# Seasonal variations of polychaete diversity, east coast of Tamilnadu, Southern India

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**Abstract :** Totally six species of polychaetes were identified and they belong to five families. Maximum turn over of abundance and diversity of polychaete were observed during the month of January 2009 (winter month) and minimum during the month of November 2008. There was a significant relationship between abundance of polychaetes and among the months studied (P<0.5) in the Tharangambadi tidal flat. With reference to cluster analysis, two major groups were identified from six species of polychaetes. The present study revealed that the abundance of benthic form of polychaete worm differs with seasonal variations.

***Key words*** **:** Benthic forms, polychaetes, abundance, tidal flats, conservation.

## Introduction

When it comes to quantitative studies on the distribution of benthic invertebrates on the Tharangambadi coastal tidal flat of Tamil nadu region, southern India very little information is available. In fact, polychaetes occur in almost all benthic marine and estuarine sediments (Fauchald, 1977) and are often the dominant components of the macrobenthos both in terms of number of species and individuals (Grassle and Maciolek, 1992; Ward and Hutchings, 1996). Over 10,000 species have been described to date (Minelli, 1993), belonging to 83 families, and various estimates have been made as to the total polychaete fauna ranging from 25,000 to 30,000 (Snelgrove et al., 1997). The ratio of described to undescribed species varies according to habitat and biogeographical region. Intertidal and shallow subtidal communities are best known for the abundance of polychaete diversity in Northern Europe (Fauvel, 1923, 1927; Hartmann-SchroÈ der, 1971), and North America (Hartman, 1968, 1969; Pettibone, 1963; Blake et al., 1996, and earlier volumes). Many other regions of the world rely on monographs produced for Europe (Fauvel, 1923, 1927), North America (Hartman, 1968, 1969) and South Africa (Day, 1967) for identification of their fauna. But in Asia, it is still not much explored.

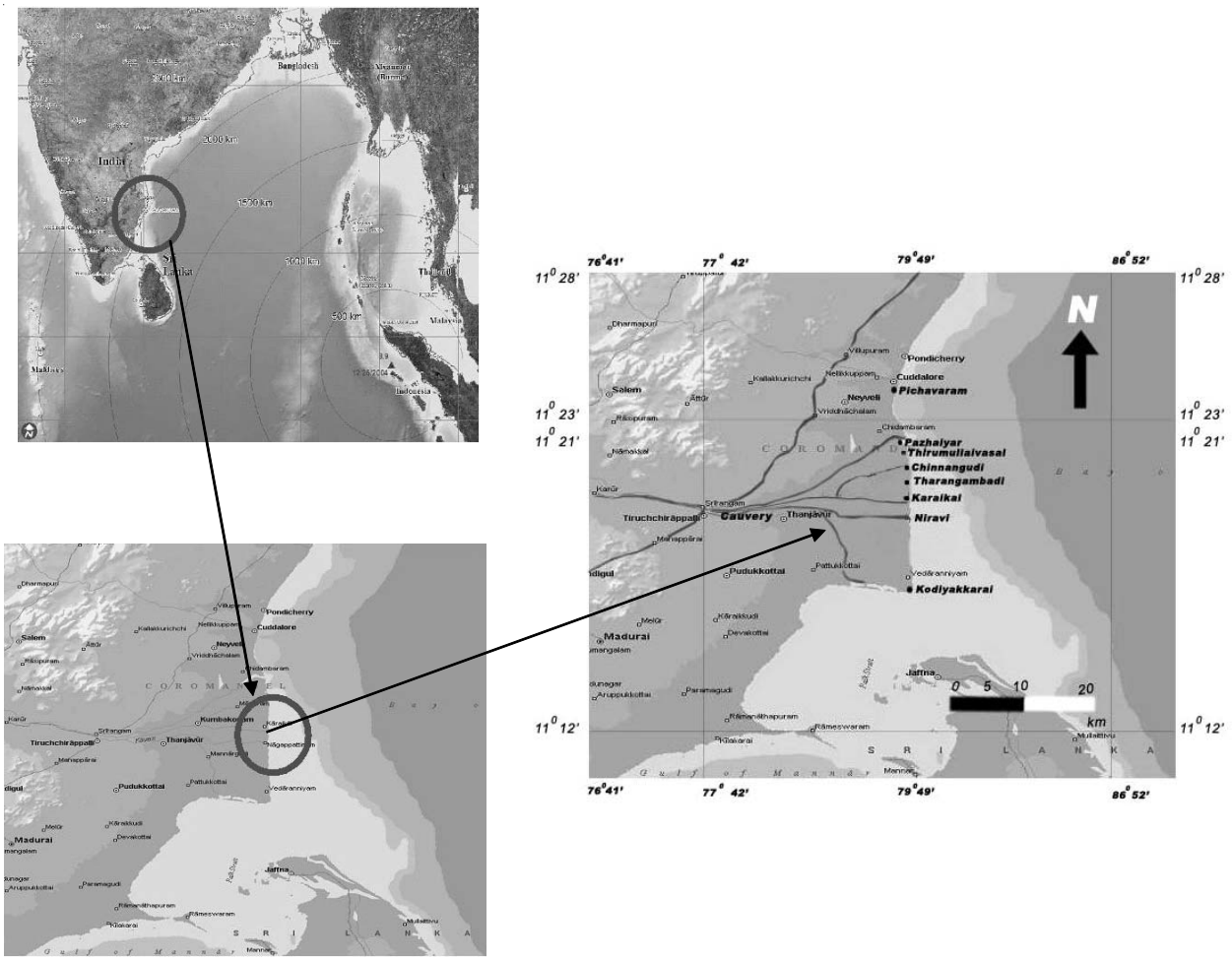
As such, this is first quantitative study of macro invertebrates in the area. The macroinvertebrates collected provide baseline information on standing crop of benthic macroinvertebrates gathered as compared to baseline data reported elsewhere (Stewart, 1983). Based on the above said information the polychaete abundance and diversity in the proposed study area was surveyed and assessed with following objectives: 1) To identify the presence of polychaete species in the Tharangambadi tidal flat and; 2) to understand the status and distribution of the polychaete sp. in Tharangambadi tidal flat.

