



E-ISSN: 2320-7078

P-ISSN: 2349-6800

www.entomoljournal.com

JEZS 2021; 9(1): 358-362

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Received: 23-11-2020

Accepted: 30-12-2020

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Seasonal variation of molluscs of Varwade rocky shore, Ratnagiri

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Abstract

A total of 25 molluscan macrofaunal species comprising 21 gastropods and four bivalves were recorded from Varwade, rocky shore, Ratnagiri. Among the gastropods, *Euchelus asperus*, *Cypraea arabica*, *Morula granulata*, *Purpura panama*, *Planaxis sulcatus* and bivalve, *Saccostrea cucullata* were dominant throughout the investigation. The gastropods, *Cantharus wagneri*, *Cerithium bifasciata bifasciata*, *Gyrineum natator*, *Clypidina notata*, *Pyrene terpischoe*, *Thais bufo*, *Conus vexillum*, *Trochus radiates*, *Turbo bruneus* and *Nerita undata* were observed consistently in all the three seasons. Among the bivalves, *Saccostrea cucullata* and *Brachidontes variabilis* were present consistently in all the three seasons. The bivalve, *Gafrarium divaricatum* was recorded consistently only during post-monsoon season, while rock boring bivalve, *Pholas dactylus* was present during pre-monsoon and post-monsoon. Seasonal variations in molluscs were maximum during the post-monsoon and minimum during monsoon season.

Keywords: Rocky shore, molluscan, seasonal, ratnagiri

Introduction

Intertidal rocky shores are particularly easy to study. Many intertidal rocky shore species are sessile and slow moving. Which are taxonomically traceable. Their abundance can be easily estimated as percentage cover or density in a non-destructive way, allowing the dynamics of populations or communities to be studied without much interference. Most importantly, as being easy to manipulate, they are particularly suitable for an experimental approach which enables a better understanding of the functioning of rocky shore communities (Paine, 1966; Connell, 1972; Little and Kitching, 1996)^[15, 7, 14].

In India, a major part of the west coast is predominantly rocky. A rocky shore consists of rocky ledges with pools of salty water, boulders and pebbles. The rocky shores are the areas of bedrock, exposed between the extreme high and low tide levels on the sea shore. The rocky shores are the most extensive littoral habitats exposed to eroding waves and thus, are ecologically very significant. These biological communities of rocky shores function as integrators of ecological processes over time scale. The communities rocky shore act as bioindicators and may be monitored to assess ecological changes. Their composition, abundance and distribution are generally influenced by seasonal water quality variation. The rocky shore offers the solid substratum for growth of wide variety of many sessile animals. Sessile animals of the rocky shore include sponges, colonial hydrozoans, anthozoans (e.g. sea anemones) etc. while the sedentary animals are a variety of invertebrates like limpets, mussels, oysters, barnacles, tubicolous polychaetes, shrimps and crabs which live in the crevices of hard rocks. Echinoderms, especially sea urchins and star fishes are also found in the rocky shore. Present study was carried out in order to report a brief account on the seasonal variations of intertidal molluscs from the Varwade, rocky shore Ratnagiri.

Materials and Methods

The study on monthly biodiversity of aquatic macro-fauna was carried out during February 2016 to January 2017 of the Varwade rocky shore, Ratnagiri (Fig 1). Ratnagiri is a coastal district of the Maharashtra state, along the west coast of India. In the present study, seven transects were marked at different locations on the rocky shore. The 30 m distance was kept between two successive transects. Monthly in situ assessment was done during low tide, using quadrat of size 0.25 m² (Boaventura *et al.*, 2002)^[6] from the intertidal exposed region of Varwade rocky shore coast, in different seasons.

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The three numbers of quadrats were sampled along each transect by stratified random sampling adopting of photo quadrat methods (Bakus, 2007) [3]. From the photographs the percentage coverage of massive sessile species like corals, sponges and associated seaweed species were estimated (Sibaja-Cordero, 2008) [17]. After collection, samples were thoroughly washed and sorted out before being passed through a 1 mm sieve. Those animals retained by the 1 mm sieve were considered to be macro fauna (Gibbons and Griffiths, 1986) [9].

