

# HUMAN IMPACTS ON LAKSHADWEEP ATOLLS, INDIA

## Abstract

The Lakshadweep (Laccadive) islands are situated in the Arabian Sea about 225 to 450 km from the southwest coast of India. These islands situated 1 to 2 meters above mean sea level has a very thin lens of fresh water floating over the seawater. Almost all fresh water sources are contaminated due to seawater intrusion. The drinking water wells contain excessive nitrate concentration originating from septic tanks, other human wastes and fertilizers used in garden. All drinking water sources show positive bacterial (faecal coliform) count exceeding the normal level. Increasing population pressure (2600 people / km<sup>2</sup>) leading to the accumulation of more diseases in corals. The newly emerging disease Red Plague Syndrome is spreading very fast in these islands. The anthropogenic impacts on coral reefs are discussed in the paper in detail.

## Keywords

Human impacts, Coral reefs, Diseases, Red plague syndrome, Lakshadweep, Atolls.

## Introduction

The Lakshadweep (Laccadive) islands are situated in the Arabian Sea (71° –74° E Longitude and 8° –12° N Latitude) about 225 to 450 km from the southwest coast of India. Lakshadweep Archipelago consists of 12 atolls, 9 reefs and sand bars. There are 27 islands in Lakshadweep covering total land area of 28.54 km<sup>2</sup>. Of which, 11 islands are inhabited and have a land area of 26.89 km<sup>2</sup>, while the 16 uninhabited islets are 1.65 km<sup>2</sup> (Attakoya, 2000). Most of the islands are located within the 12 atolls. These islands have a warm tropical and humid climate (Air temperature 20° –45° ) all through the year. The sea surface water temperature varies between 28° – 38°C, while the salinity ranges from 34 to 39.4 ppt. The annual rainfall is about 1600 mm, the sole source of ground water recharge in these islands. The height of the land above sea level in the islands is generally 1 – 2 m and the terrain is mostly flat. The tides at these islands are semi-diurnal type, with the spring tidal range of about 1.2 m and the neap tidal range of about 0.3 m (Chandramohan et al, 1993). Total population of the islands is around 70000 (60595 in the year 2001). Fisheries and coconut cultivation is the major economic activity in the islands. There are about 660150 trees in all the islands harvests about 28 million

coconuts per year. There are about 6200 fishermen engaged in fishing using 900 boats. The total fish landings in these islands per year are about 15000 tonnes. The people are dependent on the mainland for all essential supplies including fuel, vegetables, packaged foods, and infrastructure.

Lakshadweep islands are lying along a north-south axis (except Androth Island) with lagoon on the west and open sea on the east. Estimated total coral reef area in these islands is 276 km<sup>2</sup> including the reef flat area of 136.5 km<sup>2</sup> (Bahuguna and Nayak, 1998). Taxonomic studies of Lakshadweep corals are almost restricted to the pioneering works of Pillai (1989) and he showed the presence of 104 species under 37 genera. The extensive surveys made by the author during the year 2002 to 2003 and the results showing additional 9 species were present i.e. *Cycloseris costulata*, *Cycloseris tenuis*, *Fungia seychellensis*, *Herpolitha limax*, *Porites murrayensis*, *Pectinia lactuca*, *Pachyseris rugosa*, *Physogyra lichensteini* and *Hydnophora exesa*. The islands are located in the Laccadive – Maldives – Chagos ridge forms a contiguous submarine covering a distance of around 3000 km. So far, 220 species under 58 genera, and 209 species under 62 genera, have been reported respectively from Chagos (Sheppard, 2000) and Maldives (Clark, 1995). Compared with these, it is safe to presume that the biodiversity of corals in Lakshadweep is likely to be twice higher than what is known now.

## Materials and Methods

Diseased wet coral blocks were cut in to small pieces and treated with 1% streptopencillin antibiotic solution to minimize the bacterial population for fungi identification. Then the samples were plated on 2% MEA medium for the isolation of fungi. Small pieces of wet coral blocks were directly inoculated in ASN-3 medium for the isolation of cyanobacteria (Rippka et al 1979).

