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Seasonal Variation of Bivalves of Intertidal Mangrove Area of Shirgaon, Ratnagiri, Maharashtra

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

A study has been made during February 2012 to January 2013 to know the pattern of bivalve fauna in the mangrove area of Shirgaon. During the present study, nine of bivalve, viz. *Anadora granosa*, *Brachiodontes striatulus*, *Dosinia* sp., *Meretrix meretrix*, *Saccostrea cucullata*, *Lucina* sp., *Tellina palatam*, *Trapezium sublivigatum* and *Polymesoda expansa* were recorded. The bivalves, *Brachiodontes striatulus* and *Saccostrea cucullata* were recorded throughout the year. The species such as, *Lucina* sp., *Dosinia* sp., *P. expansa* and *T. sublivigatum* have shown inconsistency occurrence during the study period while *M. meretrix*, *A. granosa* and *T. palatam* were recorded only once during September, June and May respectively.

Keywords: Mangrove; bivalve; diversity; transect; quadrat.

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1. INTRODUCTION

Mangroves are a diverse group of unrelated trees, palms, shrubs, vines and ferns that share a common ability to live in waterlogged saline soils subjected to regular flooding. They are highly specialized plants that have developed unusual adaptations to the unique environmental conditions in which they are found. Mangroves preserve water quality and reduce pollution by filtering suspended material and assimilating dissolved nutrients [1]. Mangrove roots and lower parts of trunks provide substrate for oysters and mussels. Edible species of oysters, mussels and cockles are collected extensively for local consumption. The blood clam, *Anadara granosa* and other cockles can be found in large numbers in mudflats on mangrove strands, where it lies partially buried in the sediment [2]. Besides, they are utilized for ornamental trade, pharmacological products and in the manufacture of lime and cement. Most of the coastal communities of Ratnagiri depend on

Shirgaon mangroves for their livelihood but the qualitative and quantitative information on the bivalve abundance of the mangrove area of Shirgaon is scanty. The present study was carried out in order to report a brief account on the seasonal variations of the intertidal bivalves inhabiting intertidal mangrove area of Shirgaon, Ratnagiri, Maharashtra.

2. MATERIALS AND METHODS

Shirgaon mangrove area (Lat. 17°01'50.29"N, Long.73°17'03.09" E) is of nearly about two kilometer stretch and is located along Shirgaon estuary at the western side of Ratnagiri (Fig. 1.)

All samples were collected during the lowest low tide of each month when maximum intertidal exposure prevailed. Sampling was carried out by using stratified random sampling method and the month-wise and season-wise variation in environmental parameters and abundance of bivalve of the mangrove area exposed to

