoorthi. 1979. An environmental inventory of Porto Novo coastal zone. *Pro. Symp. Env. Biol.*, pp75-87.