The selected samples were preserved in 5% buffered formalin solution for further identification. All macro organisms (>1) mm were identified by using George and George (1979) [8], SubbaRao (2003) [19], Monthly in situ atmospheric, water temperature and pH were recorded. Water samples were taken in clean plastic bottles for estimation of physico-chemical parameters viz. salinity while dissolved oxygen sample was taken in DO bottles. Standard methods given by Strickland and Parsons, (1972) [18] and APHA, (2005) [2] were used for analysis.

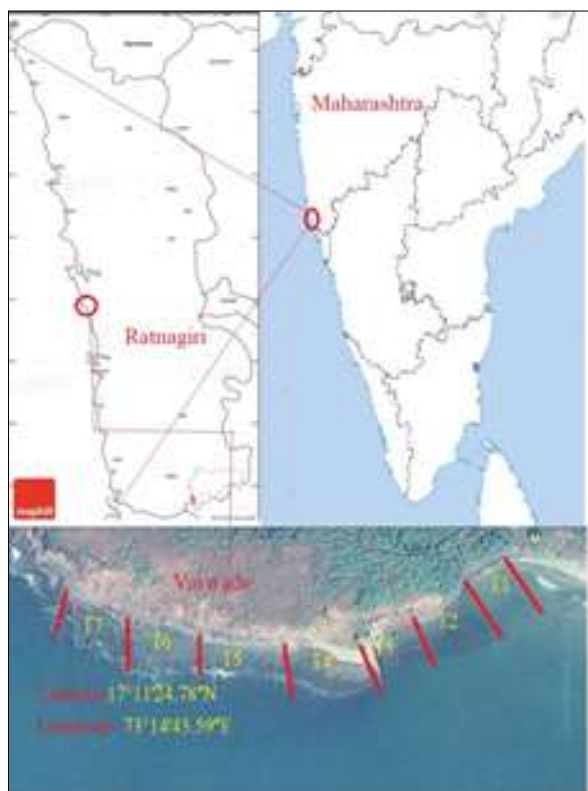


Fig 1: Sampling locations along Varwade rocky shore, Ratnagiri

Result and Discussion

The variation in water parameters was recorded season-wise: Pre-monsoon, Monsoon and Post-monsoon. The maximum atmospheric temperature was recorded in the month of March (29.33°C) and the minimum in the month of September (22.93°C). The atmospheric temperature highest (32.5°C) in the month of October, while lowest (22.0°C) in the month of January recorded along the coast of Mumbai (Anandan, 2003) [1]. The variation in air temperature could be attributed to the variations in daily changing sampling time with respect to the tides of the study area and seasonal thermal fluctuations. In general, the lower temperature, recorded during September, might be due to the cloudy coverage at the time of monsoon sampling. The highest water temperature value was recorded in the month of January (27.87°C) while lowest value in the

month of September (24.93°C). Along the rocky intertidal area of Veraval Gujarat (Temkar *et al.* 2014) [20] recorded the water temperature range between 23.22 and 25.83 °C. These variations may be attributed to seasonal insolation and variation in the time of sampling in different months because sampling was carried out according to the timing of low tide. The maximum pH was recorded in the month of October (8.60). The minimum was recorded in the month of December (7.73). Berde *et al.* (2014) [4] recorded the water pH with wide variation ranging from 7.6 to 9.2 along the Purnagad rocky shore, Ratnagiri. The highest value of pH was observed in the month of October (8.60) while the lowest was in the month of December (7.73) which may be due to the upwelling event in near shore water during the sampling period along the intertidal rocky shore Varwade, Ratnagiri. The highest value of dissolved oxygen was observed in the month of July (6.23 mg L⁻¹). And the lowest value in the month of March (3.00 mg L⁻¹). The observed maximum dissolved oxygen value in the month of July may be due to heavy rainfall, wind weather condition in same period in which high temperature values may have had negative impact on DO content.

The maximum value of salinity was observed in the month of May (37.97 psu) and the minimum in the month of July (21.67). Shivakumar and Naik (2012) [16] observed the water salinity between 12.0 (August) and 36.0 psu (May) along the coast of Karwar, Karnataka. The maximum value of salinity observed in the month of May might be attributed to high rate of evaporation during the summer season while the minimum value of salinity was recorded in the month of July due to heavy rainfall condition during the period. The highest value of alkalinity was recorded in the month of February (164.00 mg L⁻¹). The lowest in the month of September (96.93 mg L⁻¹). Anandan (2003) [1] recorded the alkalinity range from 140 (September) to 170 mg L⁻¹ (February) along the coast of Mumbai.

