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Hydrobiology of Lakshadweep Sea with special reference to Andrott Island

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ABSTRACT

The hydrobiology of Andrott Island, Lakshadweep was investigated during November 2011 to May 2012 period. Estimation of salinity, temperature, dissolved oxygen, pH, nutrients, hardness, primary productivity, phytoplankton and zooplankton communities were carried out. Among the factors mentioned above nutrient levels were significantly less in the Andrott Sea. Altogether nine species of phytoplankton and ten groups of zooplankton were identified during the present study. The filamentous algae Trichodesmium sp., diatoms such as Pleurosigma, Navicula, Skeletonema, Thalassiosira, Coscinodiscus and Nitzschia; dinoflagellates such as Dinophysis and Ceratium contributed to the phytoplankton community. Significant fauna composed of Foraminiferans, Rotifers, Polychaete larvae, Isopods, Ostracods, Crustacean larvae, Copepods, Mysids, Gastropod larvae and fish larvae.

Introduction

Hydrobiology and nutrient dynamics in coral reefs have been the focus of great scientific interest in the recent time throughout the world. Coral reefs of the Lakshadweep islands are unique and known to have the richest biodiversity. Our knowledge on the marine living resources of these atolls, their environmental conditions (physical, chemical and biological), the state of growth and maintenance of reefs and the extent of damage occurred to the ecosystem are scanty. The dearth of information on these aspects from Lakshadweep islands is largely because of the remoteness of these islands. Only a very few detailed long term studies are available on the hydrobiological conditions such as hydrography, primary productivity, zooplankton distribution and their dynamics, till date. Most of the studies on Lakshadweep group of islands are short term studies made by scientists periodically visiting this area. The hydrobiological studies *viz.* physical, chemical and biological parameters of the marine environment of Lakshadweep islands have been studied by different groups of scientists based on the data collected during the survey of these islands and also during the oceanography cruises undertaken (Nair and Pillai,1972; Qasim and Bhattathiri, 1971; Tranter and George, 1982; Goswami, 1973; Madhu Pratap, *et al*.,1977; Girijavallabhan *et al*, 1989; Vijay and Pillai, 2005 and 2007; James, 2011). Chemical characters like temperature, pH, dissolved oxygen, salinity and their diurnal variation in Kavaratti Atoll were investigated by Sankaranarayanan (1973). Information on chemical characters and zooplankton occurrence and abundance in and around Kavaratti Atoll has been provided by Goswami (1983). Studies on nitrogenous nutrients and primary production in Lakshadweep waters have been made by Wafar *et al* (1986). Wafar *et al* (1990) studied the nitrification in reef corals and its importance in reef nitrogen economy. Nair *et al* (1986) have undertaken extensive studies on zooplankton in the lagoons of Lakshadweep and the surrounding sea.

The Union Territory of Lakshadweep consists of twelve atolls, three reefs and five submerged banks. There are 36 islands, covering an area of 32 sq.km, which are geographically isolated and segregated from the mainland (08° 00' N and 12° 30' N lat. and 71° 00' E and 74° 00'E long), about 200-400 km from the Malabar Coast, the coral formations rising from depths ranging from 1500-4000m. The islands scarcely rise 2m above the surface of water. Andrott is the biggest island without a lagoon. A deep knowledge on hydrobiological aspects are very much essential for planning future utilization of the resources, introduction of culture fisheries in this environment and management and conservation of this ecosystem. It would also provide information to fill up several lacunae with regard to reef biology and oceanography of this area. The objective of the present study was to collect sufficient information on hydrobiological factors for a proper understanding of Andrott island which is one of the major island of the Union Territory.

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 blasted extensively and a breakwater and jetty was constructed for fish landing and other embarkation and disembarkation purposes.

Materials and Methods

The materials for the present study were collected at fortnightly intervals from a fixed station for a period of

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six months extending from November 2011 to May 2012. The break water area near the jetty was selected as the sampling site (Fig. I).

