

Diversity of microzooplankton in Parangipettai coastal waters, southeast coast of India

V. Ashok Prabu, P. Perumal and M. Rajkumar

C.A.S. in Marine Biology, Annamalai University, Parangipettai- 608 502, TamilNadu, India

Abstract

Species composition, density and diversity of microzooplankton along with hydrographical parameters in Vellar Estuary and Killai backwaters (Lat. 11° 29' N; Long. 79° 46' E) were studied from September 1998 to August 1999. Fifty six microzooplanktonic species including 6 larval forms representing diverse taxonomic groups such as Tintinnida (39); Rotifera (5); Foraminifera (3); Radiolaria (2); Ciliata (1) and Metazoa (6) were recorded. Species like *Tintinnopsis cylindrica*, *T. tubulosa*, *T. tocaninesis* and *Favella philippinensis* were found to be dominant. The observed maximum population density of microzooplankton (37520 ind./l) during summer season could be due to the higher levels of salinity (35‰) and dissolved oxygen (5.63 ml/l) as a result of rich phytoplankton production.

Key words : Microzooplankton, Vellar Estuary, Killai backwaters

Introduction

The hydrographical parameters undergo considerable variation due to the seasonal climatological changes, which in turn influence the spatial and temporal distribution of planktonic communities (Damodara Naidu *et al.*, 1977; Krishnamurthy and Santhanam, 1975). These variations in the lower trophic tiers influence the fishery production. The role of microzooplankton in the 'food web' of aquatic environment is being increasingly realized as they are found to be fed by organisms of higher trophic levels (Santhanam *et al.*, 1975). It acts as an intermediate link between the primary producers, the phytoplankton (bacteria, naked flagellates, coccolithophores, peridinians and diatoms) and the macro-

zooplankton. The mesozooplankton, the young fishes of *Mugil*, *Leiognathus* and *Siganus* show preference to feed upon the microzooplankton like tintinnids. In order to understand the relationship of microzooplankton with the various parameters, a study was carried out from the Vellar Estuary and the Killai backwaters.

The authors are very much thankful to the authorities of Annamalai University for providing necessary facilities.

Material and methods

The present investigation was carried out in the Vellar Estuary and Killai backwaters, covering 3 stations for a period from September 1998 to August 1999. Surface water samples were collected in

plastic containers to estimate the physical and chemical characteristics of the water. Monthly samplings were made at the sea mouth of Vellar Estuary (Stn.1), Killai backwaters (Stn. 2) and the river portion of the former (station 3) (Lat. $11^{\circ}29'N$; long. $79^{\circ}46'E$) along the southeast coast of India (Fig.1). Microzooplankton samples were collected from the surface waters by horizontal tow of a conical net (0.35m mouth diameter), made up of bolting silk (cloth No. 32, mesh size $54\mu m$) for twenty minutes, during high tide. The samples were preserved in 5% neutralized formalin and were used for qualitative analysis. To collect a good number of species and to quantitatively estimate the abundance of microzooplankton 200 l of surface water were filtered with the help of a 20 l bucket (10 times). As the

microzooplankton size is much smaller, there is considerable chance of missing few smaller-sized forms through the net. Hence, to obtain reasonable values in the tintinnid abundance the sedimentation technique was used, following the method of Sukhanova (1978). As per this method, one-litre surface water samples were collected using polyethylene bottles and fixed in 5% neutralized formalin on board. The bottles were kept undisturbed for 48 hours till complete sedimentation. Microzooplankton settled at the bottom were used for numerical counts, using Utermohl's inverted plankton microscope (Utermohl, 1958). Water samples collected for the measurement of various hydrographical parameters including nutrients were analysed following Strickland and Parsons (1972). Various biodiversity indices were calculated using the formulae of Pielou (1966, 1975) and Gleason (1922).

