ECOLOGY AND PRODUCTION IN TWO SANDY BEACHES OF GOA

PART (A)

DISTRIBUTION OF BACTERIA IN COLVA AND SIRIDAON IN RELATION TO CERTAIN ENVIRONMENTAL PARAMETERS

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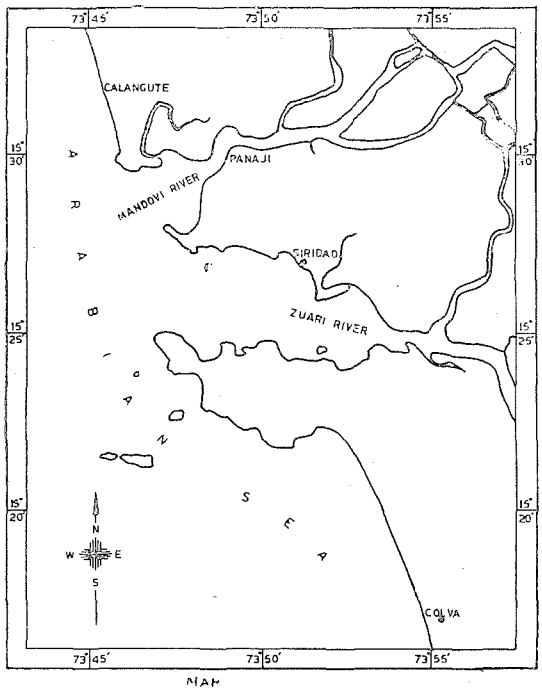
Qualitative and quantitative studies on the bacterial flora of two beaches viz , Colva and Siridaon at high tide, mid-tide and low tide levels during the pre-monsoon period were made. Estimations of important nutrients, like inorganic phosphates and nitrates and organic carbon have been made and correlation with the bacterial counts is being attempted. Definite correlation between bacterial population and organic carbon is seen; however, no correlation is observed between bacterial counts and other physico-chemical parameters.

INTRODUCTION

The heterotrophic bacteria occuring in the marine environment in India have been studied by Velankar, (1950, 1955 & 1957), Venkataraman and Sreenivasan, (1954a, 1954b& 1956), Santhakumari, (1696) and Gore, (1971 & 1972). However information on the distribution of bacteria in sandy beaches of Indian coast is quite insignificant. Gore (1971) made some observations on the bacterial flora of the Cochin beach, Ayyakkannu and Chandramohan (1970) isolated and reported certain strains, capable of secreting antibiotics, and also studied the distribution of phosphobacteria in the interstitial water at Porto Novo.

With a view to understand the relationship between bacteria and nutrients in a sandy beach ecosystem, studies on the bacterial population at different tidal levels viz, HT, MT and LT were undertaken. The present investigation deals with the distribution of bacteria at surface and at water table levels (WTL) in relation to physico-chemical parameters in two sandy beaches, of Colva (an open sandy beach) and Siridaon (an estuarine beach), respectively. (see map). The paper includes data on the total aerobic bacterial counts, salinity, dissolved oxygen, temperature, inorganic phosphate, nitrate, total organic carbon at HT, MT and LT for a period of five months, covering the February-June 1972 period. This is the first part of the project "Ecology and



Map showing location of beaches studied

production in two sandy beaches of Goa"

MATERIAL AND METHODS

Fortnightly sampling of sand from two beaches viz, Colva and Siridaon, both from surface and from water table level at HT, MT and LT was done. Sand samples were collected in sterile glass containers and transported to the laboratory within shortest possible period. Surface sand, interstitial water and sand from the water table level were also collected for total organic carbon, nutrients and dissolved oxygen and salinity. Temperature of surface sand and water was recorded in teh field. Serial dilutions using filtered, antoclaved 'aged' sea water were made. Enumeration of total viable aerobic counts of bacteria was made after 72 hours incubation, at room temperature. Sea water agar medium was employed for plating, bacteria are expressed in nos./gm of sand (wet basis). Standard methods (Kartiayani and Madhava Iyer, 1967) were employed for studying the bio-chemical reactions of the isolates. Incidence of 'coliforms' was tested by MPN methods (Barnes 1959), Strikland and Parson (1968) were employed to determine organic carbon, inorganic phosphates and nitrates.

RESULTS AND DISCUSSIONS

Bacterial population (Quantitative):

Fig. 1 shows the bacterial counts at different tide levels for both the beaches. Peaks in the bacterial counts were noticed in the month of May in both the beaches at high tide level. The lower counts at the surface may be due to the washing of the sand by wave action. Again, lower counts at the LT mark are probably due to the continuous wave action at this level. The higher bacterial count in Colva beach than in Siridaon beach, is possibly due to the texture of sand which is finer in Colva than in Siridaon and due to greater fishing activity.

