



# Seasonal variation of sandy shore crustaceans of Mirya Bay, Ratnagiri, Maharashtra

Snehal S. Lokhande\*, A. D. Adsul, S. T. Indulkar and R. Pai

College of Fisheries Shirgaon, (Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth), Ratnagiri - 415 629 (MS), India.

\*Correspondence e-mail: [snehal.lokhande147@gmail.com](mailto:snehal.lokhande147@gmail.com)

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## Abstract

This study highlights the seasonal variation of sandy shore crustaceans of Mirya bay of Ratnagiri, Maharashtra from April 2011 to March 2012. All samples were collected during the lowest low tide of each month, when maximum intertidal exposure prevailed. A total of seven macro-faunal species of crustaceans such as *Ocypode cordimanus*, *Ocypode ceratophthalmus*, *Ashtoret lunaris*, *Philyra corallicola*, *Diogenes miles*, *Emerita holthuisi* and *Gastrosaccus* sp. were recorded. A total density of crustaceans during pre-monsoon (24.31 no m<sup>-2</sup>), monsoon (29.90 no m<sup>-2</sup>) and post-monsoon (58.47 no m<sup>-2</sup>) was recorded of which, *Ocypode* species were abundant throughout the year. The ghost crab, *O. ceratophthalmus* was abundant during April to December, while *O. cordimanus* was not recorded consistently during the study period as it dwells in the burrows amongst the *Ipomea* shrubs well above the high tide mark in the semi-terrestrial zone). The left-handed hermit crab *D. miles* was found near to low tide water mark during all the months except May and June. The moon crab, *A. lunaris* was observed only during the post-monsoon season (November - December) while the mole crab, *E. holthuisi* was abundantly found during the late monsoon and post-monsoon seasons. Monthly *in-situ* parameters such

as atmospheric temperature (23.4 to 30.6°C), interstitial water temperature (22 to 30.5°C), sediment temperature (22.3 to 32.2°C), dissolved oxygen of interstitial water (3 to 9.3 mgL<sup>-1</sup>), interstitial water pH (6.5 to 9.5), sediment pH (5.6 and 8.4) and interstitial water salinity (19.83 to 34.77‰) were recorded.

**Key words:** Sandy shore, Crustaceans, interstitial, transect, quadrat

## Introduction

The exposed sandy beaches are physically harsh and highly dynamic environments. Seasonal variation in environmental parameters have direct impact on qualitative and quantitative distribution of benthic crustaceans on the beaches. Sandy shore crustaceans are valuable due to their immense ecological significance. The sandy beaches are mostly studied to understand the species richness and abundance. The diversity and abundance of the crustaceans vary greatly with beach morpho dynamics. Sand is a dynamic substrate that provides

habitats for animals and probably the biggest adaptation of sandy beach animals is their ability to burrow. The crustaceans on sandy beach are burrowing vertical to avoid desiccation and thus, the interesting benthic communities can be observed after digging (Reid, 1967). The structures of interstitial environment play an important role on the morphology and biology of the population inhabiting in it. Monitoring of macro-faunal distribution and abundance over time and space helps us to understand the changes in species diversity (Colombini *et al.*, 2003). The main objective of the present study is to determine seasonal changes in species composition and abundance of crustaceans in the exposed intertidal area of the sandy shore of Mirya bay, Ratnagiri, Maharashtra.

## Material and methods

Ratnagiri is a coastal district of Maharashtra state along the west coast of India. Mirya sandy beach (Lat. 17°00'35.25"N Long.73°16'49.42" E) is located along the western side of Ratnagiri (Fig.1). All samples were collected during lowest low tide of each month when maximum intertidal exposure prevailed, by fixing transects from lowest low tide to highest high tide mark perpendicular to the shoreline (Schoeman *et al.*, 2003) by adopting stratified random sampling method. Total of seven transect lines were fixed with a distance interval of 400 m on the intertidal region of the exposed sandy shore. In each transect, zone-wise three quadrates having size 0.0625 m<sup>2</sup> (Rathod, 2005) were placed with an interval of seven meter between lines and sediment samples upto a depth of 10 cm were collected and removed from sampling grid with the help of spade and collected in the sampling bags. After sieving the sediment samples through 1mm size sieve, the macrofaunal samples (>1mm) were preserved in 5 % formalin solution for further identification. All the macrofaunal crustaceans were studied quantitatively and qualitatively to record their monthly and seasonal variation. Samples were collected during the period from April 2011 to March 2012.

