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Zooplankton Communities of Androth Island, Lakshadweep

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ABSTRACT

Studies were undertaken on the zooplankton communities of the Androth Island. Major planktonic groups were copepods, decapods, amphipods, chaetognaths, mysids, fish eggs and larvae. Besides these foraminiferans, ciliates, cladocerans, ostracods, polychaete larvae, gastropod larvae, crustacean larvae and echinoderm larvae were also encountered during the present study. Copepoda was found to be the most abundant group. The study provides baseline information on the Zooplankton community structure, which could give new insight to the future ecological assessment of Androth waters.

Introduction

Coral reefs are the most productive environments with diverse habitats (Birkeland, 1997 and Veron, 1995) , but reports show that reefs are declining in many areas around the world due to stress that tends to threaten their survival (Lapointe *et al*, 2004; Bruno and Selig, 2007). Major oceanic reefs in Arabian Sea are confined to Lakshadweep groups of Islands. Oceanic Islands generally represent a multi-tiered ecosystem typically comprised of wetland habitats such as corals, sea-grasses, seaweeds, mangroves and sand-dune vegetation. These wetland habitats from Lakshadweep, being unique and rich in biodiversity and productivity, are of great ecological and socio-economic importance besides protecting coastal terrestrial ecosystems from the ravages of the sea (Bakus, 1993). In order to monitor the healthy state of the entire marine system, it will be important to maintain a record of the species diversity that currently exists which will begin to assess changes over time. Zooplankton plays an important role in the marine food chain as an intermediate link between transfers of energy from primary to tertiary level. Some fishes are exclusively zooplankton feeders and therefore, their abundance is directly linked to the presence of zooplankton. The rate of zooplankton production can be used to estimate the exploitable fish stock (Tiwari and Nair, 1991).

Marine ecosystems of the Lakshadweep Islands are unique and known to have a very high degree of biodiversity and a number of endemic flora and fauna. Coral reef of these Islands is known to have the richest biodiversity in the entire Indian sub-continent. During the past few decades, there has been the rapid anthropogenic development in these Islands, which has resulted in the degradation of coral colonies on the reef flats as well as in the lagoon, leading to a notable decline in their biodiversity via food web destructions. However, because of their vulnerability to anthropogenic and natural destruction, they have been considered “Marine Critical Habitats” and hence are of global concern. These coastal habitats have also been categorized as “Ecologically Sensitive Regions”; under the Coastal Regulation Zone (CRZ - I) act.

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Numerous specific works such as plankton diversity and distribution (Wafar *et al*, 1985) primary and secondary productivity, chlorophyll and phaeopigments (Bhattathiri and Devassy, 1971) have been carried out in the Lakshadweep waters. Zooplankton composition and abundance of Kavaratti were also studied (Goswami and Goswami, 1990). However, only very little information was available on the hydrography and plankton population of Androth Sea. In the present investigation we examined the zooplankton composition of Andrott island.

Study Area

The Andrott Island is the largest island with an area of 4.90 sq km, length of 4.66 km and a maximum width of 1.43 km. It lies in the east-west direction, at 10° 49' N latitude and between 73° 38' and 73° 42' E longitude. The island occupies the whole interior of atoll. The climate of Andrott is similar to the climatic conditions of Kerala. March to May is the hottest period of the year. The temperature ranges from 25^{o}C to 35^{o}C and humidity ranging from 70 -76 per cent for most of the year. The average rainfall received is 1600 mm a year. Monsoon prevails here from 15th May to 15th September. The corals have been exploited extensively and a breakwater and jetty was constructed for fish landing and other embarkation and disembarkation purposes.

Materials and Methods

To study the Zooplankton composition of the Androth sea, three near shore stations were selected: break water (Station I), South side near solar plant (Station II) and helipad (Station III) (Figure 1). The present study was conducted during April 2014.

Hydrographical factors such as temperature, salinity, pH, dissolved oxygen, nitrate, nitrite and phosphate were studied along with zooplankton communities. Sampling was conducted between 0700 to 0800 hrs from a depth of 50cm below the surface. Water samples for oxygen estimation was collected directly in BOD bottles and fixed immediately. Samples for the analysis of other hydrographical parameters were collected using a plastic bucket and taken to the laboratory for further analysis in plastic bottles.

The water temperature was recorded with a centigrade thermometer. Salinity was measured by using refractometer and pH with a digital pH meter. Standard methods of sea water analysis were followed for the estimation of other factors (Strickland and Parsons, 1972).

