Biological Forum — An International Journal, **3**(1): 78-81(2011) **ISSN : 0975-1130**

Plankton Community of the Hypersaline Salterns of Goa, India

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(Received 8 June, 2011 Accepted 15 June, 2011)

ABSTRACT : The plankton community of four hypersaline salters in Goa was studied in relation to prevailing environmental conditions and water quality. The average salinity was in the range of 45.6 to 65.1 psu while the water temperature ranged between 30.5 and 34.6°C. The values of dissolved oxygen were low and suggested stressed condition. The nutrients levels were also very high in the salterns. Among the phytoplankton, the Dunaliella salina was more in the hypersaline ponds while filamentous algae such as Oscillatoria, Pleurosigma and Nitzschia were common in all ponds. Among microzooplankton, the Fabrea salina comprised the major component while the Artemia, Brachionus and Tintinids were recorded in low numbers particularly in hyper saline zone. The microplankton community showed clear seasonal variation in occurrence. The overall species richness was low in the salt pans.

Keyword : Microplankton, Salterns, Goa coast.

INTRODUCTION

The solar pans are man made seasonal ponds constructed mainly for the production of raw salt along sides of creeks and other low lying coastal areas. These ponds offer an experimental system with an extreme environmental conditions and strong gradient in biodiversity of primary and secondary producers. It is among the most simplified ecosystem for the simple reason that the number of species at any trophic level is low (Williams, 1991). While some biological studies of salt pan is carried out else where (Rahman, 2006), there is very little information available on the plankton community of the west coast of India (Ramamoorthy and Thangaraj, 1980; Mustafa *et al.*, 1999). In the present communication we have attempted to present the result of a palnktological study of four simple salt pans of Goa, central west coast of India.

STUDY AREA

Goa lies between the co-ordinates 14º 53'57" to 15º 47'59"N and 73º 40'54" to 74º 20'11" E. The salt pans investigated fall within this zone. The salt pans are traditional type and comprised of reservoirs, condensers and crystallizers. The present salt pans are part of mangroves reclaimed areas used for salt production and agriculture. Most of these salt pans are surrounded by bundh and khazan fields. The ground levels of salt pans are kept below the low tide level for free flow of salt water through gravity. The feed water received through canal is kept in the reservoir from where it is supplied to the crystallizer pan through condenser. The production of salt takes place during summer season (Feb-May). And the pon.

MATERIAL AND METHOD

For the present study four salt work areas namely; Ribander, Siridao, Curca and St Cruz were selected in the Salcete Taluka of Goa. On each site, one station preferably in buffer zone of the feeding canal was selected for the collection and observation. Monthly samples of waster and plankton were collected during January 2002 to December 2002. The water temperature and pH was measured at the site while other parameters such as nitrite, nitrate, phosphate, and alkalinity were analyzed by following the methods given in APHA (1985). On each sampling date one liter water was collected from each station for phytoplankton and 2 liters water was used for the collection of microzooplankton followed by fixing the sample in Lugol's solution and brought to the laboratory for further analysis. All samples were then concentrated to 100 ml and supernatant solution decanted. The aliquots of phyto- and microzoo-plankton were taken for counting and identification under a binocular stero-type microscope.

RESULT

The physico-chemical parameters play key role in structuring the biological community of salterns (Davis, 2000). The values of physico-chemical parameters are given in Table 1. The annual water temperature varies considerable due to the shallowness of the salt pans. The minimum and maximum temperature was 28.5°C at Siridao to 42°C at Ribander. The salinity fluctuated widely at each station. It went up high due to excessive evaporation in the summer period and dropped sharply during the monsoon season. The annual average values were in the range of 45.6 to 65.1 psu. The lowest salinity recorded was 2.0 psu in monsoon. The DO was often showed at saturation in the feeding canal but the values decreased significantly thus giving an impression of stressed environment in the zones of higher salinity. The annual average total alkalinity fluctuated between 73.6 and 91.9 mg/l while the pH values were in the range of 7.3 and 7.9. The nutrient concentration also showed a wide fluctuation in the salt pans with values ranging between 0.1-29.6 µg-at/l for phosphate, 0.4-50.4 µg-at/l for nitrate and 0.1-21.1 µg-at/l for nitrite. The annual average value of ammonia was in the range of 2.3 and 4.6 µg-at/l.

Table 1: The environmental characteristics of the four stations located in the saltpans of Goa. Values are annual range and mean (in parenthesis).

