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Quantitative abundance of key intertidal gastropods at port Okha reef, Gujarat

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Abstract
Intertidal Rocky reef are valuable sites for investigation of relationships between biodiversity and ecosystem function. The Intertidal zones natural products provide food, not only for humans, but for marine species and migrating birds. The present study was envisaged to know the quantitative abundance of gastropods at Port Okha Reef, Gujarat. Sampling was done from October, 2011 to March, 2012 with $1m^2$ quadrant placed at a transect line in upper, middle and lower littoral region. Ecological attributes like density, frequency, cover and standing crop biomass were estimated to find out the dominant species from the study area.Three species of gastropods were found in major quantity from the entire three littoral zones which are *Turbo intercostalis, Turbo coronatus* and *Astraea semicostata.* Results of present investigation reveals that *T. coronatus* is the most dominant gastropod species in terms of density and biomass at Okha Reef. A clear dominance was observed in the middle littoral zone as compared to the other two littoral zones.

Keywords: rocky reef, Okha, gastropods, middle littoral zone, density

1. Introduction
Marine ecosystem particularly the Intertidal zone is one of the most dynamic zone that is the interface between sea and terrestrial environment. The most important physical factor that influences the life and activities of organisms of the intertidal zone is the existence of waves and duration of exposure to sunlight. The distribution of organisms is not homogeneous but changes according to abiotic and biotic factors. Zonation can be defined as the distribution of species and communities along environmental gradients. Littoral rocky shores are in the transition between terrestrial and marine environments, but because of water movement associated with tides, waves and spray, the transition is not abrupt but gradual. The distribution of organisms along this vertical gradient in a specific spatial sequence is known as littoral zonation. The hypothesis is that zonation is the main distribution pattern of littoral assemblages and species [1].
Gastropods are an important and representative component of rocky shore assemblages. They are the most species rich class within the mollusks with a reasonably well-known taxonomy. The types of habitats occupied by the gastropods are also extremely diversified. They inhabit both in terrestrial and aquatic environments. In marine environment, it can be found from the bottom of the deepest ocean trenches to supralittoral zone. The distribution of intertidal flora and fauna in these zones is controlled by various physical and biological factors that affect marine organisms [2]. The intertidal ecosystem around Port Okha reef is rocky in nature with sandstones of vast expanse and prolonged exposure. There is a clear indication of a relative change in the levels of land and sea in the past as is evidenced by the presence of raised coral reef at Port Okha still intact near the Railway Station [3]. Therefore, this study aims to describe abundance of key gastropod species from rocky habitats of the Port Okha reef.

2. Material and method
The present investigations have been conducted at Port Okha Reef located at $22^0$28'N and $69^0$05'E. Okha reef has a flat rocky intertidal belt, provided with many tide pools and crevices. The substratum here is made of limestone rock. The sandy beach gradually slopes into the rocky inter tidal belt from landward side. The intertidal belt is interspersed with many tide pools, puddles, crevices and small channels. The sequence of alternating tides result in the inevitable submergence and emergence of this habitat.

The key species were selected on the basis of their occurrence in the study area. As these were found to be the most prominent one and their presence throughout the study period would ensure the supply of the specimens for laboratory studies, these organisms were selected. Belt transect method was used for the quantitative assessment of Gastropod in the selected sites as per the method given by Dhargalkar and Kavlekar [4]. Gastropod species present within the quadrant were collected by hand. All the collected specimens were identified [5] counted species-wise and the number of individuals in each species was also recorded for quantitative assessment of abundance with information on density, frequency and cover. All the collected specimens from the quadrant were weighed to estimate the standing crop biomass. Important physiochemical parameters of seawater like Temperature, pH, Salinity and Dissolved oxygen were measured on the site [6]. Statistical analysis were done by using SPSS ver.16 software and Microsoft excel software.