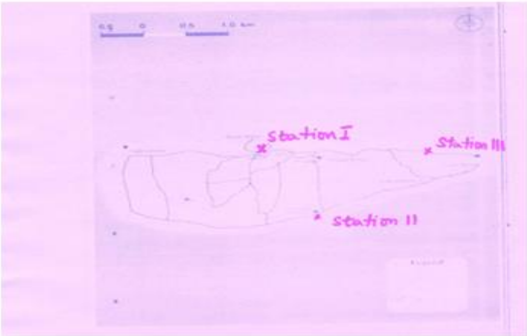
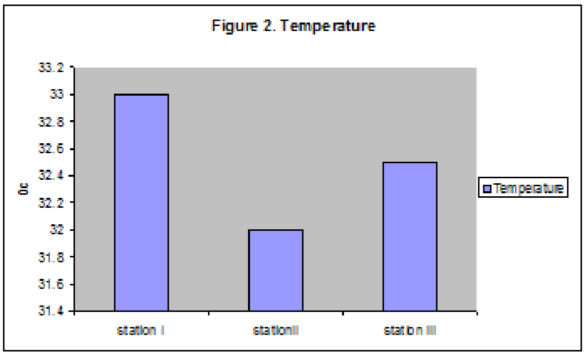


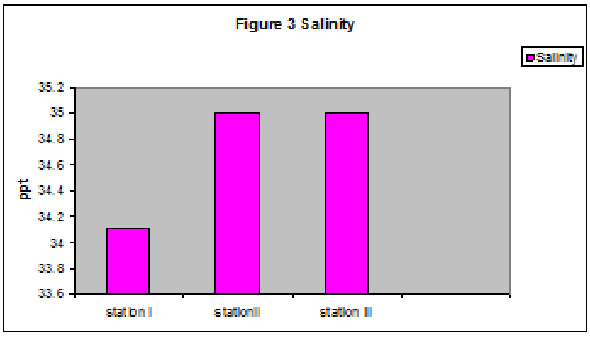
Figure 1. Study Area.

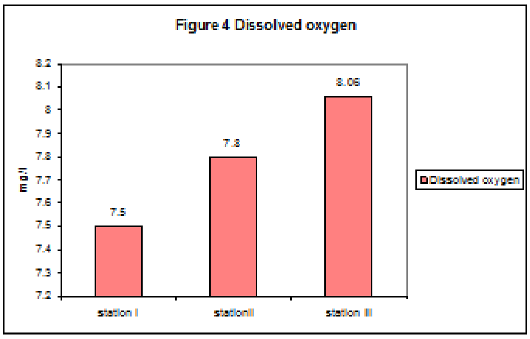
Zooplankton was collected with a net (mesh size 50 µm) having a diameter of 0.6 m, towed horizontally just below the surface for a duration of 10 min. (speed of the boat 1 knot). The samples were preserved in 5% formalin and identified later using published papers and monographs (UNESCO, 1978; Santhanam *et al*, 1987).

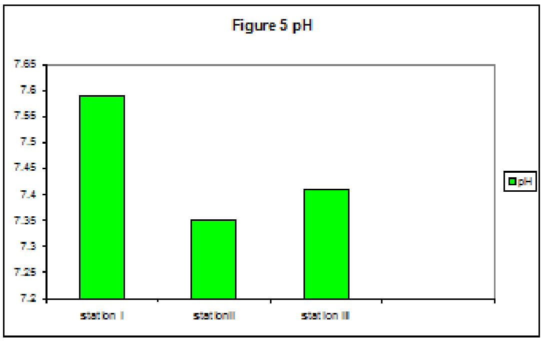
Results

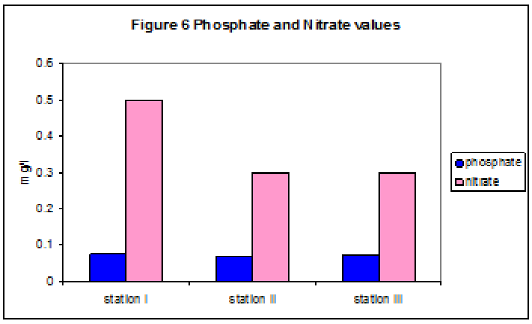
Marked fluctuations were not noticed in the hydrographical factors of Androth Sea. Figures 2 to 6 depict variations in temperature, salinity, pH, dissolved oxygen, nitrate, nitrite and phosphate respectively of the three stations. The water temperature ranged from 32.0 to 33°C. Salinity values varied from 34.1 ppt to 35 ppt. The pH values fluctuated from 7.35 to 7.59. Fairly saturated dissolved oxygen was recorded in all the stations. The values ranged from 7.5mg/l in November to 8.06mg/l in March. Nutrient values were very low in the Androth waters. The values of nitrate ranged from 0.3 to 0.5mg/l; whereas the nitrite was absent in all the three stations. The phosphate concentration was also very less in the Andrott sea. The values fluctuated from 0.071 to 0.075mg/l during the study period.