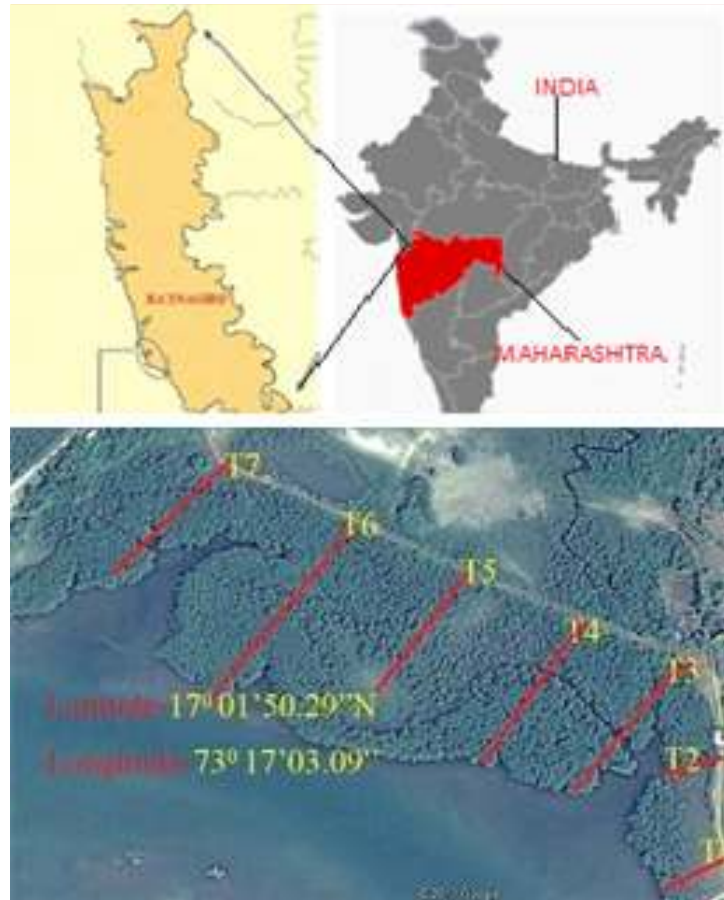


Fig. 1. Sampling location of Shirgaon mangrove area, Ratnagiri

Inter-tidal zone was recorded as: pre-monsoon (February - May), monsoon (June - September) and post-monsoon (October - January). Parameters like atmospheric temperature, water temperature, sediment temperature, dissolved oxygen, water salinity, water pH, sediment pH and organic carbon were recorded. Monthly *in-situ* sampling was carried out by fixing transects from lowest low tide to highest high tide mark perpendicular to the shoreline. Total of seven transect lines were fixed for the sampling so as to cover whole area of intertidal region of the exposed mangrove area. In each transect, three quadrates with 0.0625 m² area were selected with a distance of seven meters between two successive quadrates [3]. Quadrates were placed on transect lines and sediment samples up to a depth of 0.1 m were collected in the sampling bags. Then the bags along with the samples were transferred to the laboratory for further analysis. After sieving the sediment samples through 1mm size sieve, the bivalve samples (> 1mm) were preserved in five per-cent formalin solution for further identification. Correlation coefficient was calculated by the statistical analysis for the parameters which was carried out using SPSS software 16.0 version. Bivalves were identified as per George and George (1979), Coleman (1991), Subbarao (2003) and Dey (2006).

3. RESULTS AND DISCUSSION

Season wise variation in environmental parameters: during pre-monsoon (February-May), monsoon (June-September) and post-monsoon (October-January) was recorded. The maximum (30.13°C) atmospheric temperature was recorded during pre-monsoon season and minimum (27.00°C) during monsoon period. The maximum water temperature was recorded in March (30°C) and minimum in July (24°C). During the pre-monsoon period maximum (29.25 °C) sediment temperature was found while minimum (26.75°C) during the monsoon period. The maximum values of dissolved oxygen was recorded during the monsoon (4.3 mgl⁻¹) and minimum (3.2 mgl⁻¹) during the pre-monsoon period respectively. The maximum and minimum salinity values of water were recorded during the pre-monsoon (33.38 psu) and the monsoon (29.25 psu) seasons respectively. The intertidal water pH was recorded maximum during the post-monsoon (7.95) period and minimum in the monsoon period (7.45) respectively. During the pre-monsoon period, pH of water ranged between 7.5 and 8.3 whereas in the monsoon

period, it ranged between 6.8 and 8.1. While studying the ecology of Shirgaon mangroves it was observed that the maximum organic carbon in November (2.52%) and the minimum in August (1.47%).