3. Results

The ecological attribute like density, frequency, Cover and standing crop biomass were estimated during the study period. Three species, *Turbo coronatus, Turbo intercostalis and Astrea smicostata* were found prominent during the study period and selected for the ecology study. The mean density was found more in November and December months in upper, middle and lower littoral zone and lowest recorded in February and March (fig 1,2 and 3). Frequency also follow the same pattern and observed highest in middle littoral zone area (fig5). It was found that cover of species were not follow any pattern and fluctuate during the entire study period (fig 7,8 and 9). The standing crop biomass was recorded higher in month of November and December during the study period and it was recorded highest in middle littoral zone it was decreasing from January onwards (fig 10, 11 and 12). The mean density was observed highest in *T. coronatus* among the species in all the zones and lowest found in *A. semicostata* in all zones. The shell size of *Turbo intercostalis A. semicostata* and *T. coronatus* were observed 30 mm to 55 mm, 35 mm to 45 mm and 35 mm to 45 mm respectively during the study period.

Different physiochemical parameters of sea water were recorded during the study period. The mean range in air temperature was observed 19.5^{0}C to 26.9^{0}C while water temperature fluctuated in the range of 17.6^{0}C to 26.7^{0}C. The air and water temperature showed variation with season. Air temperature gradually decreased since October and reached its lowest value in January. pH was found almost in the average range of 7.5 throughout the study. The dissolved oxygen showed an increasing value from October to January with highest recorded 9.6 mg/l in January month. The mean salinity was found 34.66 ‰ during the entire study period and lowest value was recorded in January. Salinity showed positive correlation with water and air temperature while negative correlation with Dissolved oxygen (Table1).

4. Discussion

This study shows the spatial distribution of the gastropod in the intertidal area of rocky reef at Port Okha. In the present investigation maximum density and biomass value for all the three species of gastropods were recorded in the month of October to December, when climatic conditions and availability of food were highly favourable. During the alternating periods of submergence and emergence, there is only little transition of the lower littoral habitat from aquatic to semi-terrestrial type for a brief spell. During the period of emergence i.e., at low tides, the first part to get emerged is the upper littoral zone and the last emerged is the lower littoral zone. This resulted in a maximum exposure time of the upper littoral and minimum exposure time of the lower littoral. The upper littoral species are more exposed to the vagaries of aerial conditions like air temperature, relative humidity, wind velocity, etc. during the period of emergence, which results in increased rates of desiccation of their tissues. Hence, they migrate from upper to middle and lower zone. Gastropod species likes the hard substratum for high proliferation and they themselves are equipped with well-developed shell system and that helps them to sustain quite easily at changing condition of the atmospheric condition [7].

The results of present investigation are similar with the findings of the earlier workers on the seasonal variations in population dynamics of key intertidal molluscs from the Saurashtra region. These workers studied seasonal variation between the mollusc and the different physicochemical factors of sea water and concluded that the change in temperature and salinity did not found to leave any significant difference in population [8,9]. However, all the earlier finding and the present study conclude one important point and that is, maximum number of gastropod occurs during the month of December and January when the seawater temperature shows a minimum couple with maximum dissolved oxygen content. It has been suggested that patterns of marine species over large spatial scales are not explained by one single factor but by the combination of several causes and mechanisms [10]. In this present study higher values of ecological attributes were recorded during winter season at almost all the sampling sites. This could be due to low temperature with stable environment of this season [9]. The smoothness and the size of rock pool also play the major role in animal distribution[8]. It was observed during the study that in middle littoral zone sea weed thickness was very high compare to other two reason so it may also be the reason of higher number of gastropod assemblage in this zone as they feed on sea weed [11]. So the present study it would be suggested to study further the relationship between the sea weed and gastropod assemblage to acquire more data about the marine communities of this site.

5. Conclusion

The high density and biomass observed in the middle littoral zone and during the month of November and December indicate the species habitat preference. The presence of *T. coronatus* more in number in all the zone show its dominancy in the rocky habitat. The distribution of species in intertidal area depend on various factors and the present study indicate that it is not so much influenced by environmental factor but need to be studied for future. At the intertidal belt of Port Okha reef, though rock condition of the upper and middle zone provides sufficient suitable holes to dwell at, still the local people use these animals as food. As gastropod are indicator of healthy aquatic environment, this study will help in baseline data for study the climate change effect in the Port Okha reef.