## Material and Methods

### Study area

Thrangambadi is situated about 29 kms souththeast of Mayiladuthurai town. The former area is about 40 kms south of Chidambaram and the latter is about 11 kms north of Karaikal. The study area is located at a latitude and a longtitude of 79° 51' 19" E; 11° 01' 35" N. The study sites include six major habitat types viz, agricultural wetland, agricultural dryland, human habitation, coconut (*Cocos nucifera*) vegetation, palmyrah (*Borasus flabellifer*) vegetation and scattered trees. (Fig.1)

**Fig. 1. Map of the study area showing the six tidal flats studied at the east coast of southern India.**




**Collection and identification of Polychaetes**

To determine the availability of polychaetes, mud samples were collected at three random points from Tharangambadi tidal flat within the depth 0–20 cm (Masero *et al.*1999). At each point, three core samples were taken to a depth of 10-cm diameter (78.5 $cm^2$) were taken to a depth of 20 cm (Masero *et al.*1999). The mud collected was sieved through a 0.5µ sieve and the animals filtered and were preserved in 5% formaldehyde (Strin, 1981). The identification of polychaetes by referring to field guide by Michael 1972.

**Statistical analysis**

The diversity of polychaetes was estimated by using the Shannon index of diversity, Shannon index of diversity -

(H'): $H' = - \Sigma n_i /N \ln (n_i /N)$ (Shannon and Weaver, 1949)

To understand the associations between the density of polychaete worm and the months General Linear Model (GLM) was applied by using MINITAB 15 (Ryan *et al*., 1992). Finally, Cluster analysis was applied for knowing the polychaetes' associations in the tidal flat. Statistical inferences were made by referring to Sokal and Rohlf (1995).

**Results and Discussion**

Totally 6 species of polychaete worms were identified (Table 1) and they are from five families. They are given below: *Paramphinome* jeffreysii, *Glycera dibranchiate*, *Notocirrus spiniferus*, *Sphaerodorum gracilis*, *Ceratonereis irritabilis* and *Nephtys ciliate.*

Highest abundance of *Paramphinome pulchella jeyffrii* was recorded during December 2008 and lowest during November 2008. This species showed more or less same trend during January 2009. But, the *Glycera dibranchiate* density showed maximum occurrence during March 2009 and minimum during February 2009 and same level density was recorded during November 2008 and January 2009 (Table 1).