## Results

Lakshadweep coral reefs were severely affected by the year 1998 bleaching event. More than 80% of coral mortalities were recorded during the time. Recent survey results showed that the live coral percentage was varied from 5.5 to 32.5% in these islands. The lowest 5.5% from Amini Island and highest 32.5% from Bitra Island

were recorded. Bitra is the smallest inhabited island (0.1 km<sup>2</sup>) with the largest lagoon (42 km<sup>2</sup>) and about 225 people are living there. The live coral coverage of other islands was as follows: Kadmat 7.0%, Bangaram 7.0%, Kavaratti 8.5%, Kalpeni 9.8%, Minicoy 11.5%, Androth 11.8%, Chetlat 14.5%, Kiltan 15.25% and Agatti 20.0%. The uninhabited Suheli islands live coral coverage was 21.0% (Fig 1). The results clearly show that low live coral coverage was present in highly dense populated and housed islands. Even though the new recruitment of corals is coming up fast, diseases are devastating the corals. The White Band, Dark Band, Pink line syndrome and White Plague diseases were encountered in these islands. The first coral disease in the world was reported in 1965 and during the subsequent 3 decades, only 4 new diseases were reported. Beginning in the mid -1990s, reports of novel coral diseases increased worldwide, and by 2002, 13 new diseases were described (Sutherland 2004). The list of coral species examined in Lakshadweep and the species showing different symptoms are shown in Table 1. Various microbes were identified from these corals (Table 2). The newly emerging disease “Red Plague Syndrome” (RPS) is spreading very fast in these islands and affecting almost all species of corals (Fig 2). Similar type of another disease was reported in Mauritius (Antonius 2001). The healthy coral tissue is decaying fast by this syndrome and the entire denuded coral colony area shows red color. The western side of Agatti island (opposite to tourist resort) coral reefs are in patches and not been affected by bleaching event. The live coral cover of this particular site was more than 90%. The RPS is now severely affecting the pristine corals. The most affected corals were belongs to the genus *Porites*, *Acropora*, *Montipora*, *Favia*, *Favites*, *Turbinaria*, *Goniastrea*, *Goniopora*, *Diploastrea* and *Platygyra*. Further studies on toxicology and epizootiology of RPS using biomarker system will reveal the details.

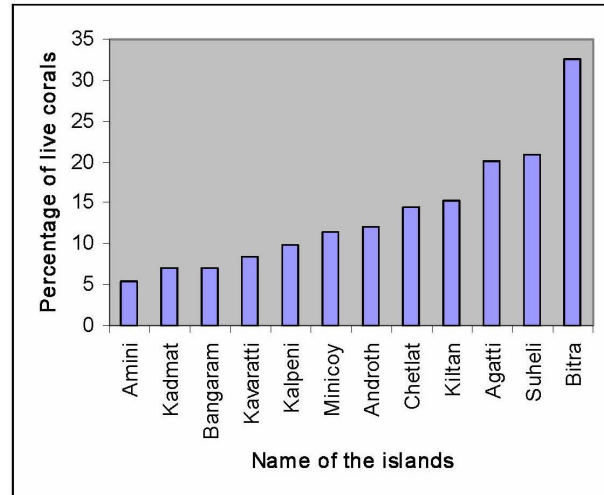


Fig 1. Live coral coverage of Lakshadweep islands



Fig 2. Red Plague Syndrome on coral *Porites lutea*

Table 1. List of coral species examined and showing different symptoms

Coral species	Blackening	Necrosis	White band	Pink line syndrome	Red Plague syndrome
<i>Acropora sp</i>	x				x
<i>Cyphastrea serralia</i>		x			
<i>Goniastrea pectinata</i>		x			
<i>Goniastrea retiformis</i>		x			
<i>Montipora divarigata</i>		x	x		x
<i>Montipora informis</i>		x			x
<i>Goniopora stokesi</i>		x	x		
<i>Pocillopora damicornis</i>	x				
<i>Porites lutea</i>		x	x	x	x
<i>Porites solida</i>		x		x	
<i>Platygyra lamellina</i>		x			x

