



## Ecological Status of *Cellanaradiata* at Dwarka Coast, Gujarat, India

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### Abstract

Marine ecosystem is known to be one of the richest amongst the entire living ecosystem. Coastal macrofaunal species are part of specific ecosystems assessing the condition of ecosystem, and considered as a useful indicator of threats to the diversity of coastal regions. Kathiawar Peninsula (Gujarat State, India) has a vast coastal line and the availability of varied types of substrate on this coastal line makes it a suitable place for rich biota. The present investigation was carried out to study the present ecological status of *Cellanaradiata* at Dwarka sea coast, Gujarat, India. *C. radiata* is a most dominating mollusk species that are found mostly on the upper and upper middle littoral zone of the rocky intertidal substratum. *C. radiata* was found to stick themselves on the vertical rocks of the pools and the creeks. This helps them to move along the upcoming tidal water for food from water. As they are covered with a very hard and solid shell, fluctuation in physical condition hardly brings any change on their distribution. It was observed from the present investigation that the frequency values did not show any definite spatio-temporal trend at the sites. It was evident that no significant difference of the population abundance existed between the sites as well as among the seasons.

**Keywords:** Dwarka coast, intertidal zone, ecological status, *Cellanaradiata*

### Introduction

The intertidal zone is considered as the most productive with the greatest diversity of plant and animal life of any ecological area of the world. Because of its accessibility, the intertidal zone has been explored in much more detail than any other. Amongst marine products for human consumption, molluscs constitute an edible group next to fish and crustaceans<sup>1</sup>. In America, Europe, Japan and other countries, molluscs are recognized as nutritive seafood rich in glycogen, vitamins and several minerals. Recently molluscs like edible oysters, mussels, clams, chanks, squids, cuttle fish and octopus have great demand as frozen or dried food in India as well as in many foreign countries. Hence, these mollusks have a status of their individual commercial fishery, and are caught and exported in great numbers.

Molluscan shells have been found to be important raw material for various commercial products as poultry feeds, fertilizers, tooth powder, tooth pest etc. Moreover, shells of a number of molluscs are cleaned, polished and used in preparation of various handicrafts like interior decoration items, jewellerys, toys, curios, ash-trays, bangles, rings, necklaces, buttons and many other items of interest and commercial use. India exports seashells and cuttle fish bones to various countries<sup>2</sup>. The commercially important molluscs, *Trochus* and *Turbo* occupy a prominent position because of their abundance and economic value<sup>1</sup>. Substantial fisheries for *Mancinella*, *Trochus* and *Turbo*'s shells and meat exist in many part of the world as important gastropod molluscs. They are also utilized as food and are caught in large number on Indian coast. Hence, commercial

exploitation of these molluscs by various coastal people has stated deeming of population of these molluscs on Indian coast including the coast of Saurashtra and Gulf of Kachchh<sup>3</sup>.

The harvest of these species along with other molluscs requires urgent need of control on their harvest or their resource managements<sup>4</sup>; otherwise the population of these economically important gastropods might be declined to extinction<sup>5</sup>. Therefore, extensive studies are of prime need in resource management in developing countries like India. Detailed studies on population status of *Cellanaradiata* would considerably help to revive the population in fishing ground in due course<sup>6,7</sup>. Moreover, these studies would be guidelines in transportation of these molluscs to those areas like Marine National Parks, and other places which are well protected from anthropogenic pressure<sup>8</sup>. Saurashtra coastline of the Kathiawar Peninsula is mostly rocky-muddy with irregular patches of sand. The industrial groups that have greater dominance in this area besides existing port with facilitate import or export of fish and fishery products are rayon, cement, food and fodder industry, fertilizers, salt, cement, soda ash and lime stone associated industries<sup>9</sup>. Tourism is also another related problem for the intertidal zones of the Kathiawar Peninsula<sup>10</sup>. Thus, present ecological status of the macrofaunal assemblage in this industrially significant coastline is very important study from ecological as well as conservation point of view not only for this particular region but also for any other coastline where the conditions are similar<sup>3</sup>. Therefore, the objective of the present study revolves around micro spatial and temporal variations in the population dynamics of *Cellanaradiata* at the selected site.