## Results and discussion

### Occurrence and abundance

During the field observations of twelve month period, a total of seven macro-faunal species of crustaceans such as *Ocypode cordimanus* (Latreille, 1818), *Ocypode ceratophthalmus* (Pallas, 1772), *Ashtoret lunaris* (Forskall, 1775), *Philyra corallicola* (Alcock, 1896), *Diogenes miles* (Fabricius, 1787), *Emerita holthuisi* (Sankolli, 1965) and *Gastrosaccus* sp. were recorded. A total density of crustaceans during pre-monsoon (24.31 no m<sup>-2</sup>), monsoon (29.90 no m<sup>-2</sup>) and post-monsoon (58.47 no m<sup>-2</sup>) seasons were recorded (Fig. 2) in which the genus *Ocypode* was



Fig. 1. Sampling site

abundantly recorded. The ghost crab, *O. ceratophthalmus* (Fig.3) was abundant during April to December while *O. cordimanus* (Fig.5) was not recorded consistently during all months of the year. As it dwells in the burrows amongst the *Ipomea* a shrub well above the high tide mark in the semi-terrestrial zone. The maximum density of *O. cordimanus* was recorded in February (15.2381 no m<sup>-2</sup>) and minimum during October (4.5714 no m<sup>-2</sup>) while *O. ceratophthalmus* was recorded maximum in November (12.1905 no m<sup>-2</sup>) and minimum during December (0.7619 no m<sup>-2</sup>). The ghost crab, *O. ceratophthalmus* and *O. cordimanus* were abundantly recorded above the high tide water mark. Similarly Philip (1970) and Nair (1978) also observed *O. ceratophthalmus* at the high water mark along the coast of Cochin and Benaulim, Goa. The left-handed hermit crab, *D. miles* (Fig.4) was found near to the low tide

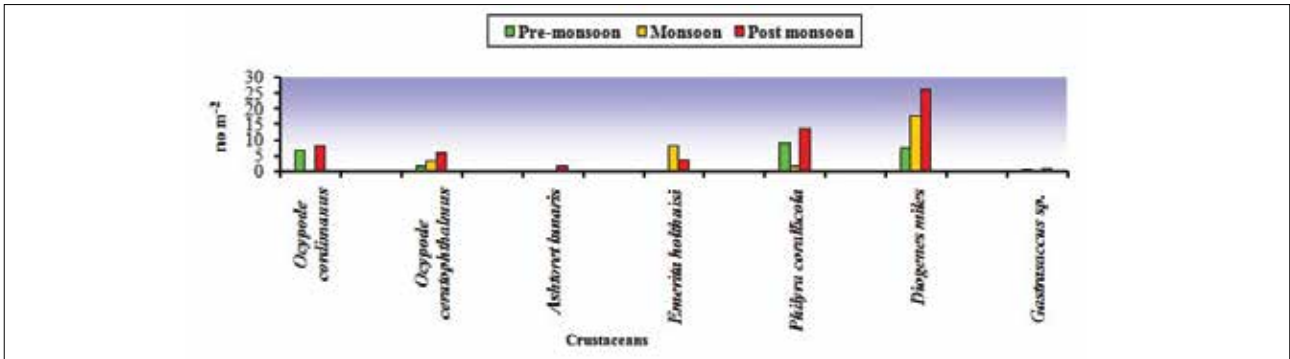


Fig. 2. Annual distribution of crustaceans (no m<sup>-2</sup>) along Mirya sandy shore



Fig. 3. *O. ceratophthalmus*



Fig. 4. *D. miles*



Fig. 5. *O. cordimanus*



Fig. 6. *P. corallicola*

water mark during all months except May and June. The maximum and minimum density were recorded during the post-monsoon season (25.904 no m<sup>-2</sup>) and pre-monsoon season (7.3684 no m<sup>-2</sup>) respectively. Nair (1978) recorded the single hermit crab species of genus *Diogenes* viz.

