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 V₁ 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 m² 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 up to the interior most station (V₄). 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 μg/at./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...
sp., Cyclops sp., Euterpinia acutifrons, Mesocha 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 V1 and V2 ranging between 6.35 and 31.9%. Oithona hebes was moderately present in stations V3 and V4 (5.8 to 18.6%). Swarming of Oithona similis, O. hebes and Mesocha sp. was observed in certain months. At station V1 the harpacticoid Mesocha was abundant during November (60.5%). Another harpacticoid species constituted 98% in May and 97% in June 1992. In station V2 Mesocha contributed 90.03% in September and at V3, Mesocha and the harpacticoid each contributed 46.6% during November. At station V4 the harpacticoid contributed 97.2% in February and 99.7% in May.

The highest density of Copepods was recorded at station V1 in December (467964/m³ = 99.8% of the total zooplankton). This was caused by the swarming of Paracalanus crassirostris (71.7%) and Mesocha sp. (22.3%). In September Oithona similis contributed 70.6% of the total copepod amounting to 120598/m³. At station V3 a swarm of Copepods (101520/m³ = 99.8% of zooplankton) was observed in April. Bestiolina similis and the Harpacticoid sp. contributed to the swarm.

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


Rosamma Stephen, K.V. Jayalakshmy and Vijayalakshmi R.Nair
National Institute of Oceanography
Regional Centre
Kochi-14