This study will be useful to evaluate the ecological status of the intertidal zone of the selected site.

## Material and Methods

The present investigation was carried out at a rocky intertidal belt at Dwarka sea coast, Gujarat, India. Dwarka (22° 13' N and 68° 58' E) is situated on the west coast of India. Prior to conducting a quantitative survey to macrofauna at Dwarka, a reconnaissance survey was done to demark the sampling sites. Total length of Dwarkacoast was about 5 km. The entire study area of Dwarka was divided in to three sites marked as Sangam Narayan temple (from Sangam Narayan temple to GaytriMandir) light house (from GaytriMandir to light house) and Dargah (from light house to Dargah). During the study all three sites viz. Site – A, Site – B, and Site – C, were frequently surveyed at regular intervals during the lowest tides. Dwarka is one of the most sacred places of Hinduism due to Dwarkadhish Temple. At all the research sites identified, the mineralogical and petrographical studies of the submerged intertidal rocks have indicated that they are calcareous sandstones. Further, it is also cited that these rocks were formed through continuous deposition during a period of lowered sea level. Selected sites are sandy, stony, rocky and calcareous eruptions.

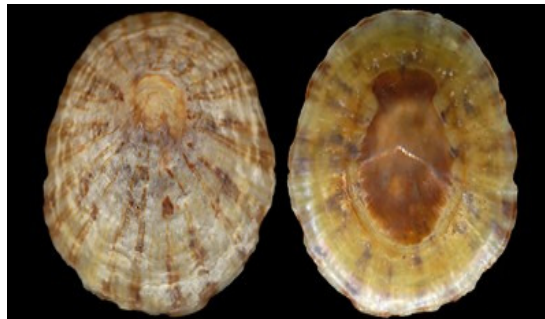
The structural attributes of the intertidal fauna were studied by transect method<sup>3</sup>. Foot transect method was used for generating the data on this belt. Quadrates of 0.25 m<sup>2</sup> were laid while following an oblique direction covering maximum area at almost regular occurrence<sup>9</sup>. Quadrante frequency was determined on the basis of the total length of the sampling site. Among the attributes, monthly variations in the population density, abundance and frequency of *C. radiata* in each sampling site were calculated. In the present communication, an attempt was made to measure the variation in the population in response to change in seasons and stations. The dominant animals selected for community ecology study showed a very restricted habitat selection along the intertidal belt, and that was the reason why the total abundance values were taken into consideration<sup>10</sup>.

## Results and Discussion

*C. radiata* used for the detailed ecological study at the Dwarka station was selected based on its majority in number, its availability throughout the year, habitat preference covering upper and upper middle littoral zone of the rocky intertidal base and to draw a baseline comparison with the time span.

**Phylum:** Mollusca, **Class:** Gastropoda,  
**Order:** Archaeogastropoda **Family:** Patelidae.

**Brief description of *C. radiata*:** *Description:* Commonly known as the ridged limpet and is famous for its attractive shell colors. Found to settle on the walls of the pools and the crevices. It is normally very sluggish in nature. Move with the upcoming wave and a true grazer. Fertilization is always external<sup>11</sup>.



*Cellanaradiata (Born)*

**Occurrence:** Found around the Globe, also recorded from North Coast, Oceania, Japan, Western Australia, Indonesia, Papua New Guinea, New Caledonia, Loyally Island, Solomon Island, Fiji, Tonga, Marquises and Indian subcontinent.

**Habitat:** This species preferred exposed rocks usually with smoother edge. Found exclusively on the upper littoral zone and spray zone.

**Status:** Most dominant species on the intertidal belt of Saurashtra coast line. Usually the most common limpet of the Indian subcontinent is the *Patella vulgate* and *Cellanaradiata*, and is spread over the rocky base of the Arabian Sea and Indian Ocean<sup>12</sup>.

**Use:** Not used in India for any industrial purpose. In China the main use of this is the human consumption. However, export of this species is currently on from the west coast of India.