*Diogenes custos* (Fabricus, 1798) which contributed the maximum component of the fauna. Parulekar (1981) reported the hermit crab, *D. miles* and *D. custos*, from Malvan sandy shore, west coast of India. The sandy shore crab, *P. corallicola* (Fig.6) was prominently recorded in low

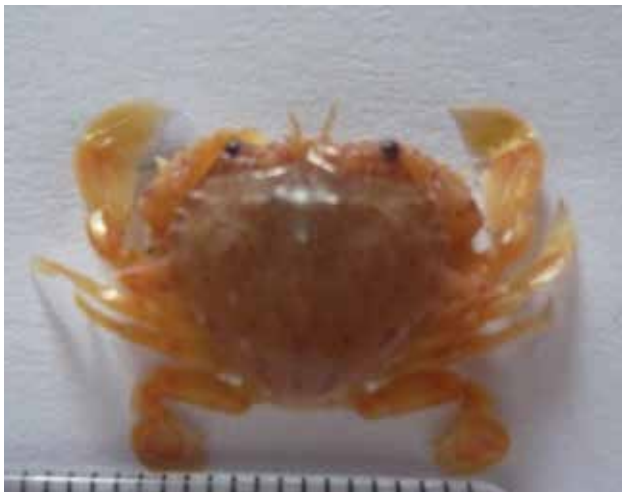


Fig. 7. *A. lunaris*

tide water mark from September to March with a maximum density (19.0476 no m<sup>-2</sup>) in February and minimum (6.0952 no m<sup>-2</sup>) in September. Nair (1978) recorded *Philyra globosa* which formed the major component of the fauna along Benaulim, the sandy shore of Goa. The moon crab, *A. lunaris* (Fig.7) was recorded only during the post-monsoon season (November - December) during the study period. Similar findings were also reported by Rathod (2005) and recorded the *Ashtoret* sp. during September to March on the Mandovi sandy shore, Ratnagiri, Maharashtra.

The mole crab, *E. holthuisi* (Fig.8) was abundantly found during the late monsoon and post-monsoon seasons. Maximum density of *E. holthuisi* (7.8095 no m<sup>-2</sup>) was recorded during the late monsoon (September) and post-monsoon season (October - January) at low tide and mid tide water mark. Ansell *et al.* (1972) reported two main periods of recruitment of *E. holthuisi*, i.e. one in the pre-monsoon



Fig. 8. *E. holthuisi*



Fig. 9. *Gastrosaccus* sp.

season (February and March) and another during the monsoon season (June - September) and the density ranged from 0 to 500 (no m<sup>-2</sup>) at the Sheratallai sandy beach, while at Cochin sandy beach it was densely distributed over 4000 (no m<sup>-2</sup>). Achuthankutty *et al.* (1978) recorded maximum abundance of *E. holthuisi* during the post-monsoon season and early pre-monsoon season along Baina coast, Goa. The maximum density of *E. holthuisi* during the post-monsoon season (390 no m<sup>-2</sup>) along Benaulim, Goa was reported by Nair (1978). Thus the present findings of distribution of *Emerita* sp., at low tide and mid tide water mark zone on Mirya sandy beach are in agreement with the findings of other researchers. The variation in zonal distribution patterns of genus *Emerita* may be attributed towards species specificity behaviour. The single species of the mysid, *Gastrosaccus* sp. (Fig.9) was recorded during the late post-monsoon season (October - January) and pre-monsoon season (February - May) at low tide water mark. The maximum density of *Gastrosaccus* sp. (0.7619 no m<sup>-2</sup>) was observed during the post-monsoon season (October - January). Achuthankutty *et al.* (1978) reported the abundance of *Gastrosaccus* sp. during the late monsoon (September) and post-monsoon season (October - January) along Baina beach, Goa. During the monsoon season Nair (1978) observed the maximum density of the *Gastrosaccus* sp. (5100 no m<sup>-2</sup>) on Benaulim, Goa. A very high abundance of the *Gastrosaccus* was reported during the monsoon season at Kalbadevi beach, Ratnagiri by Sivasdas *et al.* (2012).

### Diversity indices

Diversity indices were used to know the macro-faunal richness and species diversity of an area. According to Bakus (2007) the Shannon wiener index varies from 0 (no diversity) to 5 (maximum diversity). The Simpson index varies from 0 (no diversity) to 1 (maximum diversity).

