

## Studies on the zooplankton biodiversity and density in Adyar estuary, Chennai, India

A. Janakiraman, M.S. Naveed, P. Muthupriya, J. Sugumaran, M. Asrar Sheriff and K. Altaff\*

Unit of Reproductive Biology and Live Feed Culture, Department of Zoology, The New College (Autonomous), Chennai-600 014, India

\*Corresponding Author email : kaltaff@rediff.com

### Publication Info

Paper received:  
31 December 2011

Revised received:  
08 May 2012

Accepted:  
26 July 2012

### Abstract

The Adyar estuary was once known for its unique ecology and endemic flora and fauna, has lost its pristine condition due to urbanization, discharge of untreated domestic wastes, industrial effluents and encroachments. Zooplankton were monitored for a period of one year from July 2009 to June 2010, following standard methods to evaluate the seasonal variations in diversity and density in relation to environmental parameters like temperature (28.6-33.6°C), salinity (23.3-30.3‰), pH (7.3-7.8) and DO (4.4-7.1mg l<sup>-1</sup>). Highest diversity was observed during post-monsoon (20 species) and pre-monsoon (19 species), followed by summer (9 species) and monsoon (9 species). The zooplankton density was maximum during summer (1887167 m<sup>-3</sup>) followed by pre-monsoon (1843832 m<sup>-3</sup>), post-monsoon (1153333 m<sup>-3</sup>) and monsoon (182334 m<sup>-3</sup>). Zooplankton community structure and dynamics showed a differential pattern with dominance of harpacticoids and rotifers in pre-monsoon; cyclopoids and rotifers during post-monsoon and summer. The significance of monitoring zooplankton biodiversity as a base-line study for future investigations on environmental changes in this area is discussed.

### Key words

Adyar estuary, Zooplankton, Biodiversity

### Introduction

High and rapid fluctuations in abiotic parameters such as salinity and temperature may be experienced by every individual animal which inhabit a estuary. These fluctuations represent major physiological problems for animals. Osmotic and thermic stress cause changes in basal metabolic rate, resulting in reduction of surplus energy available for other activities such as locomotion, growth, reproduction and ultimately survival. The spacio-temporal distribution of zooplankton is reported to be related to abiotic and biotic factors of the estuary (Davies and Augustina, 2009). Zooplankton are ecologically and economically important group of aquatic organisms, that occupy a wide range of habitats extending from the nuston to benthos and are crucial for their influence on fishery, oceanography and climate (Terdalkar and Pai, 2001). They have several important roles in the estuarine ecosystem. They serve as

an important link between phytoplankton, primary production and many important carnivores including commercial fishes. They are also important in nutrient cycling in estuaries and coastal water and form an important food for a variety of estuarine consumers including ctenophores, forage fish and some benthic organisms such as sponges and molluscs (Day *et al.*, 1989). The details of diversity, abundance and population structure of zooplankton are useful tools in assessing the water quality and pollution status of aquatic bodies (Mathivanan *et al.*, 2007). In view of the above, the present study is an attempt at bio-monitoring of the Adyar estuary by analyzing the zooplankton diversity and density.

### Materials and Methods

The Adyar estuary (13°06' 47" N and 80° 16 '37"E) is part of a natural estuarine ecosystem located right in the heart of the city of Chennai, India. It has been identified as

an “Ecological Heritage Site” and is a rare instance of an estuary located within the city. Once known for its unique ecology and endemic flora and fauna, this estuary has lost its pristine condition due to urbanization, discharge of untreated domestic wastes, industrial effluents and encroachments. Zooplankton samples were collected from four sampling sites in the region of the Adyar estuary corresponding to its mouth which encloses the sand bar. The samples were collected from July 2009- June 2010 and the study period was divided into pre-monsoon (July-September), monsoon (Onset of North East monsoon in mid October- December), post-monsoon (January- March), and summer (April- June). Collection, qualitative and quantitative analysis and identification of the zooplankton were carried out according to the methods outlined by Altaff (2004). Temperature of surface water up to 10 cm depth were recorded with the help of a hand held mercury thermometer, the values were noted after two minutes of stabilization. Field estimation of dissolved oxygen (DO) was carried out following Winkler’s method (Strickland and Parsons, 1968). Salinity of the water was recorded by using Salinometer. Water pH was recorded by using pH colour comparator disc in the field. The data was statistically analysed using SPSS ver. 10.0, Statistica ver. 6.0 and Microsoft excel.

