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Domestic waste and its impact on production of *Caulerpa racemosa* (Forssk.) Weber v. Bosse at Minicoy Island, Lakshadweep

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ABSTRACT

The present study deals with the impact of domestic waste on *Caulerpa racemosa* collected from a densely populated village of Minicoy Island. Length of erect foliar portion of *C. racemosa* collected from the polluted site was only 2.15 cm while at control site it was 6.16 cm. Similarly weight of the plant was also low (0.26 g) when compared to unpolluted site (0.95 g). Length - weight relationship indicated wider variability in the size of the plant at polluted site with low r^2 values. Net primary production values showed 7.2 fold more production at contol site than that of polluted site. Environmental parameters such as temperature, salinity, turbidity and nutrients were monitored.

Introduction

Coral reefs of Lakshadweep consists of a wide variety of plants and animals and show high rates of production in nutrient poor oceanic waters. In general, primary productivity in the waters flowing over reefs greatly exceed the production of oceanic waters in the vicinity (Sargent and Austin, 1954). This high rate of production is chiefly due to the large standing crop of benthic algae, symbiotic zooxanthellae and seagrasses of the coral reef. Coastal and reef algal communities rank among highest primary producers.

Minicoy, the southernmost island of Lakshadweep Archipelago is 11 km long and has a population of 8000. This population is concentrated in 10 villages spread over an area of 2 sq.km mainly on the lagoonside on the northern part of the island. The beach adjoining the villages is used as an area for cleaning fishes and for dumping wastes arising from tuna processing and domestic activities. Due to this constant misuse of beaches and adjoining areas, the water in the lagoon near the beaches is always turbid, brownish with offensive odour and floating waste materials.

Productivity studies in Lakshadweep is mainly restricted to the primary production of the lagoon (Nair and Pillai, 1972; Wafar, 1977) and seagrass beds (Qasim and Bhattathri, 1971; Kaladharan and David Raj, 1989). Primary production of an atoll including production by macroalgae is reported by Qasim *et. al.* (1972). Kaladhran and Kandan (1997) estimated net primary production of 10 seaweeds of Minicoy Atoll. The present investigation deals with the impact of domestic pollution on the morphology and productivity of *Caulerpa racemosa* at Minicoy Atoll, Lakshadweep.

Materials and Methods

Six stations covering the first three villages of Minicoy were selected as polluted site (Fig. 1). The control sites were fixed at 2 km southward of the villages near Lakshadweep Harbour Works. Benthic communities in the polluted area comprised mainly of *Hypnea valentiae, Caulerpa racemosa* and *C. peltata,* while the control site had luxuriant growth of seagrasses *Thalassia hemprichii* and *Syringodium isoetifolium* and seaweeds *Halimeda gracilis, Caulerpa racemosa, Codium tomentosum, Gracilaria edulis* and *G. corticata.*

Caulerpa racemosa was hand-picked from shallow water during lowtide at the two sites. *C. racemosa* was found growing attached to coral stones erected as dykes perpendicular to the beach. Net productivity was determined using "light and dark" bottle oxygen technique as described by Qasim *et. al.* (1972). Data on baseline parameters such as water temperature, salinity, dissolved oxygen,nutrients, turbidity and phytoplankton productivity were also collected from control and polluted sites.

Results

The variation in biological parameters including productivity of *Caulerpa racemosa* is presented in Table 1. All parameters recorded higher values at the control site. Water quality analysis (Table 2) showed major variation between sites except for water temperature, salinity and silicate. Dissolved oxygen was low at the polluted site while nutrients were high. Turbidity values were high at the village coast resulting in low phytoplankton productivity. A 1-way ANOVA with factor "site" showed significant differences ($P < 0.01$, Table 3). Regression equations for length of assimilator against wet weight of *C. racemosa* indicated high r^2 value at control site (Table 4). This indicates that *C. racemosa* at the control site has the least variable size with a correspondingly higher r^2 value.

Discussion

Previous studies on sewage discharges in reef ecosystem have indicated an increase in phytoplankton biomass, enhanced productivity by algae and reduction in water clarity (Laws and Redalje, 1979; Smith *et. al.*, 1981;Walker and Ormond, 1982). Borowitzka (1972) has shown that high concentration of domestic sewage inhibit growth of seaweeds and green algae are more susceptible than brown algae and red algae. The low primary production by phytoplankton (Table 2) and *C. racemosa* (Table 1) at the polluted sites of Minicoy clearly indicate that algae of this area are under stress from the effects of domestic sewage.