Zooplankter consisted mainly of copepods and fish larvae. Foraminiferans, Ciliates, Polychaete larvae, Gastropod larvae, Amphipods, Ostracods, Cladocerans, Decapods, Crustacean larvae, Mysids, Chaetognaths, Echinoderm larvae and fish eggs were also encountered during the present study . The relative abundance of the eleven planktonic groups obtained from the three stations is given in Table 1. The variations in species composition are as follows:

Foraminifera

This group was rarely present in break water area. Of the four species encountered during the present study, only *Eponides repandus* was observed in the break water area. Other species observed were *Bolivinita quadrilatera*, *Textularia agglutans* and *Globigerina* sp.

Ciliata

This group was uniformly found in all the three stations. The three species reported in the present study was *Favella brevis*, *Tintinopsis cylindrica* and *Tintinopsis tubulosa*.

Chaetognatha

This group showed preference to station II and III and was completely absent in station I. Three species belonging to a single genus (*Sagitta*) was recorded.

Cladocera

This group was represented by a single species, *Evadna normani* in Station II and Station III.

Ostracoda

The genus belonging to *Conchaecia* sp. was recorded in the present study and was uniformly distributed in all the three stations.

Copepoda

This group was the major component of plankton community in all the three stations. Of the thirteen species observed in the present study, *Eucalanus monachus* and *Paracalanus parvus* were the most abundant species and these were found to be more abundant in Station I. Out of the thirteen species, eight species belonged to Calanoidia, four species were Harpacticoid copepods and one was Cyclopoid.

Amphipoda

Two species belonging to genus *Gammarus* and *Corophium* were observed in the present study. Amphipods were mainly confined to the break water region.

Decapoda

This group was represented by a single species *Leucifer hanseni* and was more abundant in station II and III.

Mysidacea

Two genus of this group was recorded in the present study. Of these *Animysis* sp. was uniformly distributed in all three stations. But, *Siriella gracilis* was absent in Station I.

Larval Forms

Six larval forms were observed during the study. Veligers and Echinopluteus were absent in Station I, copepod Nauplius was absent in station II and III and Trochophore larva was absent in station II.

Ichthyoplankton

This group consisted of fish eggs and larvae. Fish larvae belonging to the families' Holocentridae, Scorpaenidae, Stromateidae and Gobiidae were recorded in the present study.

Discussion

The present study revealed that hydrobiological conditions of the Andrott Sea are almost stable. Much variation was not observed in the values of temperature, pH and salinity. The relatively high (7.59) pH value in the break water compared to other stations (7.35 – 7.41) might be due to elevated photo-synthetic processes by benthic macro flora such as sea-grasses and seaweeds influencing the biogeochemical processes of these waters. High values of dissolved oxygen obtained in the present study may be due to the tidal influence and wind action and the active photosynthetic activity, Goswami (1983). The extreme shallowness and strong illumination assist high rate of photosynthesis by benthic plant communities.

Availability of nutrients is one of the primary factors regulating the growth and development of corals. In sub-tropical region availability of inorganic nutrients has been implicated as the most important factor limiting the productivity of the coral reef ecosystem. Further, nutrient dynamics in the coral reef ecosystem is complex, since the corals are able to utilize the nutrients either from the sediments or from the water column (D'Elia, 1988). As observed in the present study low concentrations of nutrients were also noticed by earlier workers. According to Odum and Odum (1955) areas where coral reefs established themselves are often nutrient impoverished. Goswami (1983) observed extremely low phosphate-P and Nitrate-N in Kavaratti lagoon. Present study also showed a considerably low concentration of phosphate, nitrite and nitrate. These indicate an active uptake of phosphate by coral reef plant communities as suggested by Sankaranarayanan (1973) and Atkinson (1987). Twilley *et al*. (1977) and Penhale and Thayer (1980) have reported the absorption of phosphate by angiosperms in marine and freshwater areas. Sea grasses and benthic algae may be deriving phosphate from water. The Lakshadweep waters have been reported to be generally of oligotrophic nature. This is substantiated by the fact that the coral containing zooxanthellae have been found to readily absorb inorganic phosphorus even at low nutrient concentration (D'Elia, 1988). Further, these algae within the coral tissue use the inorganic phosphorus for their photosynthetic process, thereby reducing the nutrient concentration.

Table 1. Relative Abundance Of Zooplankton Groups Recorded During The Present Study.