6. Acknowledgment

Authors are thankful to Research officer and all the Technical staff of Resarch staion of Junagadh agricultural university at Port Okha for providing all the facilities and help during the study period.

Table 1: Table showing correlation in Physico-chemical parameters of Port okha reef during the study period

Pearson Correlations						
		DO mg/L	Airtemp (^{0}C)	Watertemp(^{0}C)	Salinity (ppt)	pH
1	DO(mg/L)	1	-0.801	-.941**	-0.731	0.535
2	Air temp	-0.801	1	.869*	0.577	-0.806
3	Water temp	-.941**	.869*	1	.873*	-0.566
4	salinity	-0.731	0.577	.873*	1	-0.267
5	pH	0.535	-0.806	-0.566	-0.267	1
**. Correlation is significant at the 0.01 level (2-tailed).						
*. Correlation is significant at the 0.05 level (2-tailed).						

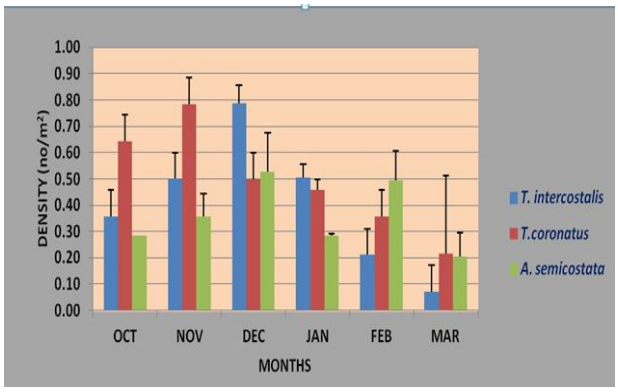

Fig 1: Density of gastropod species at upper littoeral zone

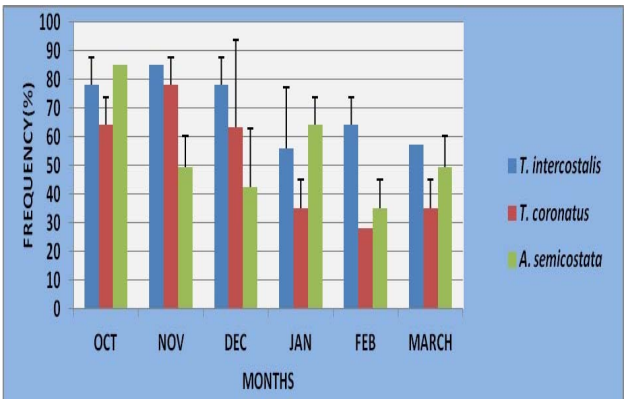

Fig 4: Frequency of gastropod species at upper littoral zone

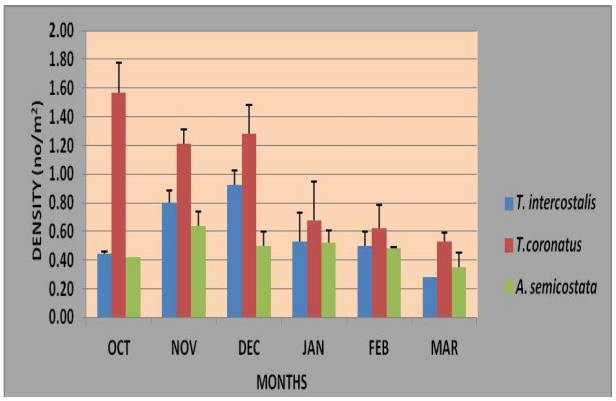

Fig 2: Mid littoral zone

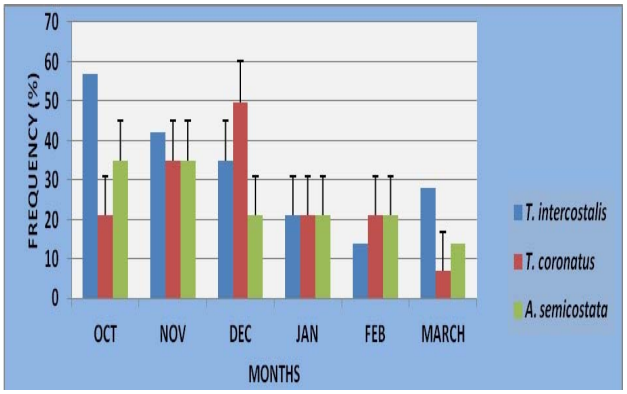

Fig 5: Mid littoral zone

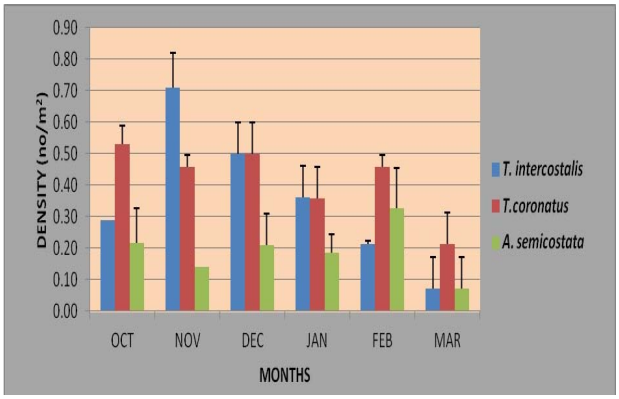

Fig 3: lower littoral Zone

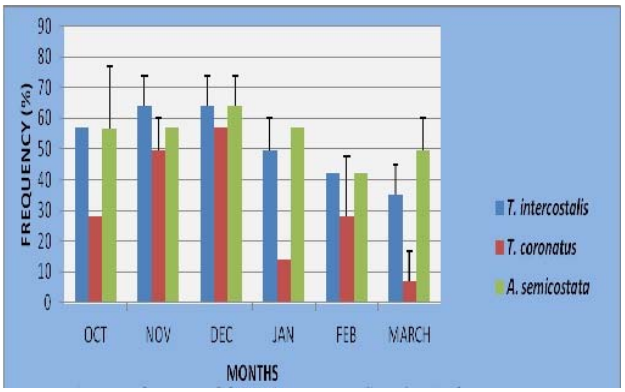

