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Note

Primary productivity in Minicoy atoll (Lakshadweep) of Arabian Sea

P. KALADHARAN

Central Marine Fisheries Research Institute,
P.B. No 1603, Cochin — 682 014, India

ABSTRACT

Primary productivity in Minicoy atoll during 1990 - 1992 was estimated from five stations around the island from the diurnal curves prepared for dissolved oxygen. Areas characterised by seagrass beds recorded a maximum productivity of 3.48 g Cm^3 d and the open sea registered a minimum of 0.97g Cm^3d, with an average productivity of 2.42 g cm^3 d. Major contribution of NPP was due to seagrasses (54 %) and seaweeds (31 %). Since the results indicated heterotrophic conditions, the need to protect the highly productive seagrass beds in Minicoy atoll against human interferences is projected.

Primary productivity of an atoll largely depends on the photosynthetic rates and standing crop of macro producers such as seagrasses and seaweeds. However, information on relative contribution of each producer component on the primary productivity in an atoll system is incomplete. Such information would be relevant for the management of the resources that are facing the threat of indiscriminate destruction. Seagrass productivity in Kavaratti atoll (Qasim and Bhattathiri, 1971) and in Amini atolKKaladharan and David Raj, 1989) in the Lakshadweep group of islands were reported. Primary production of seaweeds in Minicoy atoll was studied recently by Kaladharan and Kandan (1997).

Minicoy lagoon (8° 15'N, 73° 03' E) occupies about 9.66 sq. km area with an average depth of about 2 m and a mean tidal amplitude of 1.57 m (Gardiner, 1903). Experimental stations 1-4 were situated in the lagoon within 20 to 50 m from the shore and station 5 was in the windward side of the atoll characterising the rocky tidal zone of the open sea (Fig. 1). Primary productivity of Minicoy atoll was determined by the widely used method of Odum(1956). Replicate water samples were collected from the stations (Fig. 1) at two hourly intervals for a period of 24 hours for the determination of dissolved oxygen (Gaarder and Gran, 1927). From the mean values of dissolved oxygen, diurnal changes in oxygen were computed for each station.

To determine the specific rates of net primary production (NPP) and consumption of oxygen by seagrasses,

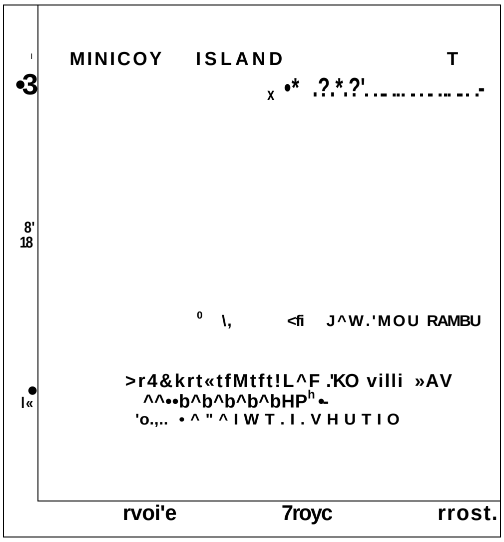

Fig. 1 Minicoy atoll showing the five sampling stations.

seaweeds, phytoplankton and sediment, a series of incubations were conducted with representative samples (10 g seaweeds/1; 10 g *Thalassia hemprichii* Aschers (Hydrocharitaceae) and 10 g sediments from a 5 x 5 cm core of sediments by a PVC corer made locally) and were incubated *in situ* in light and dark bottles (one 1) with filtered (0.45 n) seawater for 3 hours. The oxygen values were converted to carbon equivalents using the formula, 0.536/PQ, where PQ = 1.25 .(Strickland, 1960).

During the observation period (July 1990 - March 1992) the dissolved oxygen levels were below 1 ml/1 during night as well as in the early morning and above 7 ml/1 during the peak sunshine hours in all the stations except stn.-5, representing the open sea where the dissolved oxygen ranged from 2-5 ml/1. Perusal of data on production and consumption of oxygen (Table 1) showed that production (P) was lower than consumption (R) in all the stations and throughout the observation period except at stn.-3. Primary productivity (P) and respiration (R) rates calculated from the diurnal oxygen values showed the highest in the lagoon particularly between stations 2 and 3, which were characterised by *Thalassia* beds. The lagoon (stns. - 1 to 4) accounted for an average productivity of 2.782 g $Cm^{!}$ d, whereas the open sea productivity (stn.-5) was 65 % lesser than that of the lagoon (Table 1). The average productivity of all the five stations located around the atoll indicated 2.42 g Cm^{1} d and consumption of 2.50 g Cm^{3} d. Except at stn.-3, all the other four stations registered compensation point (P/R) one or below one indicating the heterotrophic nature of the atoll. *Thalassia* plants registered the maximum production of 9.133 g Cm^{3} d or 0.913 g C kg (f.w)'d. The NPP by phytoplankton was the least among the producer components. Rate of consumption (R) for a period of 24 hours was the maximum in sediment and was the lowest in *Thalassia* registering a P/R of 1.97 (Table 2).