3.1 Occurrence and Abundance of Bivalve

During investigation period, the maximum abundance of *S. cucculata* was recorded during November (127 ind.m⁻²) while it was minimum during the January (76 ind.m⁻²). Along the gulf of Kachchh, the *S. cucculata* as most dominant species throughout the year [4]. Abundance of *S. cucculata* was reported maximum and found in the large beds along the Pondicherry mangroves [5]. The next bivalve species in the order abundance was *B. striatulus*. The maximum density of *B. striatulus* was recorded in November (37 ind.m⁻²) while it was found to be minimum during January (10 ind.m⁻²). The *B. striatulus* found to be attached with rocky substratum like oyster, stone etc. The same type of distribution pattern was recorded along the Alawa coast of Ratnagiri, with the maximum density in September (12 ind.m⁻²) and minimum in April and June (0 ind.m⁻²) [6]. Other genus of bivalves were also recorded which has not shown consistent occurrence throughout the study period. The bivalve, *A. granosa*, *T. sublivigatum* and *M. meretrix* were found only in the monsoon season with a maximum density of 0.1904 ind.m⁻², 1.5238 ind.m⁻² and 0.3809 ind.m⁻² respectively. The *A. granosa* occasionally distributed along Mahul creek of Mumbai [7]. Along Sundarban mangrove environment *T. sublivigatum* was recorded [8]. Bivalve, *M. meretrix* which found in less number and in low salinity site in Mandovi estuary of Goa [9]. During the study period, *Dosinia* sp. sporadically distributed throughout the season. The density of *Dosinia* sp. was maximum (1.5238 ind.m⁻²) in January and minimum (0.7619 ind.m⁻²) in February. The bivalve, *Dosinia* sp. occasionally found along Harinbari mudflats of Sundarban mangrove [10] and along Mahul creek of Mumbai [7]. The bivalve, *P. expansa* was recorded in June and January. The bivalve, *P. expansa* was recorded along Sundarban mangrove [8]. The maximum abundance of *Lucina* sp. was recorded during the pre-monsoon season (3.9999 ind.m⁻²) while it was found to be minimum during monsoon season (0.5714 ind.m⁻²). The average density of bivalve was recorded highest in pre-monsoon season (15 ind.m⁻²) and lowest in monsoon season

