Journal of Advances in Agricultural Science and Technology
https://www.watchpub/jaast/index.htm

THE STUDIES ON DISTRIBUTION AND COMMUNITY STRUCTURE OF FIVE SELECTED SPECIES OF MARINE GASTROPODS ALONG THE ROCKY INTERTIDAL AREA OF VERAVAL, GUJARAT, INDIA

***Ganesh Temkar[1], Azeez Abdul P.[2], S.Y.Metar[3], V. T. Brahmane[2], K. M. Sikotaria[2], K. L. Mathew[2].**

[1]College of fisheries,Veraval, Junagad Agricultural University, Junagad, Gujarat, india
[2]College of Fisheries Science, Junagadh Agricultural University (JAU),Veraval, Gujarat,– 362
[3]Marine Biological Research Station, Ratnagiri, Maharashtra-415612.

Article Info:

Author(s):
Ganesh Temkar, Azeez Abdul P., S.Y.Metar, V. T. Brahmane, K. M. Sikotaria, K. L. Mathew.

History:
Received: 20-11-2014
Accepted Date: 28-11-2014

Vol 2 (6), pp, 94-101 December, 2014

Corresponding Author:
Ganesh Temkar.
College of fisheries,Veraval, Junagad Agricultural University, Junagad, Gujarat, india.

E-mail: temkarganesh1990@gmail.com, temkarganesh90@gmail.com
Tel: (Mobile) +91 7639633562

Article Type:
Full Length Research

ISSN: 2315-9951

Abstract

The present study deals with gastropod community structure along Veraval coast, Gujarat. Total five gastropod species were selected viz., *Turbo intercostalis*, *Turbo coronatus*, *Cerithium morus*, *Cellana radiata* and *Chiton peregrines* for present study from October 2012 to April 2013. The physio-chemical parameters viz., water temperature ranged between 23.22 to 25.83 ºC, water salinity between 34.75 to 35.67 ppt, pH 7.87 to 8.28 and dissolved oxygen ranged between 4.23 to 5.39 mg L^{-1}. *Cerithium morus* and *Turbo coronatus* showed dominance along the study location. The species diversity (H') values ranged between 0.99 to 1.21. The species richness (D) values ranged between 0.90 to 0.97 and species evenness (E) values having range between 0.62 to 0.75 bids / individuals.

Keywords: Gastropod diversity, Veraval, Gujarat.

INTRODUCTION

Gastropods and bivalves are among the most conspicuous members of the macrofauna of exposed sandy beaches (Brown & McLachlan, 1990), being generally more abundant on dissipative and intermediate beaches than on reflective beaches (Dexter, 1984). India has a total heritage of 3271 species of mollusks belonging to 220 families and 591 genera, including about 1900 species of gastropods (Appukuttan, 1996). Usually they are found in the water where calcium concentration is more (Tonapi, 1980). These bottom dwelling organisms play an important role in an aquatic community. They also make up an important component of the aquatic food web. Gastropods are a major class of organisms that resides in the intertidal habitat (Esqueda et al., 2000). Because of their imposex capability and ability to accumulate toxins, gastropods are often used as bioindicators of the condition of the intertidal zone (Daka et al., 2006; Gomez-Ariza et al., 2006). Moreover, gastropods vary morphologically in relation to their surroundings. On the same rocky shore, individuals of the same species may have different morphologies as a result of different microhabitats (DeWolf et al., 1997; Britton, 1995).

Gastropods also help curb macroalgae growth (Guerry, 2008; Thomas et al., 2008) and are an essential part of the diets of many molluscivorous intertidal animals (Creswell, 1990; Castell & Sweatman, 1997; Burkepile, 2007) Forming a significant proportion of intertidal organisms, being bioindicators, exhibiting morphological variation, and being part of the intertidal food chain are just some of the reasons why gastropods are of the more well-studied organisms in rocky intertidal habitats. These are also the exact reasons as to why it is crucial to understand how human interference affects their abundance and growth.

MATERIAL AND METHODS

The present study was conducted along the South Saurashtra coast at Veraval (Lat. 20°54' N, Long. 70°21' E), Gujarat, India (Figure. 1 and 2). The study was

Figure. 1: Map of the study location, Veraval, West coast of Gujarat.