**Density:** The animal shows uniform distribution in the sampling sites. The density of *Cellanaradiata* was found to be high during post monsoon in winter seasons and gradually decline during summer and monsoon seasons. It was also observed that micro-spatial variations were not much except during peak winter (January and February). High density value was observed in Site-A during peak winter and in site-B and C during September and November. The density values were minimum in May and June, at site-A. There was no significant difference the density values of Feb to April. In case of site-C it was maximum in September and minimum values were in May, June and July.

**Abundance:** Like the density, abundance values were also found to be higher at site-A in Jan and Feb, after that, the density values were declined in monsoon seasons. In case of site-A the abundance values were minimum in May, June and July and maximum in January and February. There was no significant difference in January to April as compare to August to December. In case of site-B the lower value was found in May and July and maximum values were found in September and November. The abundance values of site B ever quite difference in compared to that of Site-A. They were distributed in a range with the seasonal changes. In case of site-C it was maximum was in July. There was no more difference in Jan to April. A significant difference of the values at all sites was

observed. The fluctuation at all sites was from summer to monsoon as the two seasons after quite reserve atmospheric condition. In the December it showed no more difference where

we compare site -A, Site-B and site-C but in January and February it showed variations.

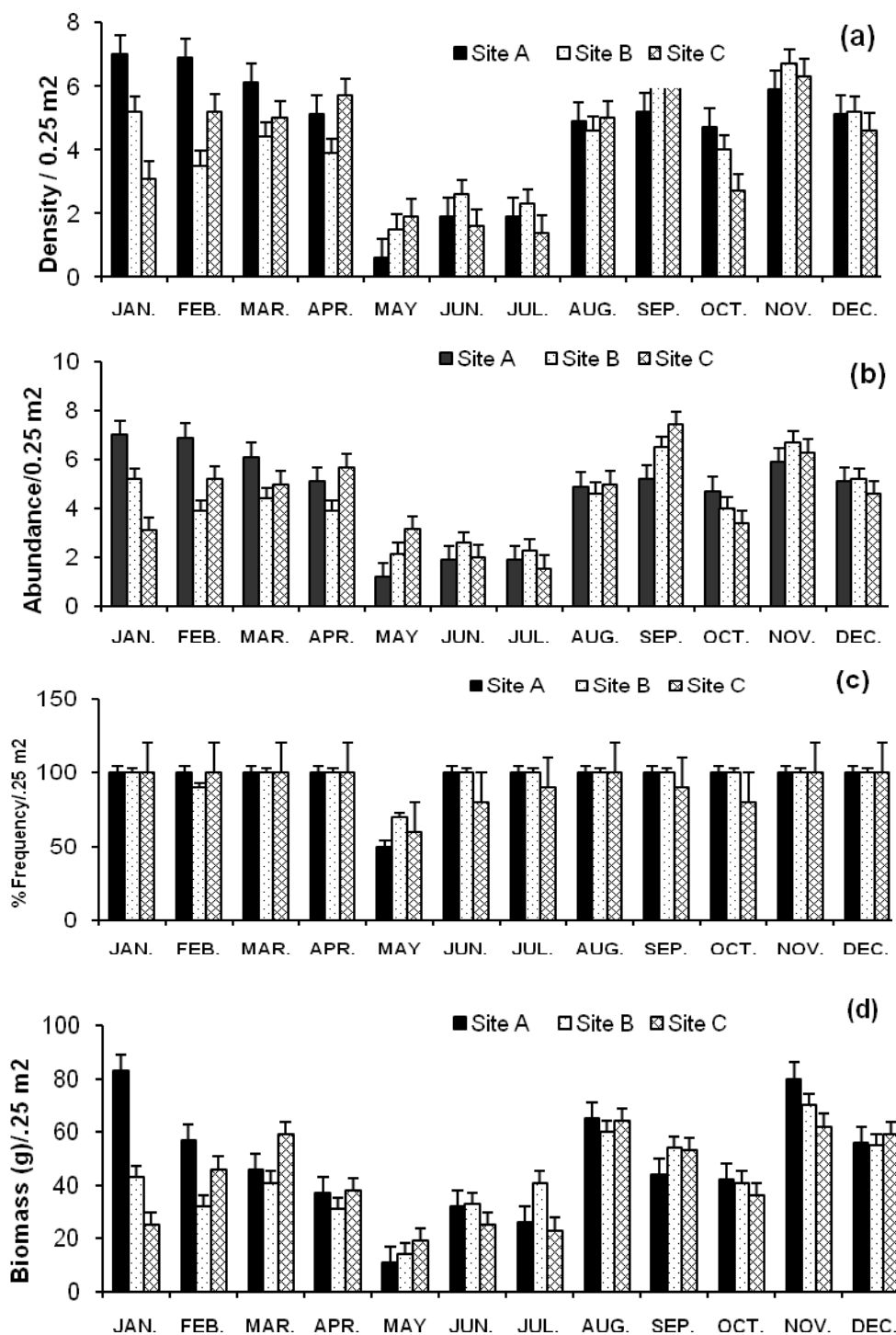


Figure-1  
 Ecological attributes of *Cellanaradiata* at the sampling sites

**Table-1**  
**Results of the one-way ANOVA without replication analysis of the mean monthly density and abundance values at the station**

Vertical Zones	Density		Abundance	
	df	F	df	F
Upper Littoral zone	2,33	0.247801	2,33	0.248879
Middle Littoral zone	2,33	0.004493	2,33	0.130292
Lower Littoral zone	2,33	0.531296	2,33	0.414986

\* Significant at P < 5 %. Tabulated value of F (2, 33) = 3.32

**Table-2**  
**Results of the regression and correlation of coefficient analyses between mean monthly abundance and mean seawater salinity, temperature and pH of Dwarka station**

Abiotic Factors	Upper		Middle		Lower	