Results and discussion

Hydrography

The Parangipettai coast gets more rain from the northeast monsoon (October - December) than from the southwest monsoon (June - August). A total rainfall of 1268 mm was registered during the study period with a maximum of 477 mm in November, 1998. Surface water temperature ($^{\circ}C$) ranged between 23 (Stn.3, Jan.) and 33 (Stn.2, Aug.) (Fig. 2). Salinity (‰) values ranged between 3 (Stn.3, Dec.) and 35 (Stn.1, May) (Fig. 2). Low values for temperature and salinity were recorded at the end of the northeast

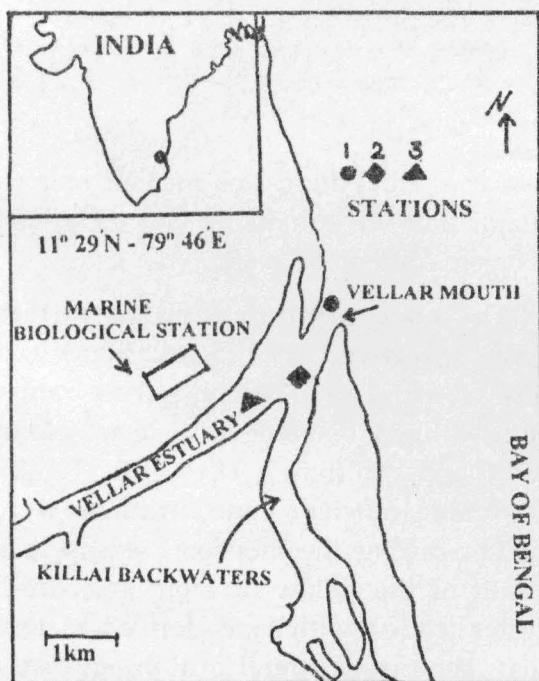


Fig. 1. Map showing location of sampling sites

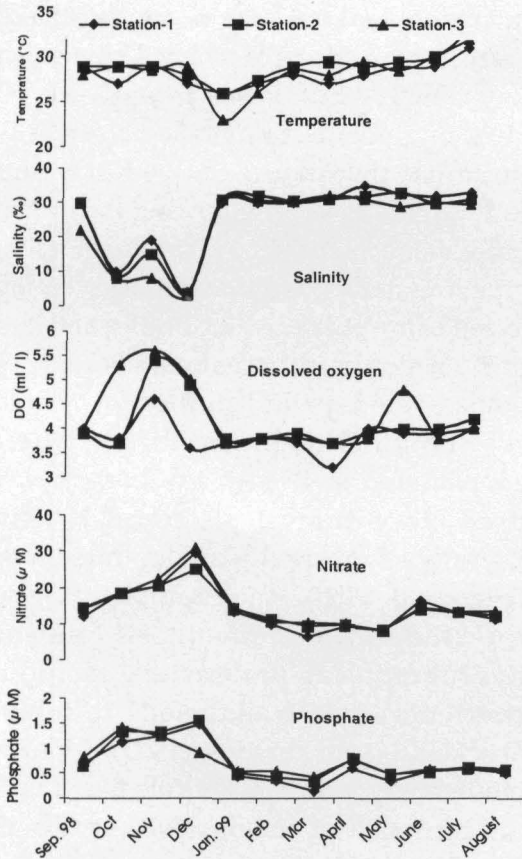


Fig. 2. Hydrographic parameters in Parangipettai coastal waters

monsoon season (December) due to monsoon showers and the consequent inflow of fresh water into the study area through the irrigation channels along the Vellar River. The recorded higher salinity values in summer (Stn. 1, May) could be attributed to evaporation of water on account of increased temperature. Dissolved oxygen values (ml/l) ranged between 3.6 (Stn.1, Dec.) and 5.6 (Stn.3, Nov.) (Fig. 2). The observed higher values of dissolved oxygen during monsoon season may be due to the renewal of fresh water flow. In addition to the fresh water run off in