Variables	*Station 1*	*Station 2*	*Station 3*	*Station 4*
Temperature 0C	30-42 (34.6)	28.5-41 (30.5)	29.5-38 (32.4)	30-38 (33.5)
Salinity (PSU)	2.0-109 (45.6)	13.5-130 (55.8)	17-105 (57.2)	16-100 (65.1)
pH	7.2-8.5 (7.9)	7-8.1 (7.8)	7.2-7.6 (7.30)	7.1-7.5 (7.3)
Total alkalinity mg/l	50-106 (73.6)	48-190 (91.9)	65-210 (87.5)	66-220 (89.16)
D.O. mg/l	2.5-5.5 (3.9)	3.0-5.3 (3.2)	2.4-7.6 (3.7)	2.7-6.7 (3.9)
PO4-P µg-at/l	1.4-29.6 (14.37)	1.2-15.1 (7.64)	0.2-10.5 (4.13)	0.2-17.7 (8.02)
NO3-N µg-at/l	1.8-50.4 (27.55)	0.6-11.8 (6.53)	1.3-2-40.2 (21.89)	0.4-22.1 (10.67)
NO2 -N µg-at/l	0.1-20.0 (10.74)	0.1-19.2 (9.56)	1.2-21.2 (10.98)	0.1-18.5 (9.31)
NH3N µg-at/l	0.3-16/1 (3.4)	0.2-9.4 (2.3)	0.3-18.2 (4.6)	0.2-18.4 (3.7)
Depth cm	75	60	65	56

PHYTOPLANKTON

The monthly distribution of phytoplankton species is given in Table 2. A total of 13 species were identified from the four locations. Members of Cyanophyceae, Chlorophyceae, Bacillariophyceae and dinophyceae were the dominant component of phytoplankton community in the salt pans. Station-wise distribution showed 9 species at St. 1, 8 species at St. 2, 8 species at Stations 3 and 7 species at St. 4. The distribution and species occurrence showed strong relation with salinity. These species of phytoplankton could be placed into halobiont (salinity range 115-185 ppt), halophilic (41-150 ppt) and stenohaline (less than 41 ppt). Therefore, in different season and under different salinity regime, different phytoplankton species dominated the community. Among the phytoplankton the *Dunaliella salina* was more in the hypersaline ponds while filamentous algae such as *Oscillatoria, Pleurosigma* and *Nitzschia* were common in all ponds *Dunalliela saline* was the only species consistently recorded from all stations in high number. Other groups occurred sporadically and not in great number. The over phytoplankton species richness was poor in the salt pans.

MICROZOOPLANKTON

The abundance of microzooplankton of the four salt pans is given in Table 3. The assemblage was dominated by ciliates, *Fabrea salina, Brachionus, Tintinids, Indomysis* sp. and *Artemia* sp. They together accounted for more than 90%. The annual numerical count was in the range of 0-458/l at station I, 0-407/l at station II, 0-240/l at station III and 0-277/l at station IV. The density was highest during pre-monsoon (April-May) and lowest in monsoon season July-August). Active and free swimming stages of *F. salina* were seen in all the four ponds between December and May. However, they were absent during the monsoon period. The diversity of microzooplankton was poor in all the ponds.

DISCUSSION

The coastal ecosystems are better understood now but little attention has been paid to the salterns. The hydrology play determinant role in the development of biological community of salterns (Davis, 2000). The evaporating water, high salinity, low oxygen and neutral pH are the characteristic features of the salt pans which were also observed in the present study (Gunde Cimerman *et al.*, 2000). The range of variability in salinity and temperature was highly significant.

The microplankton assemblage was dominated by diatoms and dinoflagellates which accounted for about 90% of the total abundance. However, the diversity and species richness remained poor in the salt pans. Poor diversity and species richness of plankton have also been reported by others from the salt pans (Rehman, 2006). The result of this study demonstrated that salt pans represent discrete ecosystem among the saline zones with unique life restricted to these system only. Despite the heavy constraints imposed by salinity it is evident that temperature plays a regulatory factor in the development of plankton community in these systems (Ayadi *et al.*, 2004). Similarly other studies suggested general decreasing trend in species richness of microautotrophic plankton community along the salinity gradient in salterns (Estrada *et al.*, 2004).

The distribution of microzooplankton suggested poor community assemblage which may be attributed to the extreme high and low environmental conditions. Frontier (1985) has suggested that extreme environmental conditions in the salt pans could be expected to be less diverse. Similarly Mustafa *et al.*, (1999) reported that the salt pans ecosystem permits the growth and survival only selectively adapted organisms which can withstand the extreme variations in environmental parameters. The salterns give impression of high biomass system due to the high biomass of *Donalliela salina*. It has been reported that *D. salina* is an important factor controlling the abundance of *F. salina* in the ponds (Ratan and Ansari, 1982). This supports our observation of high *F. salina* along with high *D. salina* in the ponds. The productivity of these ponds can be utilized for the production of fish and prawns during other season when the ponds are not used for salt production.

ACKNOWLEDGEMENTS

The authors are thankful to the Management, Dhempe College of Arts and Science for providing facilities. Financial assistance provided by UGC is also duly acknowledged.

Table 2: Distribution of phytoplankton at the four salt pans of Goa.