Figure 2: Study site Veraval coast of Gujarat.

conducted for seven months from October, 2012 to April, 2013. Sampling was done by random sampling method. Samples were collected using the square transects of 1 m^2 (100 x 100 cm.) which was laid randomly in a line up to water line during low tide. The substratum of Veraval coast is mainly rocky also with few sandy patches. There was steep vertical decline towards subtidal zone at the lower littoral zone. The intertidal belt is not uniform and exposure of rocky shore is not significantly long. The intertidal zone covers a distance of about 60-90m during spring tides (Vaghela & Khundu, 2012).

Sampling method and field work

For study of the distribution pattern and population ecology , five selected species of gastropod viz. *radiata* and *Chiton peregrinus* were selected (Figure. 6). Sampling was done at fortnightly intervals for seven months (October 2012 to April 2013), along the rocky intertidal area of Veraval coast. The Quadrates of 1 m^2 were laid randomly from upper to lower littoral zones covering maximum area in line having area up to 400 × 90 m^2. During each sampling 100 quadrates were laid in

Figure 3: Variations of Physio-chemical parameters along Veraval coast.

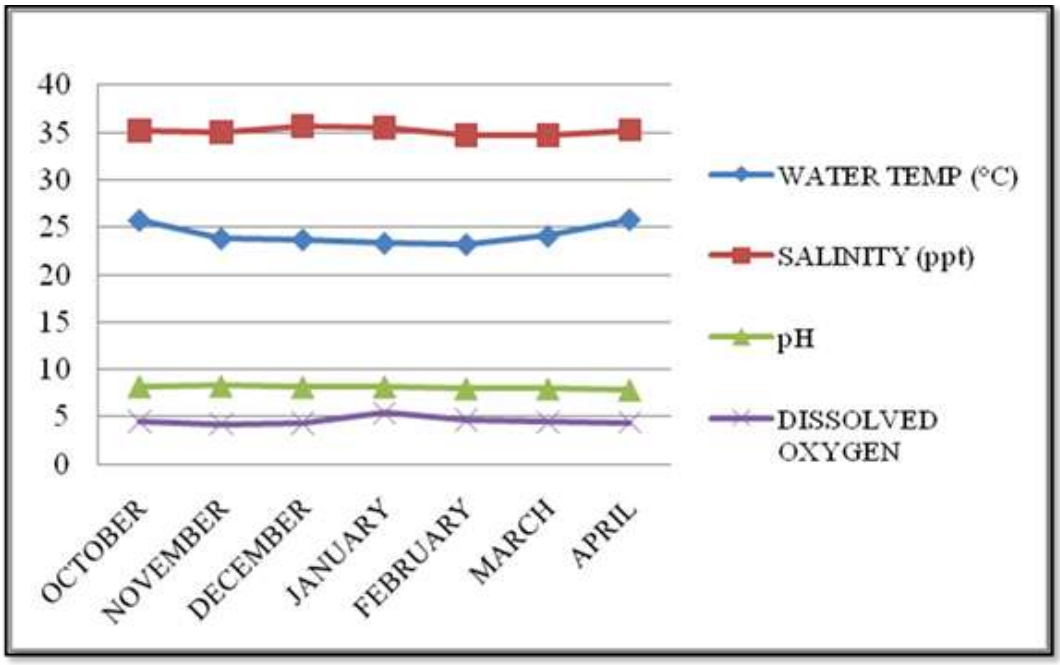
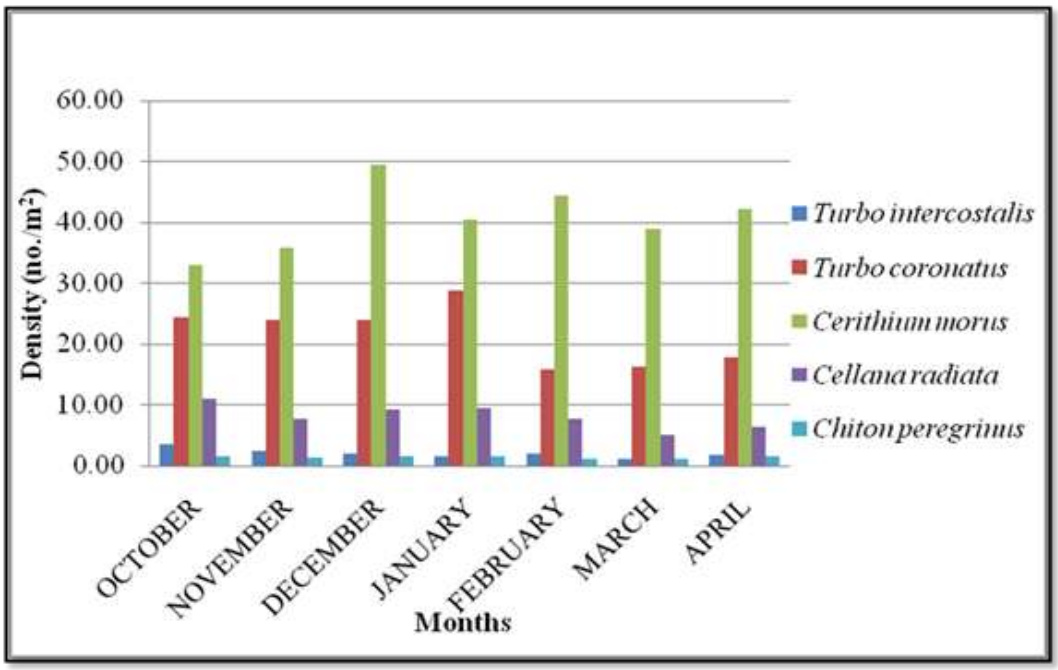


