

# INTERMITTENT SWARMING OF COPEPODS IN VERSOVA MANGROVE, MUMBAI

## Introduction

Some zooplankton taxa like Copepods, Ostracods, ctenophores and medusae exhibit dense aggregations in a wide range of marine environment. Copepods have been frequently reported to occur in swarms from coral and mangrove ecosystems. (Hamner and Carleton, 1979; Ambler *et al.*, 1999 and Buskey, 2002). This has been suggested as an adaptive advantage for feeding, propagation, protection and dispersal by currents (Folt, 1987). Copepod swarms are usually "monospecific and are composed of adult and late stage copepodites (Ambler *et al.*, 1991). While studying the Copepod composition of Versova mangrove, Mumbai, several instances of swarms of Copepods were observed. Studies on Copepods of mangrove from Indian coastal waters are few. Shanmugam *et al.* (1986) and Godhantaraman *et al.* (1994), studied the zooplankton of Pichavaram mangrove. Jagtap *et al.* (1993) summarized the works on Copepods of Indian mangroves.

The Versova mangrove is a shallow salt marsh along the tidal creek of Mumbai with a depth of about 1 to 1.5 m and has a width ranging from 30 to 40 m. The dominant vegetation of the swamp is the mangrove species *Avicennia alba* which has a height of 1 meter. During flood tide flow of sea water towards the upstream progressively inundates the creek and during extensive high tides, even the swamp vegetation is submerged. Dwivedi and Padmakumar (1980) reported that Mumbai mangrove habitat is disappearing due to human interference.

## Material and Methods

Collections were made for zooplankton and water quality studies from 4 stations in the Versova mangrove swamp (Fig. 1). Stations were selected within the creek with sufficient depth to operate a net. Station V<sub>1</sub> is located at the mouth of the creek and other stations are located towards the northern end of the creek at equidistance. Samples were collected every month for a period of 15 months from May 1991 to July 1992. Zooplankton samples were collected with a small net of 1 m length having a mouth area of 0.08 m<sup>2</sup> and mesh size of 0.1 mm fitted with a calibrated TSK flow meter. Hauls were made manually from one end to the other end of the different sections of the mangrove area.

## Results and Discussion

Water quality parameters between stations showed limited variations. This may be due to

closeness of stations and tidal influence upto the interior most station (V<sub>4</sub>). Water temperature varied from 25.5 to 35.0°C (av. 28.8°C) with minimum and maximum respectively during January 1992 and June 1991. pH values were in the range of 7.1 - 8.8 (av. 7.8). Salinity was generally low during the monsoon period which progressively increased from postmonsoon period attaining maximum during the premonsoon period. The overall range in salinity was 18.1 - 37.1 ‰ (av. 31.9 ‰). The average DO in the mangrove ecosystem was 5.7 mg/l through individual low values (< 3 mg/l) sometimes occurred. Ranges in the concentration of phosphate and nitrate were 1.1 - 44.2 µgat./l (av. 8.4) and 0.1 - 43.1 (av. 13.8) µg at./l respectively indicating that these nutrients were fairly high in the mangrove creek. Levels of nitrite were low (< 0.1 - 16.1, av. 3.3 µg at./l) while ammonia was quite high ranging from 0.3 to 77.0 (av. 15.3 µg at./l). The creek water sustained high suspended load which varied from 21.8 to 782 (av. 225) mg/l. Maximum level of suspended load was observed at

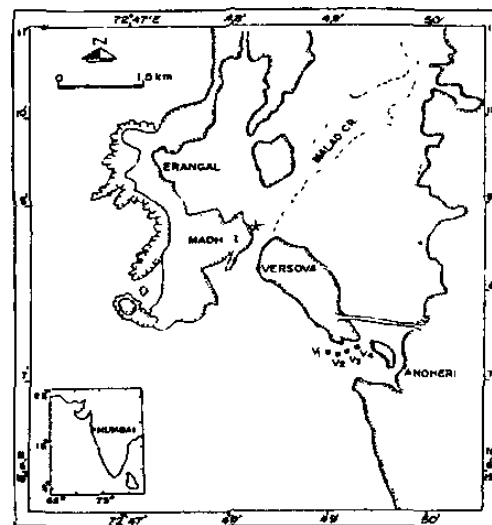


Fig. 1. Location of stations in Versova mangrove

## Copepod Density

Percentage composition of Copepods to zooplankton ranged from 30 to nearly 100%. Other components recorded were gastropods, bivalves and polychaetes. The density of Copepods were in the range of 496-4,67,964, 108-26,044, 864-1,01,520 and 378-84,893 no/m<sup>2</sup> respectively in stations 1-4. Seventeen species of zooplankton as *Canthocalanus pauper*, *Eucalanus subcrassus*, *Bestiolina similes*, *Paracalanus crassirostris*, *P. aculeatus*, *Pseudodiaptomus ardjuna*, *Acartia spinicauda*, *A. tropica*, *A. bowman*, *Tortanus forcipatus*, *Oithona similes*, *O. hebes*, *Corycaeus*

sp., *Cyclops* sp., *Euterpina acutifrons*, *Mesochra* sp., Harpacticoids were recorded.