Name of the species Station	Station I	Station II	StationIII
FORAMINIFERA			
Bolivinita quadrilatera	-	+	+
Eponides repandus	+	+	+
Textularia agglutans	-	+	+
Globigerina sp	-	+	+
CILIATA			
Favella brevis	++	+	+
Tintinopsis cylindrica	+	++	++
Tintinopsis tubulosa	+	+	+
CHAETOGNATHA			
Sagitta elegans	-	+	+
Sagitta enflata	-	+	+
Sagitta setosa	-	+	+
CLADOCERA			
Evadna normani	-	+	+
OSTRACODA			
Conchoecia sp	+	+	+
COPEPODA			
i)CALANOIDIA			
Acartia danae	+	+	+
Acartia spinicuda	+	+	+
Eucalanus crassis	+	+	+
Eucalanus elongatus	+	++	++
Eucalanus monachus	+++	++	++
Paracalanus parvus	+++	+	+
Paracalanus aculeatus	+	-	-
Pseudocalanus elongatus	+	+	+
ii) HARPACTICOIDA			
Amphidiscus sp	++	-	-
Euterpina acutiferons	+	-	-
Macrostella gracilis	+	+	+
Miracia efferata	+	-	-
iii) CYCLOPOIDIA			
Corycaeus nana	+	+	+
AMPHIPODA			
Gammarus sp	+	+	-
Corophium sp	+	-	-
DECAPODA			
Lucifer hanseni	+	++	++
MYSIDACEA			
Animysis sp	+	+	+
Siriella gracilis	-	+	+
LARVAL FORMS			
Polychaete Trochophore	++	-	+
Bivalve veliger	-	+	+
Gastropod veliger	-	+	+
Copepod nauplius	++	-	-
Brachyuran Zoea	+	+	+
Bipinnaria	+	+	+
Echinopluteus	-	++	++
ICHTHYOPLANKTON			
Fish larvae	+	++	++
Fish eggs	++	++	++

- Absent + Rare; ++ Less Abundant +++ More Abundant

Coral reef water contains very low dissolved inorganic nitrogen (Webb *et al*., 1975; Atkinson, 1988) and frequently too low to detect (Bellamy *et al*., 1982; Andrews, 1983). As with phosphate, the concentration of nitrite and nitrate in Androth was also very low during the present observations.

Such low levels of dissolved inorganic nitrogen are insufficient to maintain the high reef productivity (Webb *et al*., 1975; Hatcher and Hatcher, 1981). The process of nitrogen fixation starts with the deamination of dissolved organic or particulate nitrogen into ammonia (NH^+_4), which is oxidized to nitrite (NO^-_2) and the NO^-_2 oxidized to (NO^-_3) nitrate (Webb *et al*., 1975). But the reef water contains no appreciable amount of nitrite. It appears that there may be a tight and closed cycling of some components with benthos. The reef nitrogen fixation is mostly resulted by blue green algae (Webb *et al*., 1975; Wiebe *et al*., 1975). Apart from this, there is biological oxidation of ammonia to nitrate (nitrification) (Webb *et al*., 1975; and Webb and Wiebe, 1975), strictly mediated through bacteria (Wiebe, 1976). Low levels of nitrate and nitrite nitrogen indicated that seaweeds efficiently remove dissolved nitrogen. In addition, some seaweed species take up nutrients above and beyond their requirements for growth (Troell *et al*., 1997; Chopin *et al*., 1999).

The species richness of zooplankton communities is less in Andrott Sea. Evidence as to the abundance of zooplankton near coral reef has been conflicting. Some authors have reported extremely low concentrations (Qasim *et al*., 1972), while others have found zooplankton in large quantities (Goswami, 1973). The present study clearly shows that the zooplankton composition in Andrott is low. Earlier observations by Madhu Pratap *et a1*., (1977) and Goswami (1979) also showed that the day time zooplankton abundance in Lakshadweep waters is very low. Copepods were dominant and the most common species were *Eucalanus elongatus* and *E. monachus*. Comparatively high plankton density was observed in breakwaters. High plankton density at break waters might be due to relatively stable environmental conditions and availability of food. Coral reef zooplankton is considered as an important trophic link between primary producers and higher trophic levels on reefs (Heidelberg *et al*., 2004). It has often been assumed that coral reef zooplankton largely came from surrounding oceanic water and their densities dramatically change (Roman *et al*., 1990).

This study provides information on the zooplankton composition of Androth sea. Primary objectives were to relate the zooplankton community composition to the physical variables of the ocean. However detailed studies are required to understand the seasonal variations in plankton population and density in relation to hydrographical parameters.

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