	Regression equation	R <sup>2</sup> value	Regression equation	R <sup>2</sup> value	Regression equation	R <sup>2</sup> value
Salinity	y=0.3387x-5.6064	0.0351	y=-0.4113x+18.351	0.1236	y=-0.313x+13.498	0.1337
Temperature	y=-0.1265x+8.9111	0.0233	y=-0.321x+12.823	0.3580	y=-0.214x+8.3798	0.2971
pH	y=-1.775x + 19.835	0.0335	y=1.2484x-5.3437	0.0396	y=0.4818x-0.8137	0.011

**Frequency:** In the present study, the frequency values also recorded higher at the B than site C. But the interesting point was that, it was the same in all the four seasons rather than distributed equally with two dominating seasons for each of the sites. Smoother distribution pattern was probably responsible for this. The values were recorded maximum at site -B in all months. The lowest values were found in May. No significance difference in either site wise or season wise was evident from here a progressive trend in case of site- A and site-B while fluctuating in site-C community was observed.

**Biomass:** Biomass was recorded monthly for each of the species during study. Dry weight per specimen was calculated and recorded. The highest value of biomass was found in January and November in site-A. In case of site-A, the lowest value of biomass was found in May. In a complete year, fluctuation of the value was found in January, February and March. In November showed equal in all sites. In post-monsoon and winter seasons it showed no significant difference. The significant difference between sites of the value was found January, February and March. In case of site-B there were no more variations of the value during all seasons. But variations were found in site-A. In case of site-C it was lowest in pre-monsoon and highest in winter seasons.

Diversity and population ecology of few intertidal macrofauna in the western coastal region of India off Arabian Sea were earlier reported<sup>10,13,14</sup>. Similarly, the diversity and seasonal variations in the ecological patterns of the selected macrobenthic organisms and their relationship with the associated environmental factors<sup>15</sup> were also reported from the south Saurashtracoast of India<sup>16</sup>. However, on the coastal areas of Kathiawar Peninsular region of the Indian subcontinent, except for some patchy studies, quantitative investigations on

the ecology of intertidal macrofaunal assemblages are scanty<sup>3,17,18</sup>.