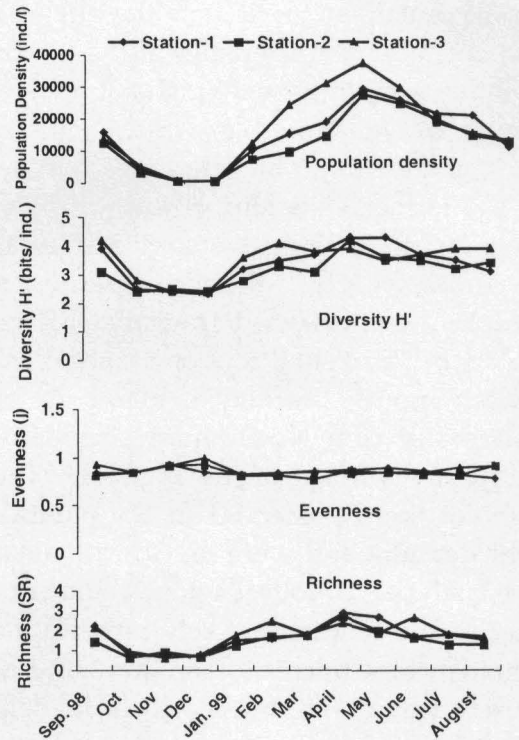


Fig. 3. Population density, diversity, evenness and richness of microzooplankton in Parangipettai coastal waters

estuaries, tidal ingression may also play a major role in enhancing the dissolved oxygen content of water.

The concentration (μM) of nitrate ranged between 6.47 (Stn.1, Mar.) and 30.89 (Stn.3, Dec.). The phosphate values (μM) ranged between 0.13 (Stn.1, Mar. 1999) and 1.55 (Stn. 2, Dec. 1998) (Fig. 2). Inorganic nutrient concentrations were higher during the monsoon season as a result of the inflow of monsoonal fresh water loaded with land derived materials. The present trend of nutrient distribution is in agreement with the observa-

tions of Choudhury and Panigrahy (1991) who have stated that the distribution and behaviour of nutrients in the coastal environs would exhibit considerable seasonal variation depending upon the local conditions like rainfall pattern, quantum of freshwater inflow, tidal inversion and biological activity like phytoplankton uptake and regeneration.

Microzooplankton biomass

The microzooplankton population density (ind./l) ranged between 500 (Stn.2) and 37520 (Stn.3) (Fig. 3). Tintinnids were the major contributors to the microzooplankton population. The maximum density recorded during the summer, premonsoon and post monsoon seasons could be linked to the relatively stable environmental conditions that prevailed during those seasons. Further, the presently observed summer maxima of microzooplankton density could be related to the high-summer-productivity of phytoplankton from this region. Senthilkumar *et al.* (2002) have reported a highest phytoplankton productivity of 4, 29,074 cells/l from Vellar Estuary (during April). Minimum density was noticed during September to November, which may be due to the inflow of freshwater during monsoon period (Mangesh *et al.*, 1996; Krishnamurthy and Damodara Naidu, 1977 and Qasim and Sen Gupta, 1981).

Microzooplankton composition

A total of fifty-six microzooplankton were identified from the collections. The number of constituent species in each

group was: tintinnids -39, rotifers -5, foraminiferans - 3, radiolarians -2, ciliate - 1 and metazoan larvae - 6.