Bacterial population (Qualitative):

Table 1 shows the physiological groups of bacteria and their numerical abundance at different tide levels in Colva and Siridaon. The physiological groups of bacteria found were nitrate reducers, denitrifiers and sulphate reducers. Coliforms (Enterobacteriaceae) were also present in February, March, April and May. Two strains of sulphate reducers were isolated from Siridaon beach in the month of June. Nitrate reducers were present in all the months.

Organic Carbon:

Fig. 2 shows the distribution of organic carbon (mg/100g.) at surface and WTL at HT, MT & LT levels in Colva and Siridaon beaches. The values of organic carbon fluctuated considerably in different months in relation to tidal levels. In general the values of organic carbon were higher at WTL than the values at

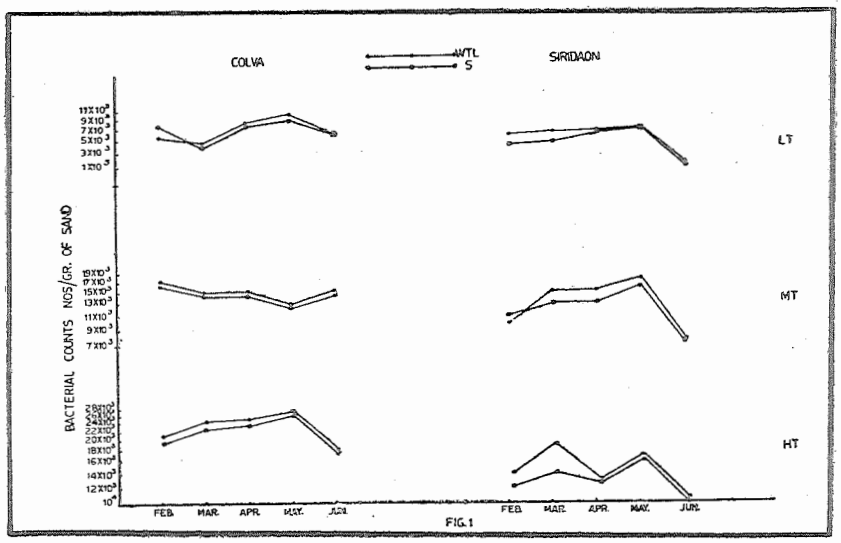


Fig. 1 Bacterial counts nos/g of sand

TABLE I. PHYSIOLOGICAL GROUPS OF BACTERIA AND THEIR NUMERICAL ABUNDANCE PER GRAM OF SAND (WET BASIS) (SAND FROM WTL).

	COLVA			SIRIDAON			
Month	HT	MT	LT	HT	MT	LT	
February	10-20	4-10	—	—	2	—	Nitrate reducers.
	2	—	—	—	1	—	Denitrifiers.
	—	—	—	10-15	—	—	Enterobacteriaceae.
March	90—100	20-50	5-10	60-70	40-50	2-5	Nitrate reducers.
	20-30	—	—	2	—	—	Denitrifiers.
	10	—	—	20	—	—	Enterobacteriaceae.
April	150-200	40-50	10-20	90-100	40-50	10-15	Nitrate reducers.
	40-50	10	—	—	—	—	Denitrifiers.
	5	—	—	50	10	—	Enterobacteriaceae.
May	30	10	—	200	50	20-30	Nitrate reducers.
	—	—	—	30-40	8	—	Denitrifiers.
	—	—	—	40	25	—	Enterobacteriaceae.
June	20-30	5-10	—	50-60	20-25	—	Nitrate reducers.
	—	—	—	—	2	—	Sulphate reducers.

surface in both the beaches. Also, the values were higher at higy-tide level than at mid-tide and low-tide levels. The lower values at LT level and at surface at HT, MT & LT levels may be due to the effect of continuous wave action. Considering the two beaches, Colva recorded higher values than Siridaon, corresponding to the higher bacterial counts. Peaks of organic carbon values were recorded in the month of May at Colva and Siridaon; in Colva at HT level and in Siridaon at MT level.