The species composition studied during the premonsoon, monsoon and postmonsoon seasons showed the abundance of calanoid Copepods *Bestiolina similis* (11.5 to 58.9%) and *Paracalanus crassirostris* (2.6 to 22.7%). *Acartia spinicauda* was a persistent species contributing upto 37.3% in premonsoon months. The cyclopoid *Oithona similis* was abundant in stations V<sub>1</sub> and V<sub>2</sub> ranging between 6.35 and 31.9%. *Oithona hebes* was moderately present in stations V<sub>3</sub> and V<sub>4</sub> (5.8 to 18.6%). Swarming of *Oithona similis*, *O. hebes* and *Mesochra* sp. was observed in certain months. At station V<sub>1</sub> the harpacticoid *Mesochra* was abundant during November (60.5%). Another harpacticoid species constituted 98% in May and 97% in June 1992. In station V<sub>2</sub> *Mesochra* contributed 90.03% in September and at V<sub>3</sub>, *Mesochra* and the harpacticoid each contributed 46.6% during November. At station V<sub>4</sub> the harpacticoid contributed 97.2% in February and 99.7% in May.

The highest density of Copepods was recorded at station V<sub>1</sub> in December ( $467964/m^3 = 99.8\%$  of the total zooplankton). This was caused by the swarming of *Paracalanus crassirostris* (71.7%) and *Mesochra* sp. (22.3 %). In September *Oithona similis* contributed 70.6% of the total copepod amounting to  $120598/m^3$ . At station V<sub>3</sub> a swarm of Copepods ( $101520/m^3 = 99.8\%$  of zooplankton) was observed in April. *Bestiolina similis* and the Harpacticoid sp. contributed to the swarm.

When the environmental variables were related, salinity played the main role in the sudden propagation. During December when *Paracalanus crassirostris* and *Mesochra* sp. occurred in swarms salinity dropped from 34.5 ‰ to 33.5 ‰ indicating 1 ‰ drop in salinity which might be conducive for the proliferation of the above species. In January the salinity rose to 35.6 ‰. When *Oithona similis* swarmed in September there was a sharp increase in salinity by 10 ‰ than the previous month.

Clumping of zooplankton prey has been shown to be a device against predation (Folt, 1987). Planktivorous fishes namely mangrove snappers and barracudas are usually found in this habitat. Buskey *et al.* (1996) reported that predators may feed mainly around the edges of the swarms. The escape responses of the Copepod tended to disperse the swarms. The aggregations would also

enhance mating opportunity. In most of the swarms appreciable number of males of both cyclopoid and harpacticoid, were observed. Since the males are short lived, swarming will enable high rate of fertilization. In the pools with high nutrients phytoplankton production will be very high and the swarming behaviour is advantageous for Copepods to utilize abundant phytoplankton. Most of the specimens were with green pigmentation indicating active feeding. In general, swarming helps the Copepods in survival and propagation.

#### References

- Ambler, J.W.D., F.D. Ferrari and J.A. Fomshel, 1991. Population structure and swarm formation of the cyclopoid Copepod *Dioithona oculata* near mangrove bays. *J. Plankton Res.*, 13: 1257-1272.
- Ambler, J.W.D., F.D. Ferrari, J.A. Fomshel and E.J. Buskey, 1999. Diel cycles of moulting, mating, egg sac production and hatching in the swarm forming cyclopoid Copepod *Dioithona oculata*. *Plankton Biol. Ecol.*, 46(2): 120-127.
- Buskey, E.J., J.O. Peterson and J.W.D. Ambler, 1996. The swarming behaviour of Copepod *Dioithona oculata*: *In situ* and laboratory studies. *Limnol. Oceanogr.*, 41:515-521.
- Buskey, E.J., 2002. Behavioural adaptations of the cubozoan medusa *Tripedalia cystophora* for feeding on Copepod (*Dioithona oculata*) swarms. *Mar. Biol.* (in press).
- Dwivedi, S.N. and K.G. Padmakumar, 1980. Ecology of mangrove swamp near Juhu Beach, Bombay, with special reference to sewage pollution. 2<sup>nd</sup> International Symposium on Biology and Management of Mangroves. Port Morseby, 24 (Abstract).
- Flot, 1978. An experimental analysis of costs and benefits of zooplankton aggregation. In: *Predation : Direct and Indirect Impacts on Aquatic Communities* (W.C. Kerfoot and A. Sih, Eds.), New England, 300-314.
- Godhantaraman, N., 1994. Species composition and abundance of tntinnids and Copepods in the Pichavaram mangroves (South India). *Cienc. Mar.*,20(3):371-391.
- Hamner, W.M. and J.H. Carleton, 1979. Copepod swarms : attributes and role in coral reef ecosystems. *Limnol. Oceanogr.*, 24:1-14.

Jagtap. T.G., VS. Chavan and H.G. Untawale, 1993.  
Mangrove ecosystems of India. A need for  
protection; *Ambio*, 22(4): 252-254.

Shanmugam, A., R. Kasinathan and  
S. Maruthamuthu, 1986. Biomass and  
composition of zooplankton from Pitchavaram

mangroves, Southeast coast of India. *Indian J.  
Mar. Sci.*, 15(2): 111-113.

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