### Results and Discussion

Under the influence of a variety of inter-related biotic and abiotic structural compounds and intensive chemical, physical and biological processes, estuaries are highly variable systems. Data on the range of temperature, DO, pH and salinity are given in Table 1. Temperature was highest

during summer season ( $33.6 \pm 0.5^\circ\text{C}$ ) and low in monsoon ( $28.6 \pm 0.3^\circ\text{C}$ ). DO was high during monsoon ( $7.1 \pm 0.4 \text{ mg l}^{-1}$ ) and low during summer ( $4.4 \pm 0.2 \text{ mg l}^{-1}$ ). pH was high during pre-monsoon ( $7.8 \pm 0.1$ ) and lower values were recorded in monsoon ( $7.3 \pm 0.1$ ). Salinity was high during summer ( $30.3 \pm 1.2 \text{ ‰}$ ) and low during monsoon ( $23.3 \pm 2.1 \text{ ‰}$ ) season. Abiotic factors like salinity and temperature could be important in influencing zooplankton distribution and abundance as estuaries experience sudden and often widespread changes in salinity, temperature and DO levels which require aquatic organisms to find ways to cope with these changes (Damotharan et al. 2010). Total 28 species of zooplankton were recorded comprising 5 major groups namely rotifers, calanoids, cyclopoids, harpacticoids and ostracods. Rotifers and cyclopoids were the dominant groups showing occurrence during all four seasons. Among various species, only *Brachionus plicatilis* and *Apocyclops dengizicus* were present throughout the study period indicating their resilience and successful adaptation to the varying environmental parameters.

Zooplankton showed wide seasonal variation both in occurrence and abundance. Maximum number of species (20) was observed during post-monsoon and the lowest (9) during monsoon and summer seasons. Zooplankton density showed a different pattern with highest density in summer and lowest during monsoon (Table 2) in the following order Summer > Pre-monsoon > Post-monsoon > Monsoon.

The zooplankton density ranged from 182334 ind.  $\text{m}^{-3}$  during monsoon period to 1887167 ind.  $\text{m}^{-3}$  during summer season. The maximum salinity in summer and minimum in

**Table 1** : Physico-chemical parameters of Adyar estuary water during July 2009 to June 2010

Environmental parameters	Pre-monsoon (July-September)	Monsoon (October-December)	Post-monsoon (January-March)	Summer (April-June)
Water Temperature ( $^\circ\text{C}$ )	$30.0 \pm 1.5$	$28.6 \pm 0.3$	$29.0 \pm 0.5$	$33.6 \pm 0.5$
Dissolved Oxygen ( $\text{mg l}^{-1}$ )	$6.6 \pm 0.3$	$7.1 \pm 0.4$	$6.4 \pm 0.2$	$4.4 \pm 0.2$
Salinity ( $\text{‰}$ )	$26.6 \pm 1.2$	$23.3 \pm 2.1$	$28.4 \pm 1.4$	$30.3 \pm 1.2$
pH	$7.8 \pm 0.1$	$7.3 \pm 0.1$	$7.5 \pm 8.1$	$7.6 \pm 0.1$

Values are mean of four sampling sites  $\pm$  SE

**Table 2** : Zooplankton density ( ind.  $\text{m}^{-3}$ ) during July 2009 – June 2010 from Adyar estuary, Chennai

	Pre-Monsoon (July-September)	Monsoon (October-December)	Post-Monsoon (January-March)	Summer (April-June)
Rotifers	494166 $\pm$ 76418	61667 $\pm$ 1667	415000 $\pm$ 95481	1351667 $\pm$ 80267
Cladocerans	-	3250 $\pm$ 333	-	-
Harpacticoids	880666 $\pm$ 134880	29333 $\pm$ 1613	229444 $\pm$ 25281	108083 $\pm$ 16799
Calanoids	286000 $\pm$ 39715	30667 $\pm$ 1752	62500 $\pm$ 5123	-
Cyclopoids	183000 $\pm$ 52381	57417 $\pm$ 3451	446389 $\pm$ 94785	427417 $\pm$ 145576
Total	1843832 $\pm$ 209077	182334 $\pm$ 6257	1153333 $\pm$ 220670	1887167 $\pm$ 242641