Table 2. Microbes isolated from the diseased coral species

Bacteria	Cyanobacteria	Fungi
<i>Vibrio spp.</i>	<i>Phormidium corallyticum</i>	Dark brown coloured non sporulating fungus
<i>Beggiatoa spp.</i>	<i>Phormidium tenue</i>	
<i>Desulfovibrio spp.</i>	<i>Lyngbyo sp</i>	
	<i>Spirulina subsalsa</i>	
	<i>Plectonema terebrans</i>	
	<i>Oscillatoria spp</i>	
	<i>Microcystis sp</i>	

## Discussion

Increasing population pressure (2600 people / km<sup>2</sup>) leading to the accumulation of more diseases in these corals. There is no sewage disposal in Lakshadweep islands. The toilets are connecting to septic tanks or soak pits. The outflow from septic tank or soak pit is coursing underground through porous coral sandy soil, contaminating the fresh water lens in these islands and ultimately finds it way into lagoon or Open Sea and finally endangering corals. The islands situated 1 – 2 meters above mean sea level has a very thin lens of fresh water floating over the seawater. Almost all fresh water sources are contaminated due to seawater intrusion. The drinking water wells contain excessive nitrate concentration originating from septic tanks, other human wastes and fertilizers used in garden. All drinking water sources show positive bacterial (faecal coliform) count exceeding the normal level. Consequently incidences of diarrhea, dysentery, hepatitis and high worm infestation are common (DST 1997). All islanders are boiling the water and drinks. The Lakshadweep Administration is now implementing Biotoilet methods in these islands to minimize the pollution. Disposal of garbage near the shore cause damaging the reefs. So, it is evident that the anthropogenic disturbance in coral reefs causes the incidence of new coral diseases.

## Acknowledgements

I express my heartfelt thanks to Local Organizing Committee for funding (LOCAP Award) to participate in the 10<sup>th</sup> International Coral Reef Symposium. I am highly indebted to Kristian Teleki and Alison Glass of International Coral Reef Action Network (ICRAN) for their financial support during my stay in Okinawa. I thank Gregor Hodgson for his support to participate in the post symposium Reef Check workshop.

## References

Antonius A (2001) Pneophylum conicum, a coralline red alga causing coral reef death in Mauritius. Coral reefs 19: 418  
 Attakoya E.P (2000) Basic statistics of the year 1998 – 99. Published by the Department of Planning and Statistics, Secretariat, Kavaratti, Union Territory of Lakshadweep. Pp. 1- 257  
 Bahuguna A, Nayak S (1998) Remote sensing applications for monitoring coral reefs. Proceedings of

the symposium on status and protection of coral reefs, March 11 – 13, Kadmat Island, U.T. of Lakshadweep. Pp. 17 – 19  
 Chandramohan P, Anand N.M, Nayak B.V (1993) Shoreline dynamics of the Lakshadweep islands. Indian J. Mar. Sci 22: 198 – 202  
 Clark S (1995) Recommendations for establishing a coral collection within the Marine Research Station, Male. Pp. 1 – 19  
 DST (1997) Environmental impact assessment of ninth five-year plan 1997 - 2002. Department of Science, Technology and Environment, Lakshadweep. Pp. 1 – 128.  
 Pillai, C.S.G, Jasmine S (1989) The coral fauna of Lakshadweep. CMFRI Bulletin No. 43: 179 – 194  
 Rippka R, Duruelles J, Waterbury JB, Herdman M, Starier RY (1979) Generic assignments, Strain histories and properties of pure cultures of cyanobacteria. J Gen Microbiology 111: 1 - 61  
 Sheppard C.R.C (2000) The Chagos Archipelago. In Coral Reefs of the Indian Ocean: Their Ecology and Conservation. (eds. McClanahan.R., Sheppard C.R.C., and Obura, D.O). Oxford University Press, New York. Pp. 445 – 468  
 Sutherland KP, Porter JW, Torres C (2004) Disease and immunity in Caribbean and Indo - Pacific zooxanthellate corals. Mar Ecol Prog Ser 266: 273-302