Tintinnids: *Tintinnidium incertum*, *T.primitivum*, *Leprotintinnus simplex*, *L.nordquisti*, *Tintinnopsis cylindrica*, *T. minuta*, *T.mortensenii*, *T.tubulosa*, *T.beroidea*, *T.directa*, *T.gracilis*, *T.glans*, *T.radix*, *T.karajacensis*, *T.tocantinensis*, *T.uruguayensis*, *T.buttschlii*, *T.kofoidi*, *T.parvula*, *T.lohmanni*, *T.bermudensis*, *Codonellopsis ostenfeldi*, *C.tessellata*, *Codonellopsis sp.*, *Dictyocysta seshaiyai*, *Dictyocysta sp.*, *Stenosemella stenei*, *S.parviclois*, *S.ventricosa*, *Coxliella ampla*, *C.annulata*, *Eutintinnus tenuis*, *E.lusus-undae*, *Epiplocylis undella*, *Dadayiella bulbosa*, *Helicostomella longa*, *Favella brevis*, *F. philippinensis* and *Favella sp.*

Rotifers: *Brachionus plicatilis*, *B. angularis*, *B. urceolaris*, *Cehalodella gibba* and *Monostyla bulla*.

Foraminifera: *Globigerina rubescens*, *G.plicatilis* and *Globigerina sp.*

Radiolarians: *Acantharia sp.* and

Table 1. Correlation co-efficient matrix among microzooplankton population and physico-chemical parameters from Parangipettai coastal waters.

Parameter	Population density (r value)		
	Station 1	Station 2	Station 3
Rainfall	-0.75003**	-0.49134	-0.57286
Temperature	0.055576	-0.46343	-0.06262
Salinity	0.792694**	0.489822	0.651399*
DO	-0.4122	-0.43162	-0.57729*
Nitrate	-0.75595**	-0.38208	-0.66467*
Phosphate	-0.74119**	-0.51353	-0.40089

* P<0.05; ** P<0.01; ***P<0.001

Thalassicolla sp.

Ciliates (other than tintinnids):

Didinium sp.

Metazoans: Copepod nauplii, Cirriped nauplii, Veliger (Bivalves and gastropods), polychaete larvae and Oikopleura larva.

Tintinnids formed the dominant group contributing to 69.6% followed by 10.7% of metazoans and 8.9% rotifers. The foraminiferans contributed 5.3%, followed by radiolarians 3.5% and ciliates 1.7%. The contribution of each group towards total microzooplankton composition in the descending order is as follows:

Tintinnida > Metazoa > Rotifera
> Foraminifera > Radiolaria > Ciliata.

Microzooplankton diversity (H') index varied from 2.35 to 4.32 at Stn.1. Evenness (j) ranged from 0.77 (Stn.2) to 0.98 (Stn.3) and Richness (SR) from 0.61 (Stn.3) and 2.18 (Stn.1) (Fig. 3). The minimum and maximum values of microzooplankton density were in the monsoon and summer seasons respectively. The presently recorded species composition of tintinnids is comparable to that of the Bahuda Estuary in Orissa (Sujata Mishra and Panigrahy, 1999). Out of 39 species of tintinnids recorded in the present study, 21 were found to occur at all the 3 stations. The major contributors to the population of tintinnids were: *Tintinnopsis cylindrica*, *T. tubulosa*, *T. tocaninesis* and *Favella philippinensis*. The domination of species belonging to the genera *Tintinnopsis* and *Favella* has already been reported (Krishnamurthy and Santhanam,

1975). Maximum species diversity of *Tintinnopsis* spp. recorded during summer, post monsoon and premonsoon seasons, generally coincided with the maximum tintinnid numbers. High diversity values were observed during the period from March to June when the hydrological features were stable. The observed low diversity of population during the monsoon period might be related to the inflow of fresh water on account of heavy precipitation (Qasim and Gopinathan, 1969). The rotifers were found to occur at all the 3 stations. The major contributor was *B. plicatilis*. This has already been reported by Santhanam *et al.* (1975). Among the metazoans, during the present study, the nauplii occurred abundantly during premonsoon, postmonsoon and summer seasons, which facilitated the occurrence of fish larvae. The metazoans were abundant during the non-monsoonal period as a result of favourable environmental conditions and the availability of suitable phytoplankton diet (Srinivasan *et al.*, 1988 and Gouda and Panigrahy, 1995). During non-monsoonal period, due to the stability of hydrographical parameters coupled with rich phytoplankton production, the diversity and density of microzooplankton were found to be high.