Phosphate and nitrogen levels at the polluted site is significantly higher than that of control sites (Table 2). Although experiments of Kinsey and Domm (1974) indicate that regular fertilization of the general lagoon environment may prove to be valuable, high nutrient levels in polluted site seems to have detrimental effect on *C. racemosa* (Table 1). The turbidity values recorded at the polluted site (Table 2) is greater than the maximum levels observed by Grigg (1995) at Hawaii. High concentrations of suspended solids and turbidity interfere with light penetration to the bottom and thereby limits photosynthesis. The increased turbidity might have effected the growth and biomass of *C. racemosa* since higher variability is noticed at the polluted site than the control site. Changes in environmental parameters such as dissolved oxygen

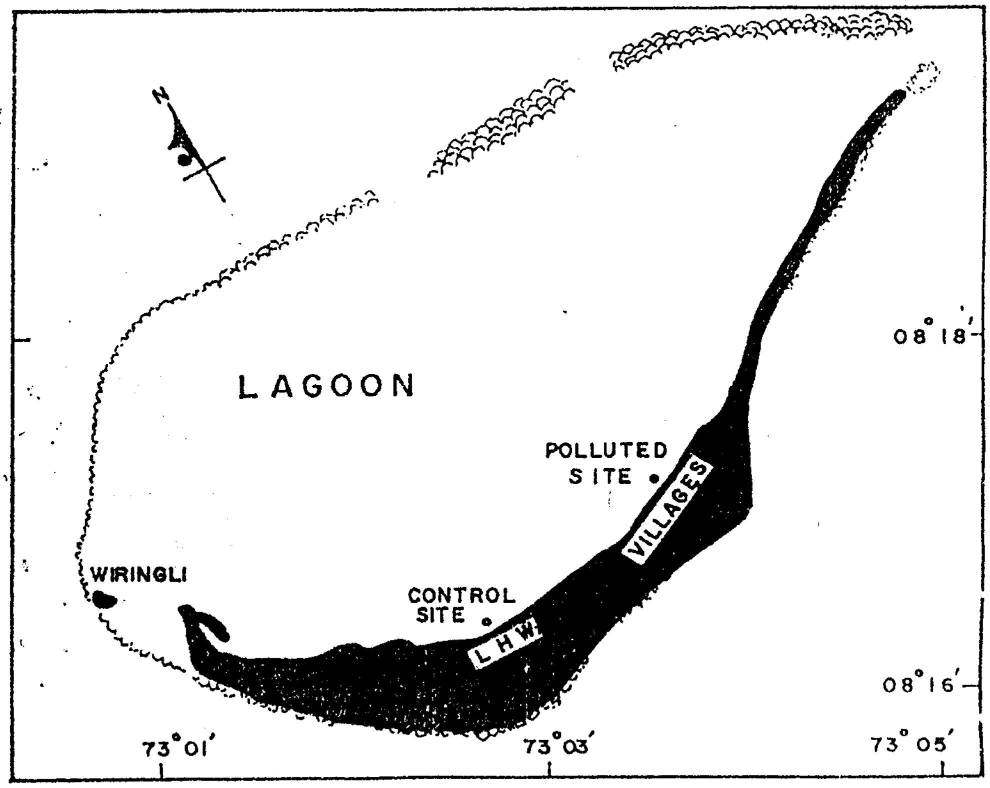

Fig. 1. *Map of Minicoy Island showing the sampling stations*

Table 1. *Length, weight and productivity values of* Caulerpa racemosa

Biological Parameters	Polluted site		Control site	
	Mean	Range	Mean	Range
Length (cm)	2.15 ± 0.57	1.4 - 3.5	6.16 ± 2.59	3.1 - 10.3
Weight (g)	0.26 ± 0.11	0.12 - 0.54	0.95 ± 0.55	0.17 - 2.14
Productivity (mgC/g/d)	0.14 ± 0.03	0.10 - 0.18	1.03 ± 0.03	0.99 - 1.07
Biomass (g/sq.m)	210 ± 17	174 - 238	800 ± 16	755 - 864