Inorganic phosphates:

The Table 2 shows the values of inorganic phosphates of the interstitial

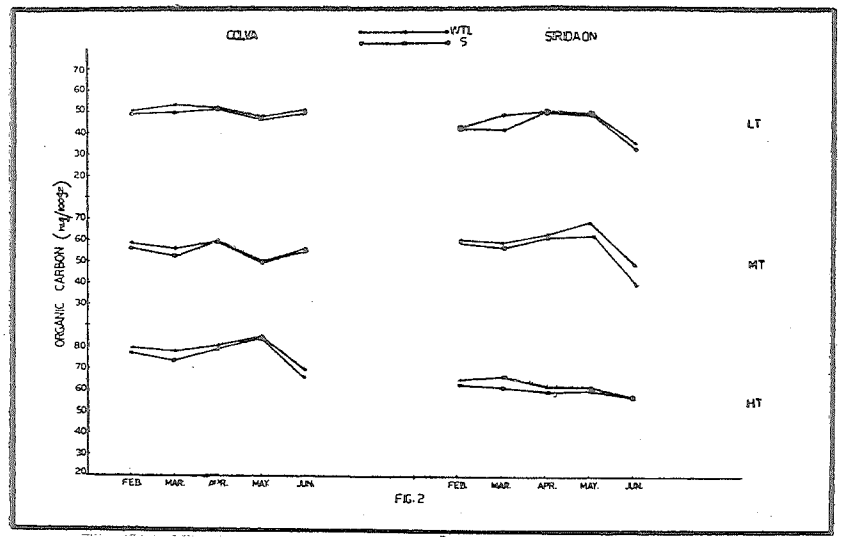


Fig. 2 Organic carbon % (mg/100g)

TABLE II

Inorganic phosphates μg at p/litre

Month	COLVA			SIRIDAON		
	HT	MT	LT	HT	MT	LT
February	2.01	1.92	1.60	1.02	0.76	0.57
March	1.03	1.06	0.48	0.72	1.04	0 92
April	0.83	0.84	0.62	0.83	0.79	0.65
May	0.81	0.91	0.40	0.69	0.68	0.68
June	0 90	0.99	1.02	0.88	0.80	0.63

waters at HT, MT & LT levels in Colva and Siridaon for different months. The concentration of inorganic phosphates of the interstitial waters in both the beaches recorded monthly fluctuations. A significant drop in the phosphate concentration in Colva from February to May and a progressive higher bacterial counts' may be partially exblained as due to active utilization of phosphates bacterias The highest values of inorganic phophate. were recorded at HT level in Colva in February and in Siridaon during March.

Nitrates:

'Nitrate values showed minor fluctations from month to month at all tide

TABLE III

Inorganic nitrates μg at N/litre

Month	COLVA			SIRIDAON		
	HT	MT	LT	HT	MT	LT
February	0.96	0.68	0.82	0.80	0.92	0.86
March	0.65	1.90	1.13	1.36	2.45	2 46
April	0.74	0.63	0.97	1.43	0.83	0.93
May	0.80	1.21	0.58	0.92	0.96	0.86
June	1.10	0.92	1.23	0 92	0.93	0.97

TABLE IV

Month	COLVA HT	COLVA MT	COLVA LT	SIRIDAON HT	SIRIDAON MT	SIRIDAON LT
	Salinity ‰					
February	31.08	31 88	32.90	32.80	32.80	32.10
March	34.27	34.10	34.23	32.99	32 80	32.67
April	33.42	33 60	33.18	34.20	34.10	33.98
May	34.40	34.20	34.27	34.20	34.30	34 23
June	32.00	32.10	30.68	31.60	31.10	31.12
	Dissolved Oxygen, ml/litre.					
February	4.11	4.00	4.12	4.20	4.10	3.92
March	4.20	4.10	3.60	3.16	3.26	3.14
April	3.40	3.30	3.40	320	3 40	3.12
May	4.10	4.12	4.00	3.20	3.40	3.12
June	3.68	3.90	4.20	3.50	3.60	3.20
	Temperature °c of water.					
February	31.0°c	31.2°c	31.0°c	30.9°c	30.6°c	30.8°c
March	30.6°c	30.8°c	30 6°c	31.2°c	31.3°c	31.0°c
April	29.9°c	29.8°c	29.8°c	30.2°c	30.4°c	30.1°c
May	30.8°c	30.6°c	30 8°c	29.9°c	29.6°c	29.6°c
June	31.6°c	31.2°c	31.2°c	30 6°c	30.9°c	30.9°c

levels in both the beaches. This may be due to the higher bacterial counts, particularly nitrate reducers, in these months (see table 3).

The values of salinity, dissolved oxygen, temperature and the extent of water table level at different tide levels in the two beaches is given in table 4, from which it can be seen that although there appear to be minor fluctuations, yet there was no definite correlation with the bacterial population.

CONCLUSION

The present observations clearly indicate high degree of variation in bacterial population in relation to nutrients and organic carbon in the two different environments as well as at different tidal levels within the same environment. The variation in the nutrient salts (phosphates, nitrates) are consistent with the fluctuations in the bacterial population. The bacterial counts also appears to be a function of human activities like fishing and curing. These observations may have an important bearing on the relative productivity of these sandy beaches. Similar studies could be extended to understand the overall productivity of the other important beaches along the coast.

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Abbreviations used:

WTL	Water Table Level
HT	High Tide
LT	Low Tide