References

- Choudhury, S.B. and R.C. Panigrahy. 1991. Seasonal distribution and behaviour of nutrients in the creek and coastal waters of Gopalpur, east coast of India. *Mahasagar-Bull. natl. Inst. Oceanogr.*, **24**: 81-88.
- Damodara Naidu, W., R. Santhanam, K. Krishnamurthy and R. Natarajan. 1977. The

- species biomass and the seasonal composition of Tintinnida (Protozoa: Ciliata). *Proc. Sym. Warm. Water. Zoopl.* (Spl. Publ. NIO/UNESCO), p. 520-527.
- Gleason, H.A. 1922. On the relation between species and area. *Ecology*, **3**: 156-162.
- Krishnamurthy, K. and R. Santhanam. 1975. Ecology of tintinnids (Protozoa: Ciliata) in Porto Novo region. *Indian J. mar. Sci.*, **4**: 181-184.
- K. and W. Damodara Naidu. 1977. Swarming of the tintinnids (Protozoa: Ciliata) in the Vellar Estuary. *Curr. Sci.*, **46**: 384.
- Mangesh Gauns, R. Mohan Raju and M. Madhupratap. 1996. Studies on the microzooplankton from the central and eastern Arabian Sea. *ibid.*, **71**: 874-877.
- Pielou, E.C. 1966. The measurement of diversity in different types of biological collections. *J. Theoret. Biol.*, **13**: 131-144.
- 1975. *Ecological diversity* (John Wiley and Sons, New York). 165 pp.
- Qasim, S. Z. and C. K. Gopinathan. 1969. Tidal cycle and the environmental features of Cochin backwater (a tropical estuary). *Proc. Indian Acad. Sci.*, **693**: 336-348.
- and R. Sen Gupta. 1981. Environmental characteristics of the Mandovi-Zuari estuarine system in Goa. *Estuar. Coast. Shelf. Sci.*, **13**: 557-578.
- Rajashree Gouda and R.C. Panigrahy. 1995. Seasonal distribution and behaviors of nitrate and phosphate in Rushikulya estuary, east coast of India. *Indian J. mar. Sci.*, **24**: 233-235.
- Santhanam, R., K. Krishnamurthy and R.B. Subbaraju. 1975. Zooplankton of Porto-Novo, South India. *Bull. Dept. Mar. Sci.*, University of Cochin, **7**: 899-911.
- Senthilkumar, S., P. Santhanam and P. Perumal. 2002. Diversity study in phytoplankton from Vellar Estuary, Southeast coast of India. In: Ayyappan, S., Jena J.K. and Mohan Joseph M. (Eds.) *Proc. Fifth Indian Fisheries Forum*. Published by AFR IB, Mangalore and AoA, Bhubaneswar, India. p.245- 248.
- Srinivasan, A., R. Santhanam and G. Jegadeesan. 1988. Biomass and seasonal distribution of planktonic tintinnids of Pullavazhi estuary, southwest coast of India. *Indian J. mar. Sci.*, **17**: 131-133.
- Strickland, J.D.H and T.R Parsons. 1972. A practical handbook of Seawater analysis. *Bull. Fish. Res. Bd. Canada*, **167**, 310 pp.
- Sujatha Mishra and R.C. Panigrahy. 1999. Zooplankton ecology of the Bahuda (Orissa) estuary, east coast of India. *Indian J. mar. Sci.*, **28**: 297-301.
- Sukhanova, Z. N. 1978. Settling without the inverted microscope. In: Sournia A. (Ed.). *Phytoplankton manual UNESCO*, Page Brothers (Noruie) Ltd., 97 pp.
- Utermohl, H. 1958. Zur vervallkom-mnug der quantitative phytoplankton methodik, Mitt. Int. Verein. Theory Angew, *Limnol.*, **9**: 1-38.