Values are mean of four sampling sites  $\pm$  SE in each season; NF= Not found

monsoon could be a limiting factor in the distribution of zooplankton and its variation caused by dilution and evaporation might influence the faunal distribution of coastal ecosystems. The stable environments in summer and peak phytoplankton diversity have been attributed as possible causes for high zooplankton abundance (Madhu *et al.*, 2007; Perumal *et al.*, 2009). The low zooplankton density during monsoon could be due to the sudden shift in salinity, turbulence and the consequent inability of zooplankton to adapt and re-populate (Damotharan *et al.*, 2010). Among the zooplanktonic groups, rotifers and copepods like harpacticoids, cyclopoids and calanoids formed the dominant groups and is in confirmation with the earlier report of Qasim (2005) and Madhu *et al.* (2007). The dominance of rotifers may be due to their ability to multiply fast as a result of parthenogenesis and the dominance of copepods might be due to their quick and high reproductive potential, production of resting/dormant eggs and the ability to withstand the rigors of the environment and re-populate (Perumal *et al.*, 2009; Verghese and Krishnan, 2009). The zooplankton is considered a good indicator of changes in water quality because the community is strongly influenced and has a fast response to changes in the environmental conditions (Gannon *et al.*, 1997). Thus, this study on the patterns of zooplankton species and abundance reflects the status of productivity and diversity in Adyar estuary. This base-line information of zooplankton diversity and density would form a useful tool for further ecological assessment and monitoring of estuarine ecosystems.

#### Acknowledgment

We are thankful to The Adyar Poonga Trust, Chennai, Tamil Nadu for providing financial support under Adyar Poonga/Invertebrate Survey/WO/25/2009.

#### References

- Altaff, K.: A manual of zooplankton. UGC, New Delhi, p. 155 (2004).
- Damotharan, P., N. Vengadeshperumal, M. Arumugam, P. Perumal, S. Vijayalakshmi and T. Balasubramanian: Studies on zooplankton ecology from Kodiakkara (Point Calimer) coastal waters. *Res. J. Biol. Sci.*, **5**, 187- 198 (2010).
- Davies and O. Augustina: Spatiotemporal distribution, abundance and species composition of zooplankton of Woji-Okpoka creek, Port Harcourt, Nigeria. *Res. J. Apl. Sci. Eng. Technol.* **1**, 14-34 (2009).
- Day, J.W., C.A.S. Hall., W.M. Kemp and Y.A. Araneibia: Estuarine Ecology. *John Wiley Sons, Inc. Canada* (1989).
- Gannon, D.P., A.J. Read, J.E. Craddock, K.M. Fristrap and J.R. Nicholas: Feeding ecology of long finned pilot whales *Globicephala melas* in the Western North Atlantic. *Mar. Ecol. Prog. Ser.*, **148**, 1-10 (1997).
- Laprise, R. and J.J. Dodson: Environmental variability as a factor controlling spatial patterns in distribution and species diversity of zooplankton in the St. Lawrence Estuary. *Mar. Ecol. Prog. Ser.*, **107**, 67-81 (1994).
- Madhu, N.V., R. Jyothibalu and K.K. Balachandran: Monsoon impact of planktonic standing stock and abundance in a tropical estuary. *Estuar. Coast. Shelf. Sci.*, **73**, 54-64 (2007).
- Mathivanan, V., P. Vijayan, Selvi Sabhanayakam and O. Jeyachitva: An assessment of plankton population of Cauvery river with reference to pollution. *J. Environ. Biol.*, **28**, 523-526 (2007).
- Perumal, V., M. Rajkumar, P. Perumal and K.T. Rajsekar: Seasonal variations of plankton diversity in the Kaduviyar estuary, Nagapattinam, Southeast coast of India. *J. Environ. Biol.*, **30**, 1035-1046 (2009).
- Qasim, S.Z.: Zooplankton of some major estuaries of India. *J. Indian Ocean. Stud.*, **13**, 439-446 (2005).
- Strickland, J.D.H. and T.R. Parsons: Determination of dissolved oxygen: In: A practical handbook of seawater analysis. *Fisheries Research Board of Canada, Bulletin*, **167**, 71-75 (1968).
- Terdalkar, S. and I.K. Pai: Statistical approaches for computing diversity of zooplankton in the Andaman Sea. *Trop. Ecol.*, **42**, 243-250 (2001).
- Verghese, M. and L. Krishnan: Distribution of zooplankton in selected centres of Cochin backwaters, Kerala. *J. Mar. Biol. Ass. India*, **51**, 194-198 (2009).