The Evenness index varies from 0 (no evenness) to 1 (greatest evenness) and the Dominance index varies from 0 to 1 (greatest dominance). The diversity indices like, the Shannon Wiener index varied from minimum (0.7246) during the monsoon and maximum (1.9852) during the post-monsoon season. The Simpson index was recorded maximum during the post-monsoon (0.7066) and minimum during the monsoon season (0.3238). The Evenness was recorded maximum during the post-monsoon (0.8033)

Table 1. Season-wise biodiversity indices for the crustaceans of Mirya sandy shore during 2011-2012

Indices	Pre-monsoon	Monsoon	Post-monsoon
H'	0.8318	0.7246	1.9852
S	0.3432	0.3238	0.7066
J'	0.4675	0.5500	0.8033
D	0.0325	0.2001	0.1968

H'- Shannon's diversity index, S – Simpson index, J' – Evenness index, D- Dominance index

while minimum during the pre-monsoon (0.4675) and the Dominance index was recorded maximum during the monsoon (0.2001) and minimum during the pre-monsoon (0.0325) (Table.1). The low diversity indices of Shannon and Simpson during monsoon season may be due to the harsh environmental conditions along the coast which discourages the diversity of crustaceans of the Mirya sandy shore. Abiotic factors are vital and can cause direct impact on diversity and distribution of faunal organisms.

### Environmental parameters

Season-wise variation in environmental parameters: during pre-monsoon (February-May), monsoon (June-September) and post-monsoon (October-January) was recorded. During the investigation period, correlation analysis of the parameters like atmospheric, interstitial water and interstitial sediment temperatures and also the interstitial water salinity did not show any significant correlation with sandy shore of crustaceans, which suggest that all these sandy shore

Table 2. Monthly and seasonal variation of environmental parameters of water in Mirya sandy shore

Year	Months	Atm. temp. °C	Water temp. °C	Sand temp. °C	DO of interstitial water (mg/Lit)	Salinity of interstitial water (‰)	pH of water	pH of soil
2011	Apr	30	30.57	32.20	4.4	30.03	8.5	7.6
	May	29.83	30.27	31.60	4.1	29.23	7.5	6.8
	Jun	26.33	24.87	27.40	7.4	28.87	6.5	5.6
	Jul	24.87	24.40	25.00	8.5	24.63	7.5	5.9
	Aug	26.00	26.23	25.80	9.3	19.83	7.5	6.3
	Sep	27.17	26.73	27.70	5.8	24.47	8.5	6.3
	Oct	26.17	26.37	27.50	6.6	25.33	8.5	6.8
	Nov	27.57	28.47	26.90	4.5	29.73	8.5	7.4
Dec	30.67	30.43	31.10	4.9	34.77	9.5	8.2	
2012	Jan	29.60	29.43	29.70	3.4	34.53	8.5	7.7
	Feb	28.27	28.17	28.00	5.4	33.23	9.5	8.4
	Mar	23.43	22.07	22.30	3	33.27	7.5	8.1

Table 3. Correlation co-efficient among environmental parameters and crustaceans of Mirya sandy shore

	Atm Temp°C	Interstitial Water Temp°C	Interstitial sediment Temp°C	Interstitial water DO	Sediment pH	Interstitial Water pH	Interstitial Water Salinity ‰	Crustaceans (no m <sup>-2</sup> )
Atm Temp.OC	1							
Interstitial Water Temp.°C	0.974**	1						
Interstitial sediment Temp. °C	0.954**	0.930**	1					
Interstitial water DO (mg/l-1)	-0.400	-0.355	-0.299	1				
Sediment pH	0.384	0.370	0.199	-0.744**	1			
Interstitial Water pH	0.551	0.579*	0.403	-0.359	0.717**	1		
Salinity ‰	0.440	0.325	0.297	-0.805**	0.788**	0.424	1	
Crustaceans (no m <sup>-2</sup> )	-0.280	-0.247	-0.357	0.042	0.060	0.402	-0.144	1

\* Significant at the 0.05 level

\*\* Significant at the 0.01 level

crustaceans are well adapted to seasonal fluctuation in environmental conditions.

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