Fig 6: lower littoral Zone

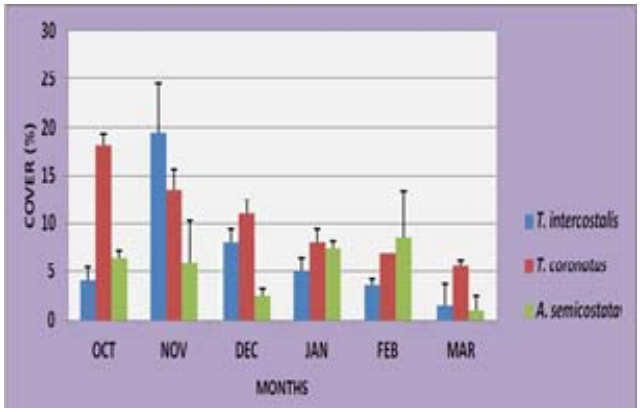

Fig 7: Cover of gastropod species at upper littoral zone

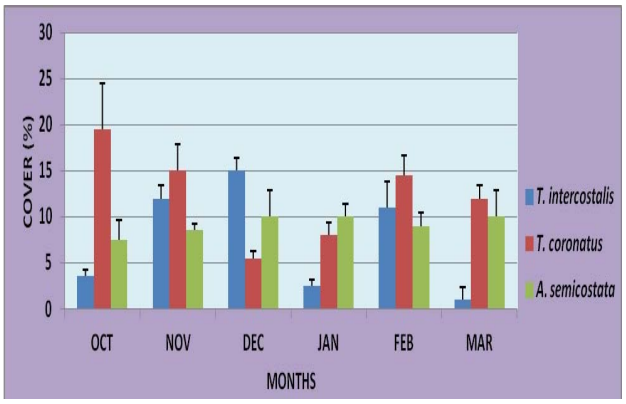

Fig 8: Mid littoral zone

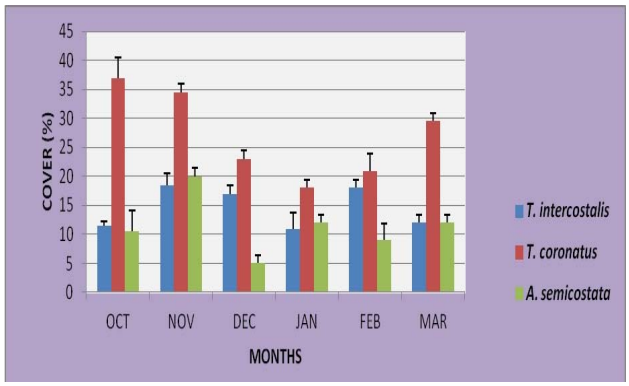

Fig 9: lower littoral Zone

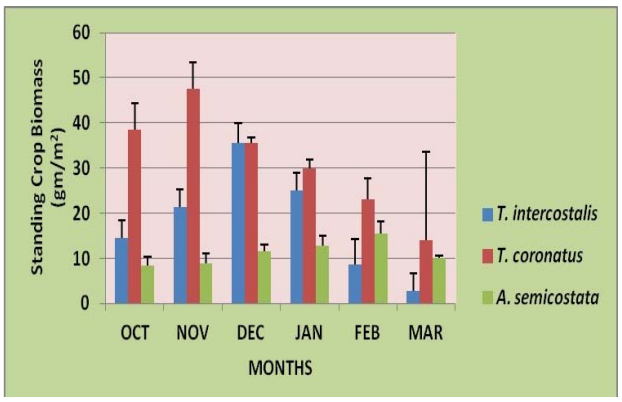

Fig 10: Standing crop biomass of gastropod species at upper littoral zone

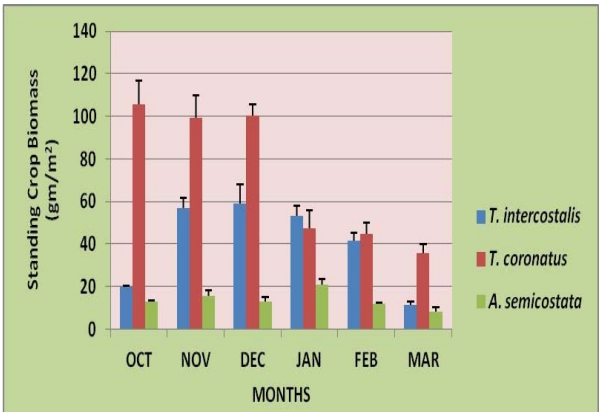

Fig 11: Mid littoral zone

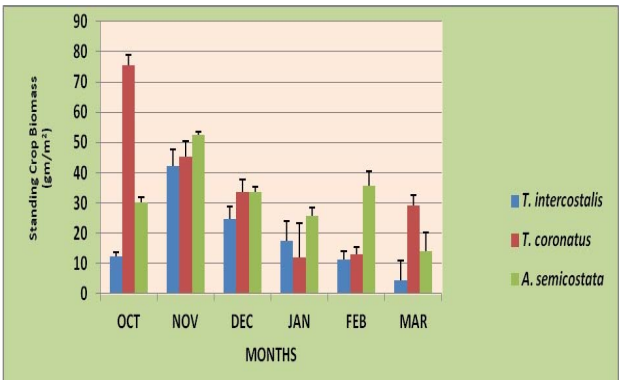

Fig 12: lower littoral Zone

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