In the case of *Notocirrus spiniferus*, maximum density

was noticed during January 2009 and minimum during February 2009, whereas the average density was found in November 2008 and in March 2009. But about *Shaerodorum gracilis*, highest density was recorded in January 2009 and lowest during November 2008.

In fact the *Ceratonereis irritabilis* was observed maximum during the month of January 2009 and minimum during the month of November 2008. However, *Nephtyus ciliate* species was found in maximum density during the month of January 2009 and minimum in the month of December 2008. But, during the months of November 2008 and February and March 2009 showed average density (Table 1).

**Table.1. Abundance of Polychaete worms (No./m$^2$) recorded in the Thrangambadi tidal flat during the study periods from November 2008 March 2009.**

| S. No | Species Name | MONTHS | | | | |
|---|---|---|---|---|---|---|
| | | Nov. 2008 | Dec. 2008 | Jan. 2009 | Feb. 2009 | Mar. 2009 |
| 1 | *Paramphinome pulchella* | 9 | 26 | 25 | 18 | 11 |
| 2 | *Glycera dibranchiate* | 3 | 1 | 3 | 0 | 4 |
| 3 | *Notocirrus spiniferus* | 2 | 1 | 3 | 0 | 2 |
| 4 | *Shaerodorum gracilis* | 0 | 2 | 7 | 1 | 2 |
| 5 | *Ceratonereis irritabilis* | 3 | 8 | 13 | 10 | 8 |
| 6 | *Nephtyus ciliate* | 2 | 1 | 4 | 2 | 2 |

The overall results of the present study can be given as; the polychaete abundance and diversity were noted to be maximum during the month of January 2009 (winter month) and minimum during the month of November 2008 (pre winter month).

The study revealed that, polychaete abundance increased during the months of winter (Table 1). The benthic faunal density and diversity regulates the complicated food web and trophic structure in tidal zones and acts as dominant prey base for water birds (Nagarajan & Thiyagesan 1994, Pandiyan, 1999, 2000 and 2002 and Pandiyan et al., 2006). There was a significant relationship between months and polychaete abundance (Table 2).

**Table.2. Analysis of variations showing the significant differences between thepolychaetes worm density and monthly variations in the Tharangambadi tidal flat during the study period from November 2008 to March 2009.**

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between months | 51.036 | 13 | 3.926 | 9.723 | 0.000 |
| Within months | 36.464 | 16 | 2.279 | | |
| Total | 87.500 | 29 | | | |

However, most of the polychaete fauna remains to be correctly identified and there is no doubt that, they are a highly diverse group in biodiversity. Diversity of polychaetes in a wide variety of habitats and geographical regions is known (see Knox, 1977, for additional earlier studies). Comparing such sets of data is difficult for many reasons. Sampling techniques, mesh size used, and the size and number of replicates collected and over what time period greatly influence the number of species and individuals found. Mackie and Oliver (1996) discuss these problems in some details and the sampling strategy employed can obviously be determined by the questions being asked about the data as well as about funding and logistical restrictions.

**Fig.2. Overall abundance (No/m$^2$) and diversity (H') of polychaetes recorded from the Tharangambadi, tidal flat, during November 2008 to March 2009.**

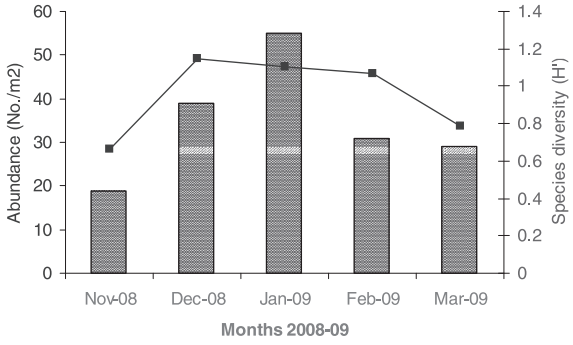
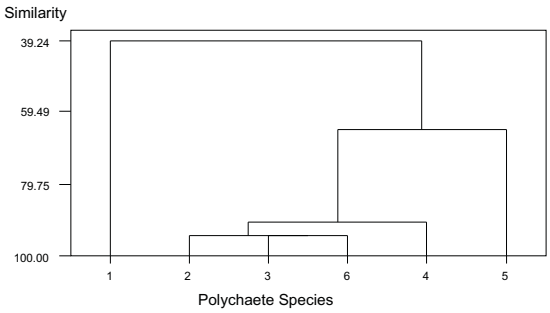