Occurrence and abundance of Gastropods

A total of 21 gastropods (Fig 2) were recorded of which *Euchelus asperus*, *Cantharus wagneri*, *Cerithium bifasciata*, *Gyrineum natator*, *Morula granulata*, *Planaxis sulcatus*, *Clypidina notata*, *Cypraea arabica*, *Pyrene terpsichore*, *Purpura panama*, *Thais bufo*, *Conus vexillum*, *Trochus radiates*, *Turbo bruneus* and *Nerita undata* were observed consistently in all the three seasons. The gastropods, *Cellana testudinaria*, *Nerita oryzaeum*, *Chiton sp.* and *Nerita articulata* were recorded only during post-monsoon season, but their presence was not consistent. Vadher *et al.* (2014) dominantly reported gastropods viz., *Babylonia spirata*, *T. bruneus*, *Nerita albicilla*, *Nerita chamaeleon*, *C. notata*, *P. panama*, *T. bufo*, *P. terpsichore* and *Chiton sp.* along the Chorwad, coast Gujarat. Jaiswar and Kulkarni (2001) [10] observed the gastropods viz., *Nerita oryzaeum*, *Nerita polita*, *N. oryzaeum*, *N. albicilla*, *P. sulcatus*, *P. similis*, *Cerithium morus*, *Ergaea walshi*, *Thais blanfordi*, *T. tissoti*, *T. carinifera*, *C. arabica*, *Bursa tuberculata*, *P. terpsichore*, *Hemifusus pugilinus* and *Cellana radiata* along the intertidal coast of Mumbai, Maharashtra. Variation in occurrence of gastropods species in the present study is attributed to the geographical variation and substrate variation of sampling site.

The gastropod, *E. asperus*, (1.38 no m⁻²), *C. arabica* (1.19 no m⁻²), *M. granulata* (5.90 no m⁻²) and *P. panama* (1.38 no m⁻²) recorded highest density in pre-monsoon season, while *Phidiana anlifera* (0.57 no m⁻²) was recorded only in post-

monsoon season. The other gastropod like *G. natator*, *C. notata* and *P. sulcatus* were recorded with highest density in monsoon (3.24 no m⁻²), (6.53 no m⁻²) and (21.34 no m⁻²) respectively.

Along the coast of Gulf of kutchh, Gujarat, Kardani *et al.* (2014) [11] recorded 36 species of 18 families of gastropods. The species density of 170 and 472no m⁻² was observed at coast of Sanghi during summer and Monsoon. At the coast of

Mundra highest density of (1207no. m⁻²) was observed during winter and lowest of (267 no m⁻²) during summer was recorded. The high numbers of individual were found during monsoon compared to the other two seasons. Along the coast of Chorwad, Gujarat, Vadher *et al.* (2014) reported 69 species of molluscs. The maximum species found in the month of October total 56 species were recorded.