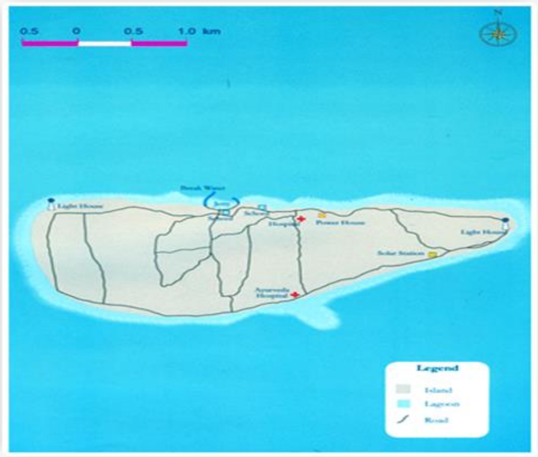


Figure 1. STUDY AREA

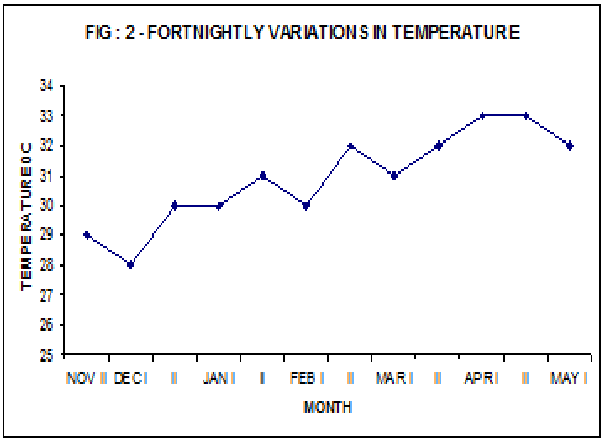
The average depth of water in this area is 3m and the tidal amplitude (semi-diurnal) is 1.2m. Typical conditions prevail from November to May. During other months Sea is strongly influenced by the monsoon rains.

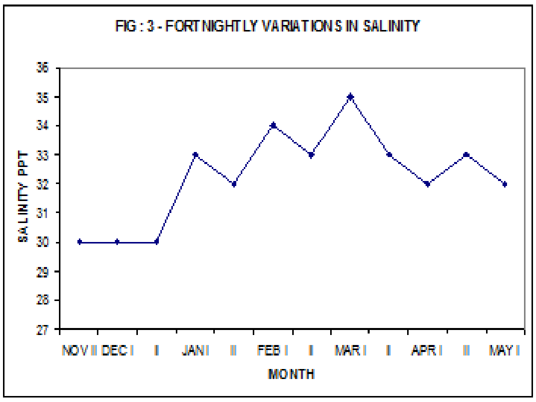
Hydrobiological factors such as temperature, salinity, pH, dissolved oxygen, total hardness, nitrate, nitrite and phosphate were studied along with phytoplankton and zooplankton communities. Sampling was conducted between 0700 to 0800 hrs from a depth of 50cm below the surface. Water samples for oxygen 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).

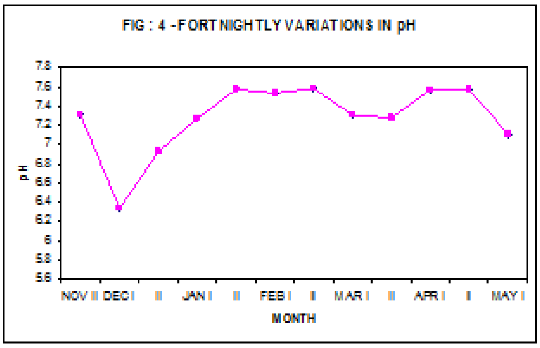
Samples for phytoplankton analysis were collected by filtering 100 litres of water through a plankton net having mesh size 10µm. For zooplankton studies samples were taken with the help of 50µm mesh plankton net. The samples were preserved in 5% formalin and identified later using published papers and monographs (UNESCO, 1978; Santhanam *et al*, 1987).

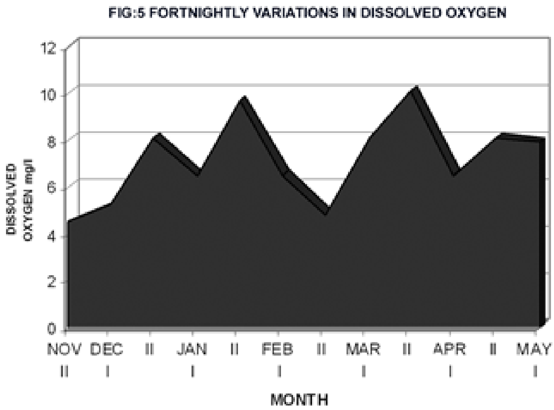
Results

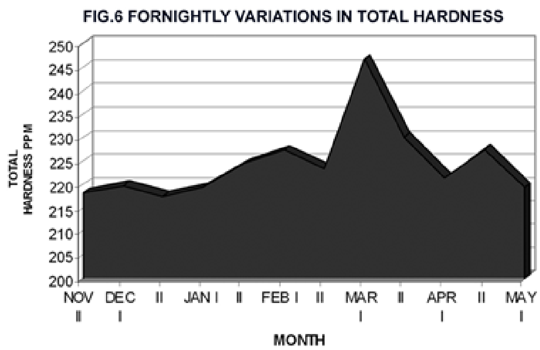
Marked fluctuations were not noticed in the hydrographical factors. Figures 2 to 9 depict fortnightly variations in temperature, salinity, pH, dissolved oxygen, total hardness, nitrate, nitrite and phosphate respectively.