**Fig. 3. Dendrogram showing the polychaetes assemblages recorded in the Tharangambadi tidal flat during the study period. (Mean values of polychaetes of fives months data were used) For Species name please refer table 1.**




The results of the dendrogram show that, these six species were grouped into two major categories (Fig. 3). Among the six species the species *Paramphinome pulchella* forms a separate group than the other five species (Fig 3), it seems the *Paramphinome pulchella* could have significant behaviour and adaptatability than other species recorded in the tidal flat. The factors such as sediment type (Etter and Grassle, 1992), salinity regimes (Stephenson et al., 1979), historical disturbances (Gray, 1997), organic content, microbial associations and food availability (see review by Snelgrove and Butman, 1994) also greatly influence the total number of species and individuals present and the species composition. In most cases selection of habitat will occur at

the time of larval settlement (Butman and Grassle, 1992; Grassle et al., 1992; Wu and Shin, 1997).

Hence, the population of polychaetes depends on many environmental factors, which directly or indirectly influence the survival of polychaetes. Therefore, it is suggested that an intensive study involving the assessment of physico-chemical factors along with the population estimation of polychaetes would provide a clear picture of the interactions and survival strategies of polychaetes in this ecosystem tidal flat.

**Conservation implications**

The practice of wetland management for providing suitable habitat for waterbirds, it is necessary to develop effective tools of predicting the effects of wetland management on the dynamics of waterbirds and their habitats. This requires simplified decision supporting systems on the basis of complex multidisciplinary knowledge. The socioeconomic scenarios can also be involved in the systems to provide an integrated design for wetland management. Especially the coastal wetlands need to be saved for the sake of waterbirds and shorebirds these are the basic habitats suited for waterbirds and shorebirds during their life cycle. In addition, polychaetes are the major prey items for the shorebirds during their migratory season (Pandiyan *et al* 2010).

**References**


- Blake, J.A., Hilbig, B. and Scott, P.H. (1996) The Annelida Part 3- Polychaeta; Orbiniidae to Cossuridae. In Taxonomic Atlas of the Benthic Fauna of the Santa Maria Basin and The Western Santa Barbara Channel. 6, 1- 418. Santa Barbara Museum of Natural History, California.
- Butman, C.A. and Grassle, J.P. (1992) Active habitat selection by Capitella sp. 1 larvae. Two-choice experiments in still water and voluume ¯ows. J. mar. Res. 50, 669-715.
- Day, J. (1967) A Monograph of the Polychaeta of Southern Africa. London: British Museum Natural History Publication 656.
- Etter, R.J. and Grassle, J.F. (1992) Patterns of species diversity in deep sea as a function of sediment particle size diversity. Nature 360, 576-7
- Fauchald, K. (1977) The Polychaete Worms, definitions and keys to the Orders, Families and Genera. Nat. Hist. Mus. LA County Mus. Sci. Ser. 28, 1-190.
- Fauvel, P. (1923) PolycheÁtes errantes. Faune de France, Paris 5, 1-488.
- Fauvel, P. (1927) PolycheÁtes seÂdentaires. Faune de France, Paris 16, 1-488.
- Grassle, J.F., Butman, C.A. and Mills, S.W. (1992) Active habitat selection by Capitella sp. 1 larvae. 11. Multiple-choice experiments in still water and volume ¯ows. J. Mar. Res. 50, 717-743.
- Grassle, J.F. and Maciolek, N.J. (1992) Deep-sea species richness; regional and local diversity estimates from quantitative bottom-sampling. Am. Nat. 139, 313-41.
- Hartman, O. (1968) Atlas of the errantiate polychaetous annelids from California. Allan Hancock Foundation. Uni. South California, LA.
- Hartman, O. (1969) Atlas of the sedentariate polychaetous annelids from California. Allan Hancock Foundation. Uni. South California, LA.
- Hartmann-SchroÈder, G. (1971) Annelida, Borstenwurmer, Polychaeta. Tierwelt Deutschlands 58, 1-594.
- Knox, G. (1977) The role of polychaetes in benthic soft-bottom communities. In Essays on Polychaetous Annelids in memory of Dr Olga Hartman (D.J Reish and K. Fauchald eds.) pp. 547- 604. Allan Hancock Foundation, University of Southern California.
- Mackie, A.S.Y. and Oliver, G. (1996) Marine Macrofauna: Polychaetes, Molluscs and Crustaceans. In Methods for the Examination of Organismal Diversity in Soils and Sediments. (G.S. Hall, ed.) pp. 264-284. CAB INTERNATIONAL.
- Michael,P. 1986. Ecological methods for field and Laboratory investigations. New Delhi: Tata McGraw-Hill Publishing co. Ltd.
- Minelli, A. (1993) Biological Systematics: the state of the art. London: Chapman & Hall.
- Nagarajan, R. & Thiyagesan, K. 1998. Significance of adjacent croplands in attracting waterbirds to the Pichavaram mangrove forests. *In* Dhinsa, M.S., Rao, P.S. & Parasharya, B.M. (eds). *Birds in Agricultural Ecosystem.* Society for Applied Ornithology (India), Hyderabad. pp. 172–181.
- Pandiyan, J. 1999. *Water bird use of unprotected mudflats of Nagaipattinam District, Tamilnadu, Southern India.* M.Sc., Dissertation submitted to A.V.C. College, Bharathidasan University, Trichy- 24.