Figure 4: Variations in species-wise density (no./m^2) of selected gastropod species along Veraval coast.



selected area of Veraval coast (Jaleshwar coast up to Light House). The sampling was done along the intertidal area during low tide. Among the ecological attributes, density, species diversity (H'), species richness (D) and species evenness (E) of five selected species was calculated.

Physiochemical parameters

The surface water temperatures was measured using standard mercury filled centigrade thermometer and for pH measurement multi-parameter PCSTestr (35 series) was used. For dissolved oxygen level and water salinity,

Figure 5: Variations in different species diversity indices among gastropod population along Veraval coast.

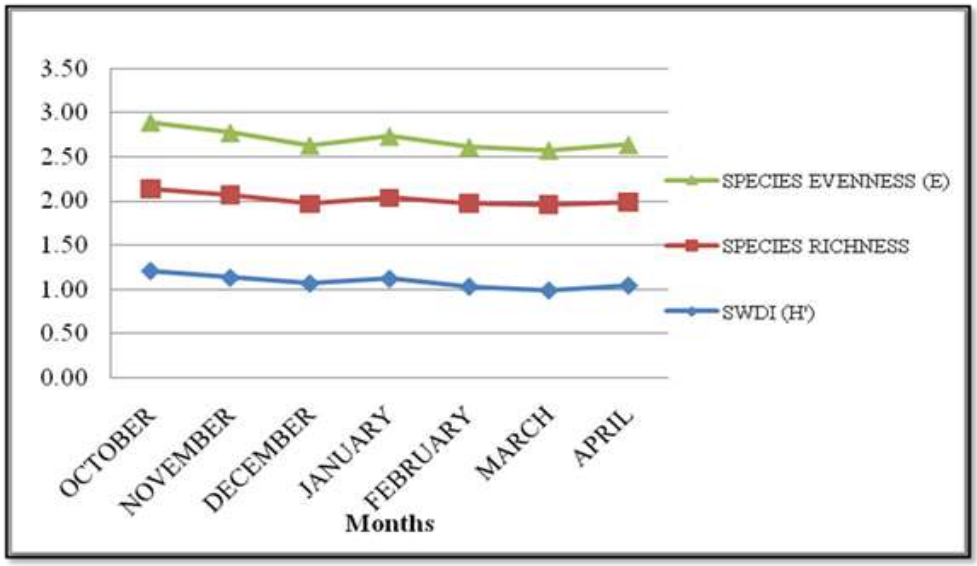


Figure 6: Five selected gastropod species for the present study.

Turbo intercostalis

Turbo coronatus

Cellana radiata

Cerithium morus

Chiton peregrinus

the DO meter (DO600) refractometer (APHA, 1998) was used respectively.