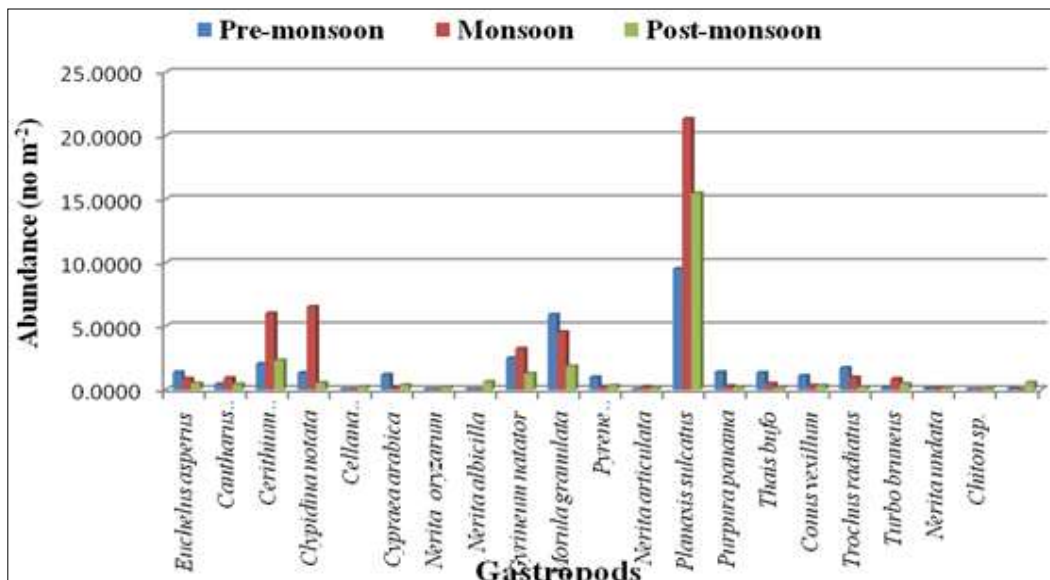


Fig 2: Season-wise distribution (no m⁻²) of gastropods on Varwade rocky shore

Occurrence and abundance of bivalves

Among the bivalves (Fig 3), *Saccostrea cucullata* and *Brachidontes variabilis* were present consistently in all the three seasons. The *Gafrarium divaricatum* was recorded consistently only during post-monsoon season, while rock boring bivalve, *Pholas dactylus* was absent in monsoon season. The bivalves, *S. cucullata* and *B. variabilis* were recorded with highest (69.86 no m⁻²) and (0.24 no m⁻²) in pre-monsoon season respectively, while *P. dactylus* highest density (0.71 no m⁻²) was observed in post-monsoon. Bhatade (2011) [5] reported the bivalve species, *G. divaricatum*, *cardium sp.*, *Perna viridis* and *Brachidontes sp.* and *S. cucullata* along the coast of Mirya, Ratnagiri and recorded the

S. cucullata was highest density in August. Khade and Mane (2012) [12] recorded the bivalve species viz., *Crassostrea cattuckensis* and *S. cucullata* along the coast of Ratnagiri. Kurve *et al.* (2013) [13] reported the *G. divaricatum* and *Crassostrea sp.* being most abundant along the coast of Borli, Raigad. During the present study, bivalves as *G. divaricatum*, *B. variabilis*, *P. dactylus* and *Scucullata* were recorded. The bivalves, *S. cucullata* and *B. variabilis* were present consistently in all the three seasons which might have better adapted to wide variation of physico-chemical parameter of rocky shore of Varwade. Abiotic factors and substratum may be the controlling factors for distribution of bivalve in the intertidal zone.

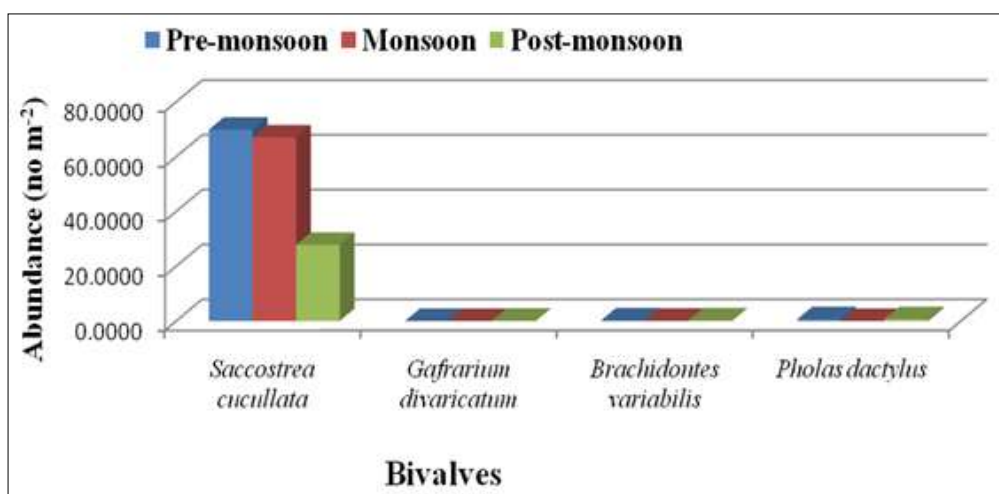


Fig 3: Season-wise distribution (no m⁻²) of bivalves on Varwade rocky shore

Correlation with environmental parameter

The correlation co-efficient for the selected parameters of

Varwade rocky shore is given in Table. 1 Statistical analysis for the parameters which was carried out using SPSS software

16.0 version. The data showed that the atmospheric temperature was positively correlated with the water temperature ($r=0.704 < 0.05$) and pH ($r=0.928 < 0.01$). The

water temperature was positively correlated with water pH ($r=0.627 < 0.05$) and total alkalinity ($r=0.716 < 0.01$).