- Pandyan, J. 2000. Factors influencing waterbird use of coastal sandflats and mudflats of Napaipattinam District, Tamilnadu, Sothern India, M.Phil. Thesis submitted to Bharathidasan University, Trichy- 24.
- Panidyan, J. 2002. Ecology of Shorebirds in the tidal flats of Cauvery deltaic region of Tamlnadu, Southern India, Ph.D. Thesis submitted to Bharathidasan University, Trichy- 24.
- Pandiyan, J., S. Asokan, K. Thiyagesan and R. Nagrajan. 2006. Use of tidal flats in the Cauvery Delta region of SE India by shorebirds, gulls and terns. *Wader Study Group Bull. 109*: 105–111.
- Pandiyan, J and S.Asokan. (2008a) Abundance and Distribution of plovers, Pazhaiyar mudflat, Nagaipatinam district, southern India, J. Ecotoxicol. Environ. Monit. 18(2): 142-152.
- Pandiyan, J. and S. Aokan. (2008b). Patterns of association and habitat use by migrating shorebirds on intertidal mudflats of Tirumullaivasal estuary, Nagaipatinam district, southern India, J. Ecotoxicol. Environ. Monit. 18(3): 259-265.
- Pettibone, M. (1963) Marine Polychaete worms of the New England region 1. Aphroditidae through Trochochaetidae. U.S. Nat. Mus. Bull. 227, 1±356.
- Shannon CE, Wiener W (1949) The mathematical theory of communication. Illinois University Press, Urban III.
- Snelgrove, P.V.H., Blackburn, T.H., Hutchings, P.A., Alongi, D.M., Grassle, J.F., Hummel, H., King, G., Koike, I., Lamshead, P.J.D., Ramsing, N.B. and Solis-Weiss, V. (1997) The importance of Marine Sediment Biodiversity in Ecosystem Processes. Ambio. 26(8), 578±583.
- Sokal, R.R. and Rohlf, F.J. 1995. *Biometry*. W.H.Freeman and Company, New York:
- Stephenson, W., Saenger, P. and Cook, S.D. (1979) Problems in establishing a benthic baseline during a macrobenthos survey near Gladstone, Queensland. Proc. R. Soc. Qd. 90, 21- 32.
- Stewart, P.L. 1983**.** Measurements of benthic macro invertebrate standing crop from the Canadian continental shelf and slope of southern Davis Strait and Ungava Bay. Canadian Journal of Fisheries and Aquatic Sciences 40:652-657.
- Stirn,J. 1981. Manual of methods in Aquatic Environment Research, Part 8, Ecology assessment of pollution effects (Guidelines for the FAO/GFCM/ UNEPjoint coordinate project on pollution in the Mediterranean), FAO Fish.Tech. Pag.209.
- Ward, T. and Hutchings, P.A. (1996) E.ects of trace metals on infaunal species composition in polluted intertidal and subtidal marine sediments near a lead smelter, Spencer Gulf, South Australia. Mar. Ecol. Progr. Ser. 135, 123±35

  http://rmbr.nus.edu.sg/polychaete/Descrip.html