Gastropod community study

The variation in population density of gastropod was expressed in no./m^2 by using formula by Misra (1968). The species richness was estimated by using Margalef's Index (D; Margalef, 1958). The species diversity was calculated by using Shannon's - Weiner index (H'; Shannon's – Weiner, 1949).

$$Density = \frac{Total\ number\ of\ individuals\ recorded\ from\ the\ sample\ plot}{Total\ number\ of\ sample\ plot\ studied}$$

Margalef's Index (D) $D = \frac{S-1}{\ln (N)}$

Where, N = total number of individuals collected
S = number of species

Shannon's - Weiner index (H')

$$H' = -\sum_{i=1}^{S} \frac{ni}{n} \times \ln \frac{ni}{n}$$

Where, H' = the sample diversity
S = number of species;

Apart from that species evenness index (E; Pielou, 1966) were also studied to understand the distribution of the gastropod species.

Evenness Index (E)

$$D = \frac{H'}{\ln (S)}$$

Where, H' = the sample diversity
S = number of species

RESULTS AND DISCUSSION

Gastropod molluscs are collected and used for food by coastal people of the Saurashtra peninsula (Misra and Kundu, 2005 and Vaghela, *et al.* 2010). It was earlier reported that highest diversity of molluscs groups was due to the gastropod species occur in the intertidal zone when the wave action is moderate to strong and this also increases the recruitment and settlement of these animals at intertidal zone (Prasad and Mansuri, 1982; Misra and Kundu, 2005 and Vaghela, *et al.* 2010).

Physiochemical parameters

The seawater surface temperature varied from 23.22ºC to 25.83ºC in coastal area of Veraval coast during the study. Salinity as well as pH varied from 34.75 to 35.67 ‰ and 7.87 to 8.28 respectively. During March month the minimum value for salinity (34.75 ‰) and minimum value for pH (7.87) was recorded during April month. The Dissolved oxygen content varied from 4.23 to 5.39 mg L^{-1} along with the Veraval coast (Figure. 3). Bhadja (2010) reported that along Veraval coast the highest temperature (25.83 ºC) was recorded during summer month which was very much similar with present study. In the same study the highest pH was recorded along Veraval coast was 8.32, while highest salinity was 35.30‰ and the dissolved oxygen value was ranged between 5.62 to 6.38 mg L^{-1}. As like temperature values of pH, salinity and dissolved oxygen were shows nearby similarities with present study.

Other studies along Veraval coast by Raghunathan, *et al.* (2003), reported that water temperature, salinity, pH and dissolved oxygen was varied between 26.50 – 26.80 ºC, 34.40 – 34.60 ppt, 8.32 – 8.34 and 4.11 – 4.96 ml l^{-1}, respectively during October 1998, while during June 1999 these parameters ranged between 26.50 – 27.00 ºC, 34.60 ppt. (Max.), 8.33 (Max.) and 4.36 – 5.01 ml l^{-1}, respectively. This shows as like Bhadja (2010) studies results were same with present study. On the other hand, another study along Veraval coast by Bhadja and Kundu (2012) recorded 21.14 ± 0.08 – 25.83 ± 0.11 ºC water temperature, 32.47 ± 0.06 – 35.40 ± 0.08 ‰ salinity and pH ranged between 8.20 ± 0.01 – 8.32 ± 0.06, while dissolved oxygen 5.64 ± 0.04 – 6.38 ± 0.04 mg l^{-1}, indicates the salinity, pH and dissolved oxygen values shows little difference with present study.

Gastropod Community Composition

For present study five species of gastropod were selected viz., *Turbo intercostalis, Turbo coronatus, Cerithium morus, Cellana radiata* and *Chiton peregrinus*, whereas study was conducted in two seasons winter and summer. Amongst them *Turbo coronatus* and *Cerithium morus* shows highest individual count throughout the study. During present study, it was observed that these five species of gastropods are associated with seaweed. The distribution pattern of selected species shows that at the upper littoral zone the *Cellana radiata* and *Chiton peregrinus* were observed mostly, while in the middle littoral zone the *Turbo intercostalis* and *Turbo coronatus* were observed mostly throughout the study, which shows similar results with Bhadja (2010) and Vaghela (2010).