Table 1: Correlation co-efficient among environmental parameters and macro-fauna of Varwade rocky shore

	Atm. temp. °C	Water temp °C.	Alkalinity (mg l ⁻¹)	DO(mg l ⁻¹)	pH	Salinity (psu)	Bivalves (no m ⁻²)	Gastropods (no m ⁻²)
Atm. temp. °C	1							
Water temp. °C	0.704*	1						
Alkalinity (mg l ⁻¹)	0.290	0.716**	1					
DO(mg l ⁻¹)	-0.087	0.133	0.178	1				
pH	0.928**	0.627*	0.234	0.078	1			
Salinity (psu)	0.450	0.389	0.413	-0.351	0.414	1		
Bivalves (no m ⁻²)	-0.205	-0.237	0.219	0.005	-0.256	-0.087	1	
Gastropods (no m ⁻²)	-0.217	-0.490	-0.277	0.042	0.066	-0.027	0.103	1

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

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

Species richness and diversity indices

Diversity indices (Fig. 4) are used to know the macro-faunal richness (Table 2.0 & 2.1) and species diversity (Table 3.0 & 3.1) of that area. According to the Bakus (2007) [3], the Shannon Wiener index, Simpson index, Evenness and Dominance were calculated as given below.

Table 2.1: Season-wise species richness of the macro-fauna of Varwade rocky shore Ratnagiri (2016-17)

Season	Pre-monsoon	Monsoon	Post-monsoon
Species richness (S)	2.9048	2.7143	3.7143

The species richness observed to be minimum (2.7143) during monsoon while maximum (3.7143) during post-monsoon. The Shannon's diversity index (H') was highest in post-monsoon

(2.2371) while minimum in post-monsoon (1.7350). Simpson index (S) also depicted same pattern being highest in post-monsoon (0.7029) and lowest in pre-monsoon (0.4799). Maximum value of evenness index (J') was recorded in post-monsoon (0.5275) and minimum in pre-monsoon (0.4399). Index of dominance (D) was maximum in pre-monsoon (0.5601) and minimum in monsoon (0.4725).

Table 3.1: Season-wise biodiversity of the macro-fauna of Varwade rocky shore Ratnagiri during (2016-17)

	Pre-Monsoon	Monsoon	Post-Monsoon
H'	1.7350	1.8373	2.2371
S	0.4799	0.6832	0.7029
J'	0.4399	0.4831	0.5275
D	0.5601	0.5169	0.4725

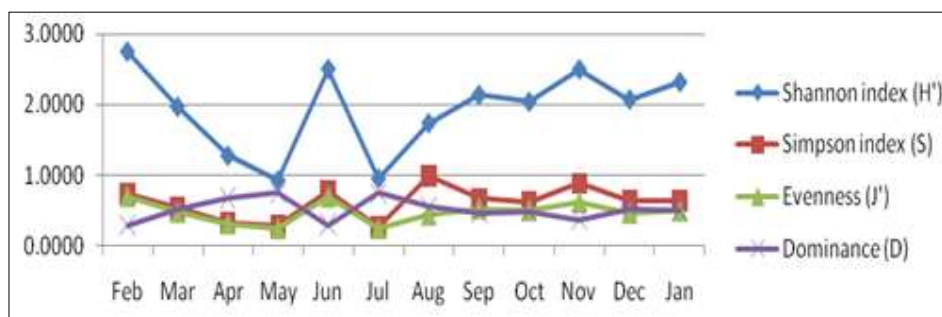


Fig 4: Month-wise biodiversity indices for the intertidal macrofauna of Varwade rocky shore during (2016-17)

Conclusion

The ability of these molluscs to survive in a wide range of environmental conditions is certainly due to the euryhaline and eurythermal characteristics of these animals. The present study therefore concluded that the mollusc community associated with the intertidal rocky substrate of Varwade is very diverse.

Acknowledgements

Authors wish to thank the authorities of College of Fisheries, Shirgaon, Ratnagiri (Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli) for providing me all the necessary facilities as well as for giving the needful support during the course of the investigation.

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