The measured rate of primary productivity in Minicoy atoll was comparable to those obtained by Qasim and Bhattathiri (1971) and Kaladharan and David Raj, (1989) in Kavaratti and Amini atolls respectively. However, it is known from the extensive study over a period of several years on the turtlegrass communities that the rate of production differs not only seasonally but there are marked differences from one year to the other (Odum, 1963). Other explanations offered for the fluctuation noticed in productivity as shown in Table - 1 are (i) grazing on benthic flora by herbivores, especially fishes as reported by Randal (1965) and Chennubhotla *et al.* (1994) and (ii) the human interferences in Minicoy atoll as

TAULE 1. *Oxygen production (P) and consumption (R) values (0,ml/l) computed from the mean values of diurnal curves for dissolved oxygen for a period of 24 hours*

Date		Stn. 1	Stn. 2	Stn. 3	Stn. 4	Stn. 5
20/21 Jul. '90			7.51	6.71		2.40
	R	-	7.30	5.93		2.40
15/16 Sep. '90	P	3.72	7.11			2.11
	R	4.17	9.71			2.04
13/14 Mar. '91	P	5.43	7.64		5.77	
	R	6.52	8.70	-	5.81	-
6/7 Oct. '91	P	4.22	-	9.84	6.64	-
	R	5.07	-	7.92	6.81	-
3/4 Mar. '92	P	~	-	7.83	5.46	2.29
	R		-	7.42	5.33	2.35
Mean (0_2ml/l)	P	4.46	7.42	8.12	5.96	2.27
	R	5.25	8.57	7.09	5.98	2.26
Primary productivity (mg $C.m^3.d$)						
	P	1.91	3.18	3.48	2.56	0.97
	R	2.25	3.67	3.04	2.56	0.97
	P/R	0.85	0.87	1.14	1.0	1.0

Mean primary productivity for the entire atoll: P = 2.42 gCm^3d, R = 2.50 gCm^3d, P/R = 0.97

Mean primary productivity for the lagoon only (Stns 1-4): P = 2.78 gCm^3d, R = 2.88 gCm^3d, P/R = 0.97

observed by Pillai (1986).

In the windward side (stn.5) the values of productivity obtained were parallel to the earlier observations (Prasad and Nair, 1964). Productivity in stn. 3 was found to be the highest among other stations in Minicoy lagoon (Table - 1) because of the shallow depth and the dense beds of *T. hemprichii* found growing there. Consumption rates exceeding the production rates in the lagoon may be due to the respiratory demand by seagrasses, benthic seaweeds and the associated fauna such as sea cucmbers, sea urchins, sponges etc., besides fish and shell fishes.

TABLE 2. *NPP (P) and consumption (R) of various producer components of Minicoy lagoon*

Component producers	NPP (P) (gCm^3d)	Consumption (R) (gCm^3d)	P/R	Relative share of	
				P (%)	R (%)
Phytoplankton	0.978	0.931	1.05	5.72	6.89
Sediment	1.656	2.677	0.62	9.69	19.85
Seaweed	5.316	5.264	1.00	31.12	39.04
Seagrass	9.133	4.613	1.97	54.46	34.21

Among the producers studied, the NPP rate of *Thalassia* alone was observed to be self supporting since the production exceeded consumption (P/R = 1.97) and the result was concomitant with that of Qasim and Bhattathiri (1971). NPP due to phytoplankton was within the ranges reported from Minicoy earlier (Prasad and Nair, 1964) and the contributions by seaweeds, sediment and phytoplankton to the lagoon productivity were limited. Primary productivity of seagrass beds (Table 2, stn. 2-3) and the NPP of seagrass obtained from light and dark bottle incubations were sufficient to confirm the higher production rates that can sustain the respiratory oxygen requirement in the lagoon.

The reason for the observed change of Minicoy atoll from autotrophic (Nair and Pillai, 1972) to heterotrophic may be attributed to the changes in the pattern of distribution, composition as well as decrease in the benthic macroproducers. Perusal of earlier reports (Untawale and Jagtap, 1984; Kaladharan *et al.*, 1998) indicates that the pattern of seagrass vegetation has changed since 1984 in Minicoy atoll. The degree of destruction caused to the flora and the fauna of of Minicoy atoll has been extensively dealt by Pillai (1986). Hence it is essential that seagrass beds along the intertidal zone of Minicoy Island should be protected from the destructions caused by man and nature.

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