On the other hand, *Ceratrium caeruleum* species was found mostly on upper littoral zone as well as lower middle littoral zone of intertidal substratum of Dwarka coast (Gohil and Kundu, 2013), which was having similar pattern of present study along Veraval coast. The association of these animals due to the algae provided them protection from extreme high and low temperature

Table 1: Month-wise variations in selected gastropod species density (no./m^2) throughout the study period along, Veraval Coast**.**

Sr. no.	Months / Species	October	November	December	January	February	March	April
1	*Turbo intercostalis*	3.52	2.35	1.97	1.44	2.05	1.20	1.76
2	*T. coronatus*	24.41	24.01	23.91	28.80	15.85	16.35	17.85
3	*Cerithium morus*	32.96	35.79	49.45	40.42	44.51	38.91	42.10
4	*Cellana radiata*	11.04	7.81	9.24	9.44	7.72	4.98	6.41
5	*Chiton peregrinus*	1.64	1.34	1.51	1.62	1.11	1.07	1.52

and their dislodgement by wave action. While another reason for their algal association may be that they also feed on spores, filaments or detritus matter of these algae as evident by their food content (Misra, 2004). The *Cellana radiata* and *Chiton peregrinus* was associated with *Ulva lactuca*, whereas *Turbo sp.* also associated with Ulva *lactuca* and *Ulva fasciata* for feeding, which shows similar observations as that of Bhadja (2010).

The gastropod density ranged from approximately 62.49 to 86.07 no./m^2. The maximum density was recorded in December a winter month and lowest in March a summer month (Table. 1; Figure. 4). In general, amongst the selected species *Cerithium morus* was observed more and the density was ranged from 32.96 to 49.45 no./ m^2, which was followed by *Turbo coronatus* (15.85 to 28.80 no./ m^2), *Cellana radiata* (4.98 to 11.04 no./ m^2) and *Chiton peregrinus* (1.07 to 1.64 no./ m^2) throughout the study (Table. 1).

The Shanon- Weiner Species diversity index ranged from 0.99 to 1.21 during the present study, which indicates that the species diversity was normal. The maximum diversity index value was observed in the month of October which is winter month whereas the minimum value was observed during March (summer month). The Margalef's Species Richness Index (D) varied from 0.90 to 0.97 and on the other hand Species Evenness Index (E) varied in very narrow range i.e. 0.62 to 0.75. The value of richness and evenness not shows much more difference. Species Richness shows the maximum value during March month, while it shows lowest value during December month and Species Evenness was maximum during October month and lowest during March month, respectively (Figure. 5).

The study along Veraval coast of *Turbo coronetus* and *Turbo intercostalis* shows, the maximum abundance value of *Turbo coronetus* was 1.38 no./ 0.25 m^2 and of *Turbo intercostalis* was varies between 47.78 no./0.25 m^2 and 56.67 no./0.25 m^2 (Vaghela, 2010). Where in present study the values of *Turbo coronetus* were high and *Turbo intercoastalis* values were very less, this may mostly happen due to harvesting of *Turbo intercoastalis* for food by coastal people mostly. The Shannon's diversity index of turrids was varied from 1.94 – 0.68, the species richness was varied from 2.21 to 0.31 and the species evenness was varied from 0.9 to 0.6 among the four landing centers of Southeast coast of India (Elaiyaraja, et al. 2012). Another study shows Shannon's-Weiner biodiversity index (H') ranged from 2.1749 in the pre-monsoon season to 5.7641 during the post-monsoon months, while the Margalef (Species richness) index ranged from 0.5412 in the pre-monsoon season to 4.4866 during the post-monsoon months and the Pielou (Species evenness) index was ranged from 0.9128 in the pre-monsoon season to 1.9534 during the post-monsoon months, along the GOA coast (David, 2013). The species diversity, species richness and species evenness values of above studies were higher as compare with the present study. David (2013) also reported that species abundance was higher in rocky inter-tidal zones when compared with sandy and or sub-tidal zones along GOA coast. The present study also revealed that gastropod species abundance along Veraval coast was good and rich in species diversity, because the coast having rocky area that provides substrate for gastropods population.

ACKNOWLEDGEMENTS

Authors would like to thank Dr. K. L. Mathew, Professor and Head of Dept. Fisheries Resource Management and the Dr. A. Y. Desai, Dean and Principal, College of Fisheries, Veraval, Junagadh Agricultural University, Gujarat for granting permission to carry out present study.