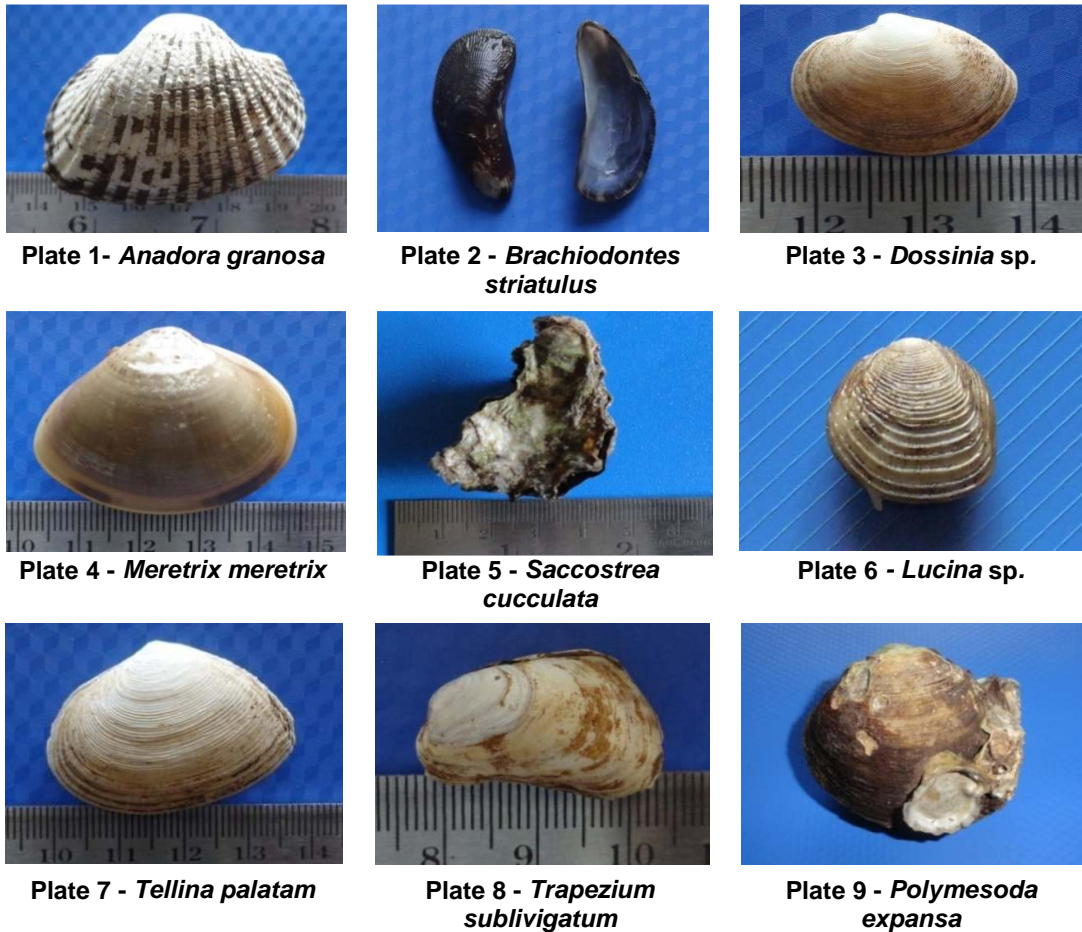


Fig. 2. Bivalve of mangrove area Shirgaon, Ratnagiri

(13 ind..m²). This is because in monsoon, due to self-dilution of the body fluid, the sensitive bivalves were unable to adjust the fluctuating osmotic balance quickly hence their mortality was high. After the monsoon season because of adjustment, the mortality rate of bivalve decreased gradually. As a result, density of bivalve increased.

3.2 Correlation with Environmental Parameters

The correlation coefficient for the selected parameters of mangrove area of Shirgaon is given in Table 1. The data showed that the atmospheric temperature was positively correlated with the water temperature ($r = 0.982$, $p < 0.01$) and sediment temperature ($r = 0.965$, $p < 0.01$). Water temperature was positively correlated with sediment temperature ($r = 0.955$, $p < 0.01$). The dissolved oxygen of water was

negatively correlated with water pH ($r = -0.737$, $p < 0.01$) and water salinity ($r = -0.657$, $p < 0.05$). The pH of water was positively correlated with pH of sediment ($r = 0.617$, $p < 0.05$) and water salinity ($r = 0.714$, $p < 0.01$).

3.3 Diversity Indices

Diversity indices were used to know the bivalve richness and species diversity of that area. The month and season wise diversity indices were shown in table 2 and 3. According to Bakus [11] the Shannon Wiener index varied from 0 (no diversity) to 5 (maximum diversity). The Simpson index varied from 0 (no diversity) to 1 (maximum diversity). The Evenness index varied from 0 (no evenness) to 1 (greatest evenness) and Dominance index varied from 0 to 1 (greatest dominance). During the present investigation, the diversity indices like Shannon Wiener index varied from minimum (0.8264) during the

Table 1. Correlation coefficient among environmental parameter and bivalve of mangrove area of Shirgaon

	Atm temp °C	Water temp °C	Sediment temp °C	DO of Water (mg l ⁻¹)	pH of water	pH of sediment	Salinity (psu)	Organic carbon (%)	Bivalves (ind..m ⁻²)
Atm temp°C	1								
Water temp°C	0.982 **	1							
Sediment temp°C	0.965 **	0.955 **	1						
DO of Water (mg l ⁻¹)	-0.392	-0.408	-0.331	1					
pH of water	0.431	0.476	0.339	-0.737 **	1				
pH of sediment	0.324	0.311	0.138	-0.270	0.617 *	1			
Salinity (psu)	0.548	0.563	0.563	-0.657 *	0.714 **	0.321	1		
Organic carbon (%)	0.156	0.182	0.112	-0.216	0.148	0.108	0.256	1	
Bivalves(ind..m ⁻²)	-0.218	-0.255	-0.264	-0.560	0.238	0.216	0.338	0.194	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

DO- Dissolved oxygen

Table 2. Month-wise biodiversity indices for the intertidal bivalve of mangrove area of Shirgaon