### Conclusion

In the present study, *Cellanaradiata* was found to be most prominent group in almost all sampling sites studied. The abundance values were much higher than the Density values at the stations. However, it showed a rapid decline during monsoon season. *C. radiata* inhabits in exclusively spray and to some extent upper littoral zone because their habitat is restricted to walls of pools, creeks and the big rocks. At most of the cases they are found to be stacked vertically. Saurashtra coast is predominantly rocky sandy coast providing best and widest habitat for this group of animals, which was the reason for their high occurrence. At Dwarka, the intertidal belt is in the form of a gradual plane with pools and creeks at about regular interval. This condition did not provide any room to these animals to move along with the upcoming water during high tide. That makes a uniform distribution of the species at Dwarka as there is no extra benefit to be obtained from the substratum. This species, being the dweller of the upper littoral zone, rather to the spray zone, the density is mostly a reflector of the atmospheric physical factors, the degree of tidal harshness.

### References

1. Appukuttan K.K., *Trochus* and *Turbo* fishery in Andaman's, *Seafood Export J.*, **9(12)**, 21-25 (1977)
2. Sarvaiya R.T., Many uses of Molluscs, *Sci. Rep.*, **2**, 278-280 (1988)
3. Bhadja P. and Kundu R., Community structure and distribution pattern of intertidal macrofauna in few

- anthropogenically influenced rocky coasts, *Ind. J. Geo-Mar Sc.*, in press (2011)
4. Chapman M.G., Patterns of spatial and temporal variation of macrofauna under boulders in a sheltered boulder field, *Austral Ecology*, **27**, 211-228 (2002)
  5. Crowe T.P. and A.J., Underwood, Differences in dispersal of an intertidal gastropod in two habitats: the need for and design of repeated experimental transplantation, *Journal of Experimental Marine Biology and Ecology*, **237**, 31-60 (1999)
  6. Grange K.R., Rough water as a spawning stimulus in some Trochid and Turbinid Gastropods, N. 2, *Journal of Marine and Freshwater research*, **10(I)**, 203-16 (1976)
  7. Glasby T.M., Surface composition and orientation interact to affect subtidalepibiota, *Journal of Experimental Marine Biology and Ecology*, **248**, 177-190 (2000)
  8. Jeffery C.J., Determination of abundance and distribution of an intertidal barnacle: settlement or post-settlement mortality, *Marine Ecology Progress Series*, **246**, 291-305 (2003)
  9. Misra S., Studies on the biodiversity and the impact of anthropogenic pressure on the ecology and biology of certain intertidal macrofauna, Ph.D. Thesis, Saurashtra University, Rajkot, India (2004)
  10. Misra S. and Kundu R., Seasonal variations in population dynamics of key intertidal mollusks at two contrasting locations, *Aquatic Ecology*, **39**, 315-324 (2005)
  11. Newell R.C., Biology of intertidal animals, Elek Books, London, **555** (1970)
  12. Norton T.A., *The Ecology of Rocky coasts* (eds. Moore, P.G. and Seed, R.) Hodder and Stoughton, London, 7-21 (1985)
  13. Patel N.D., Ecological on few invertebrate macrofauna of Narara Reef off Gulf of Kachchh, Ph.D. Thesis, Saurashtra University, Rajkot (2002)
  14. Prasad M.N. and Mansuri A.P., Population density of the Limpet, *Cellanaradiata* (Born) in polluted waters at Porbandar, West coast of India, *Ind. J. Mar. Sci.*, **11**, 180-181 (1982)
  15. Underwood, A.J. & M.G. Chapman Spatial analyses of intertidal assemblages on sheltered rocky shores, *Australian Journal of Ecology*, (**23**): 138-157, (1998a)
  16. Vaghela A., Bhadja P., Ramoliya J., Patel N. and Kundu R., Seasonal variations in the water quality, diversity and population ecology of intertidal macrofauna at an industrially influenced coast, *Water Science and Technology*, **61**, 1505-1514 (2010)
  17. Vaghela A. and Kundu R., Spatiotemporal variations of hermit crab (crustacea :decapoda) inhabiting rocky shore along Saurashtra coast, western part of India, *Ind. J. Geo-Mar Sc.*, in press, (2011)
  18. Yung A.M., Differential utilization of gastropod shells by three hermit crab species in North Inlet, South Carolina, U.S.A. Crustaceana (Suppl.) *E. J. Brill. Leiden*, **5**, 49-51 (1979)