Taxa	***J***	***F***	***M***	***A***	***M***	***J***	***J***	***A***	***S***	***O***	***N***	***D***	
Species						Station 1							
Oscillatoria salina	-	+	+	+	+	+	-	-	-	-	+	+	
Anacystisdimidiatus	+	+	-	-	+	-	+	+	-	+	-	+	
Dunaliella salina	+	+	+	-	+	+	-	-	+	+	+	+	
Chaetoceros sp.		+	-	-	-	-	+	+	+	-	+	-	+
Spirulina platensis	-	-	-	-	-	+	+	+	-	+	-	-	
Amphora sp.		-	-	+	-	-	+	+	+	+	-	+	+
Coscinodiscus sp.	+	-	-	-	-	+	+	+	+	-	-	-	
Navicula sp.		-	+	-	-	+	-	-	+	+	-	-	+
Pleurosigma sp		+	-	-	-	+	+	-	+	+	+	+	-
						Station 2							
Dunaliella salina	+	+	+	+	+	+	-	-	+	+	+	+	
Coccochloris sp.	-	-	+	-	+	-	+	-	-	-	+	+	
Glococapsa sp.		-	+	+	-	-	+	-	-	-	+	-	+
Oscillatoria sp.		-	-	-	+	+	+	+	-	-	-	+	-
Pleurosigma sp..	+	-	-	-	-	-	+	+	+	+	+	-	
Coscinodiscus sp.	+	-	-	-	-	+	+	+	+	-	-	+	
Surirella sp.		-	+	-	+	+	+	-	-	-	-	+	+
Chaetocerosa sp.	+	+	-	-	-	-	+	+	+	+	-	+	
						Station 3							
Anacystis dimidiatus	-	-	+	+	+	-	-	-	-	-	+	+	
Oscillatoria salina	+	+	+	+	+	-	-	-	-	+	-	-	
Dunaliella salina	-	-	+	+	+	+	-	-	-	-	+	-	
Navicula sp.		+	+	-	-	-	-	+	-	+	+	-	+
Amphora sp.		-	-	+	-	-	+	+	-	+	-	+	-
Coscinodiscus sp.	-	+	-	-	-	+	+	+	+	+	+	-	
Chaetoceros sp.		-	-	-	-	-	+	+	+	-	+	+	+
Bidulphia sp.		+	-	-	-	-	-	+	=	+	=	-	-
						Station 4							
Coccochloris sp.	-	-	+	+	+	+	-	-	-	+	-	+	
Anacystis dimidiatus	+	-	-	+	+	-	-	-	-	+	+	-	
Dunaliella salima	+	+	+	+	+	-	-	+	+	-	+	+	
Spirulina platensiosd	-	-	-	+	+	+	+	-	+	+	-	-	
Lyngbya sp		-	-	+	+	+	+	-	-	-	-	-	+
Synura SP		+	-	-	-	+	+	-	-	-	-	+	+
Bidulphia sp.		+	+	-	-	-	-	+	+	+	-	-	-

+ present, - absent

Table 3: Distribution and abundance of micro zooplankton at the four salt pans of Goa, values are average no. 1.

Taxa	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
						Station 1						
Fabrea salina	105	286	304	324	400	0	0	0	0	0	0	164
Brachionus sp.	16	0	8	0	0	0	0	0	0	10	0	8
Tintinids	11	4	16	0	4	0	0	0	0	0	4	0
Artemia	0	0	25	30	48	0	0	0	0	0	6	0
Indomysis sp.	12	6	10	22	6	0	0	0	6	16	12	12
Total	144	296	363	376	458	0	0	0	6	26	22	184
						Station 2						
Fabrea salina	262	180	112	212	362	0	0	0	0	0	0	145
Brachionus sp.	0	4	12	12	0	0	0	0	10	4	0	0
Tintinids	12	0	0	0	10	0	0	0	0	0	0	0
Artemia	0	15	43	80	23	6	0	0	0	10	0	20
Indomysis sp.	0	6	6	0	12	6	0	0	0	6	0	12
Total	274	205	173	304	407	12	0	0	10	20	0	177
						Station 3						
Fabrea salina	122	104	108	112	216	0	0	0	0	0	0	0
Brachionus sp.	4	4	0	0	8	0	0	0	6	0	4	0
Tintinids	0	0	6	0	4	0	0	0	0	4	0	0
Artemia	0	14	0	20	0	0	0	0	0	0	0	10
Indomysis sp.	0	12	6	24	12	6	0	0	0	0	6	6
Total	126	134	120	156	240	6	0	0	6	4	190	16
						Station 4						
Fabrea salina	0	162	108	241	245	60	0	0	0	0	0	0
Brachionus sp.	12	0	8	0	0	0	0	0	10	4	0	4
Tintinids	4	0	0	0	0	0	0	0	8	0	6	0
Artemia	4	0	16	22	20	10	0	0	0	0	0	0
Foraminifera	0	0	0	0	0	0	0	0	4	0	0	12
Indomysis sp.	6	0	0	0	12	6	0	0	0	6	6	0
Total	26	162	132	263	277	76	0	0	22	10	12	16

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