Indices	2012											2013
	Pre-monsoon			Monsoon				Post-monsoon				
Month	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
No of sp.	3	4	3	3	4	3	3	4	2	3	2	5
H'	0.8845	1.1050	0.7546	0.7953	0.7330	0.8949	0.7909	0.9410	0.7764	0.8663	0.6978	0.9653
S	1	0.4246	0.3017	0.3328	0.2895	0.3612	0.3179	0.3563	0.3552	0.3699	0.3074	0.3260
J'	0.5581	0.5525	0.4761	0.5018	0.3665	0.5646	0.4987	0.4705	0.7764	0.5466	0.6978	0.4157
D	0.4419	0.4475	0.5239	0.4982	0.6335	0.4354	0.5013	0.5295	0.2236	0.4534	0.3022	0.5843

H'- Shannon index, S - Simpson index, J'- Evenness index, D - Dominance index, No of sp.- Number of species

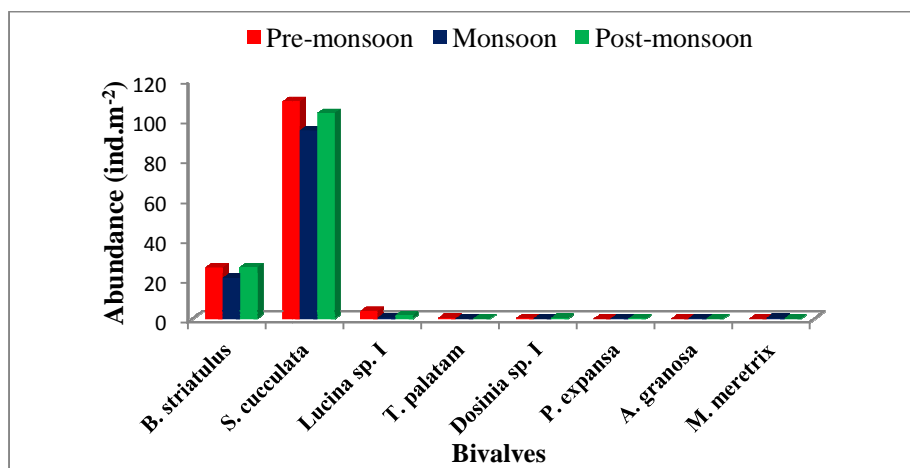


Fig. 3. Season-wise distribution (ind.m⁻²) of bivalves along mangrove area of Shirgaon

post-monsoon period and maximum (0.8848) during the pre-monsoon period. The Simpson index (S) was maximum (0.5147) during the pre-monsoon period and minimum (0.3312) during the monsoon period. The evenness index recorded maximum during the post-monsoon period (0.6094) and minimum during the monsoon period (0.4750). The dominance index was maximum during the monsoon period (0.5249) and the minimum during the post-monsoon period (0.3908). Along Pondicherry mangroves, the Shannon diversity index to vary from 1.80 to 2.83. The species richness varied from 0.47 to 0.74 while dominance index from 0.17 to 0.50. The evenness index varied from 0.45 to 0.72 [12]. The changes in diversity indices may be due to the dynamic fluctuation in the environmental parameters and seasonal spawning of invertebrates.

Table 3. Season-wise biodiversity indices for the intertidal bivalve of mangrove area of Shirgaon

Indices	Pre-monsoon (Feb-May)	Monsoon (Jun-Sept)	Post-monsoon (Oct-Jan)
H'	0.8848	0.8399	0.8264
S	0.5147	0.3312	0.3396
J'	0.5221	0.4750	0.6091
D	0.4778	0.5249	0.3908

4. CONCLUSION

The results revealed that, Shirgaon mangrove area is productive in nature for bivalves. The occurrence and abundance of bivalve was peak

in pre-monsoon season while low in monsoon season. Moreover the cloudy weather during monsoon might have resulted in low abundance of bivalves. During present investigation, there is no significance correlation observed between bivalve and environmental parameter. So it can be concluded that bivalve abundance not affected by wide fluctuation of environmental parameter. The present study therefore concluded that the bivalve diversity indices were moderately diversified and show moderately high evenness.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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