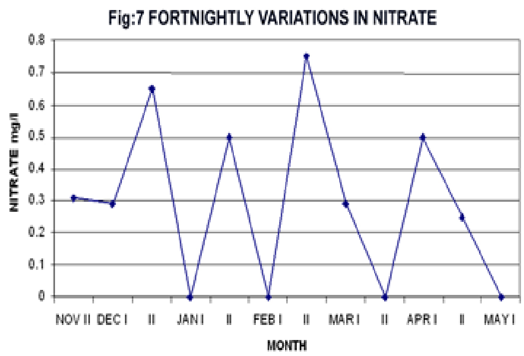


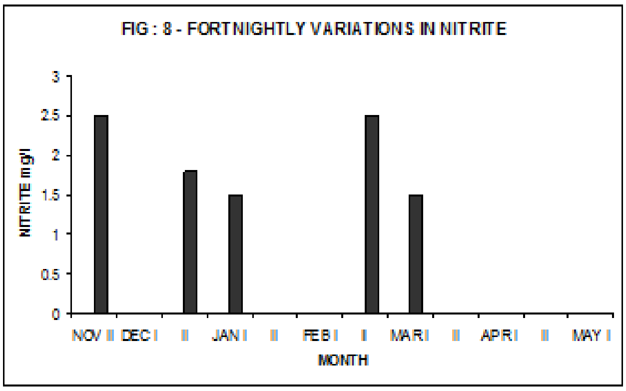


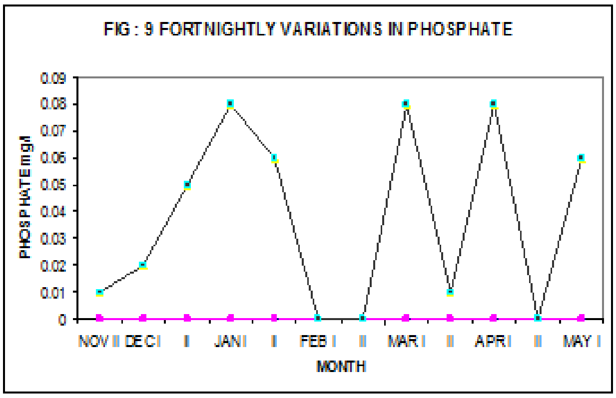












The water temperature ranged from 28.0 to 33°C. Salinity values varied from 30 ppt (November) to 35 ppt (March). The pH values fluctuated from 6.34 (January) to 7.59 (February). Remarkable variations were observed in dissolved oxygen values. The values ranged from 4.5mg/l in November to 10.06mg/l in March. The total hardness values varied from 217.5 to 246.8 ppm. A homogenous pattern was not noticed in the values of nitrate, nitrite and phosphate values. The values of nitrate ranged from 0 to 0.75mg/l; whereas the nitrite concentration varied from 0 to 2.5mg/l. The phosphate concentration was also very less in the Andrott sea. The values fluctuated from 0 to 0.08mg/l during the study period.

The list of phytoplankton collected during the study period is presented in Table 1. A total of 9 species were identified during the study. The phytoplankton community consisted of members of the Cyanophyceae, Bacillariophyceae and Dinophyceae. The most prominent groups among the phytoplankton were the diatoms.

Table 1. Phytoplankton Species recorded during the present study.

S.No	Name of Phytoplankton
	BACILLARIOPHYCEAE
1	*Coscinodiscus sp.*
2	*Navicula sp.*
3	*Nitzschia*
4	*Pleurosigma sp.*
5	*Skeletonema*
6	*Thalassiosira*
	DINOPHYCEAE
1	*Dinophysis sp.*
2	*Ceratium sp.*
	CYANOPHYCEAE
	Trichodesmium sp.

The zooplankter consisted mainly of copepods and fish larvae. Foraminiferans, Rotifers, Polychaete larva, Ostracods, Isopods, Crustacean larva, Mysids and Larvae of Gastropods were also encountered during the present study (Table – 2).

Table 2. Zooplankton groups recorded during the present study.

S.No	Name of Zooplanktons
1	Foraminiferans
2	Rotifers
3	Polychaete larva
4	Isopods
5	Ostracods
6	Copepods
7	Decapod larva
8	Mysis
9	Gastropod larva
10	Fish larva

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. 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. 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), Atkinson (1987). Twilley *et al*. (1977) and Penhale and Thayer (1980) have reported the absorption of phosphate by angiosperms in marine and freshwater areas. The lush growth of sea grasses and benthic algae may be deriving phosphate from water.

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 Andrott 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 bluegreen 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 phyto and zooplankton communities is less in Andrott Sea. Oceanic atolls harbour relatively low phytoplankton standing stock and their contribution to reef production is very low, often insignificant (Lewis, 1977). Availability of nutrients is of major importance to phytoplankton production (Steeman-Nielsen and Jensen, 1957). Variation in one or more assimilable forms of nitrogen determines the rate of production (Wafar *et al*., 1986). He stated that Nitrogen in Lakshadweep Sea limits phytoplankton production. Coral reefs are phytoplankton impoverished, and therefore if such ecosystem with its diverse fauna were to flourish, it must have pockets of high productivity, like the sea grasses beds, within itself. Evidence as to the abundance of zoo plankton 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.

These types of ecological studies are essential for the future management and optimal exploitation of the coral reef ecosystem. Detailed studies are required to understand the seasonal variations in hydrographical parameters in relation to plankton communities.

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