Table 2. *Water quality at polluted and control sites*

Physical Parameters	Polluted site		Control site	
	Mean	Range	Mean	Range
Temperature (°C)	30.0 ± 1.00	29.0 - 31.0	30.2 ± 0.56	29.3 - 30.5
Salinity (ppt)	34.0 ± 0.58	33.3 - 34.3	33.1 ± 0.68	32.6 - 33.9
Dissolved oxygen (ml/l)	3.65 ± 0.36	3.34 - 4.04	4.62 ± 0.79	4.14 - 5.53
Phosphate (µg at/l)	0.54 ± 0.34	0.16 - 1.12	0.23 ± 0.17	0.16 - 0.38
Nitrate (µg at/l)	0.40 ± 0.12	0.26 - 0.60	0.25 ± 0.01	0.24 - 0.26
Silicate (µg at/l)	4.19 ± 0.82	2.34 - 6.10	4.25 ± 1.14	3.00 - 5.89
Turbidity (NTU)	4.80 ± 1.15	2.50 - 6.00	2.64 ± 0.51	2.12 - 3.81
Phytoplankton productivity (mgC/cub.m/d)	7.67 ± 3.70	5.21 - 11.6	9.58 ± 3.45	5.92 - 13.[illegible]

Table 3. *One-way ANOVA between stations for different parameters (n = 30)*

Parameters	df	MSS	F	P
Dissolved Oxygen	1	20.533	81.45	< 0.01
Phosphate	1	2.266	25.09	< 0.01
Nitrate	1	0.543	76.22	< 0.01
Turbidity	1	51.764	42.67	< 0.01
Phytoplankton productivity	1	56.087	7.99	< 0.01
Seaweed productivity	1	11.762	148.08	< 0.01
Biomass	1	5364.000	179.06	< 0.01

Table 4. *Regression equations for length against wet weight of* Caulerpa racemosa. *(W=wet weight in g, L = maximum length of assimilator in cm, n = 132)*

Site	Regression equation	R^2
Polluted	W = 0.0909 L + 0.0679	0.22
Contorl	W = 0.1767 L - 0.1424	0.71

brought about by domestic pollution are also important when we consider the growth and density of most tropical reef organisms including algae.

Short-term observations like the present study are only capable of documenting impacts at a given point in time. The increase in human population and the continued use of coastal areas as dumping sites for domestic wastes in Lakshadweep, warrants that immediate, comprehensive, long-term studies be undertaken to preserve this fragile coral reef ecosystem.

Literature cited

Borowitzka, M. A. 1972. Algal species diversity and the effect of pollution. *Aust. J. Mar. Freshwater Res.*, 23 : 74-84.

Grigg, R. W. 1995. Coral reefs in an urban embayment in Hawaii : A complex case history controlled by natural and anthropogenic stress. *Coral Reefs*, 14 : 253 - 266.

Kaladharan, P and I. David Raj 1989. Primary production of seagrass *Cymodacea serrulata* and its distribution to productivity of Amini Atoll, Lakshadweep Islands. *Indian J. Mar. Sci.*, 18 : 215 - 216.

Kaladharan, P and S. Kandan 1997. Primary productivity of seaweeds in the lagoon of Minicoy Atoll of Laccadive Archipelago. *Seaweed Res. Utiln.*, 19 : 25-28.

Kinsey, D. W and A. Domm 1974. Effects of fertilization on the coral reef environment-primary production studies. *Proc. 2nd. Int. Symp. Coral Reefs*, Brisbane, 1 : 49-66.

Laws, E. A and D. G. Redalje 1979. Effect of sewage enrichment on the phytoplankton population of a subtropical estuary. *Pacif. Sci.*, 33 : 129 - 144.

Nair, P.V.R and C.S.G. Pillai 1972. Primary productivity of some coral reefs in the Indian seas. *Proc. Symp. Corals and Coral Reefs*, Mandapam Camp. pp 33 - 42.

Qasim, S. Z and P. M. A. Bhattathiri 1971. Primary production of a seagrass bed on Kavaratti Atoll (Laccadives). *Hydrobiologia*, 38 : 29 - 38.

Qasim, S. Z., P. M. A Bhattathiri and C. V. G. Reddy 1972. Primary production of an atoll in the Laccadives. *Int. Revue. ges. Hydrobiol.*, 57 : 207 - 225.

Sargent, M. C and T. S. Austin 1954. Biological economy of coral reefs. Organic productivity of an atoll. *Geol. Survey*, 260 - e : 293 - 301.

Smith, S. V., W. J. Kimmerer, E. A. Laws, R. E. Brock and T. W. Walsh 1981. Kaneohe Bay sewage diversion experiment; perspectives on ecosystem responses to nutritional perturbation. *Pacif. Sci.*, 35 : 279-302.

Wafer, M.V.M. 1977. Phytoplankton production of two atolls of the Indian Ocean. *Mahasagar*, 10 : 117 - 121.

Walker, D. I and R.F.G. Ormond 1982. Coral death from sewage and phosphate pollution at Aqaba, Red Sea. *Mar. Pollut. Bull.*, 13 : 21 - 25.