REFERENCES

American Public Health Association. 1998. Standard Methods for examination of water and wastewater. 20'th edition. American Public Health Association, Washington, DC.

Appukuttan KK (1996). *In:* Marine molluscs and their conservation. Published by Central Marine Fisheries Institute, Cochin, India.

Bhadja P (2010). Marine wealth of Saurashtra Coast: Spatial and Temporal variations in the seawater Quality and its role in intrertidal assemblage and macrofaunal diversity around anthropogenically

influenced shores. *Ph. D. Thesis*, Saurashtra University, Rajkot, India.
Bhadja P, Khundu R (2012). Status of the seawater quality at few industrially important coast of Gujarat (India) off Arebian Sea. Indian Journal of Geo-Marine Sciences, 41(1): 90 – 97.
Britton JC (1995). The relationship between position on shore and shell ornamentation in 2-size dependent morphotypes of *Littorina striata*, with an estimate of evaporative water-loss in these morphotypes and in *Melarhaphe neritoides*. *Hydrobiologia,* 309(1–3): 129–142.
Brown AC, Mclachlan A (1990). Ecology of sandy shores. *Elsevier*, Amsterdam.
Burkepile DE, Hay ME (2007). Predator release of the gastropod *Cyphoma gibbosum* increases predation on gorgonian corals. *Oecologia,* 154(1): 167–173.
Castell LL, Sweatman HPA (1997). Predator-prey interactions among some intertidal gastropods on the Great Barrier Reef. J. Zool*.,* 241(1): 145–159.
Creswell PD (1990). Handling times, prey size and species selection by *Cancer novaezelandiae* (Jacquinot, 1853) feeding on molluscan prey. *Journal of Experimental Marine Biology and Ecology,* 140(1–2): 13–28.
Daka ER, Ifidi I, Braide SA (2006). Accumulation of heavy metals from single and mixed metal solutions by the gastropod mollusc *Tympanotonus fuscatus* (Linnaeus) from a Niger Delta estuary: Implications for biomonitoring. *African Journal of Biotechnology,* 5(20): 1954–1962.
David A (2013). Biodiversity and distribution of marine gastropods (Mollusca) during pre- and post-monsoon seasons along the Goa coastline, India. *J. Mar. Biol. Ass. India,* 55 (1): 17-24.
Dewolf H, Backeljau T, Medeiros R, Verhagen R (1997). Microgeographical shell variation in *Littorina striata*, a planktonic developing periwinkle. *Marine Biology*, 129(2): 331–342.
Dexter DM (1984). Temporal and spatial variability in the community structure of the fauna for four sandy beaches in southeastern New South Wales. *Australian* J. Marine and Freshwater Res., 35: 663–672.
Elaiyaraja C, Sekar V, Rajasekaran R, Fernando JO (2012). Diversity and Seasonal distribution of the turrids (Gastropoda: Turridae) among the four landing centers of Southeast coast of India. *Annals of Biological Research,* 3(12): 5718-5723.
Esqueda MC, Rios-Jara E, Michel-Morfin JE, Landa-Jaime V (2000). The vertical distribution and abundance of gastropods and bivalves from rocky beaches of Cuastecomate Bay, Jalisco. Mexico. *Revista de Biologia Tropical,* 48(4): 765–775.
Gohil B, Kundu R (2013). Ecological status of *Cerethium caeruleum* at Dwarka coast, Gujarat. *Indian Journal of Geo-marine Sciences,* 42(4): 481 - 486.
Gomez-Ariza JL, Santos MM, Morales E, Giraldez I, Sanchez-Rodas D, Vieira N, Kemp JF, Boon JP, Ten-Hallers-Tjabbes CC (2006). Organotin contamination in the Atlantic Ocean off the Iberian Peninsula in relation to shipping. *Chemosphere*, 64(7): 1100–1108.
Guerry AD (2008). Interactive effects of grazing and enrichment on diversity; Conceptual implications of a rocky intertidal experiment. *Oikos*, 117(8): 1185–1196.
Irma D, Sofyatuddin K (2012). Diversity of Gastropods and Bivalves in mangrove ecosystem rehabilitation areas in Aceh Besar and Banda Aceh districts, Indonesia. Aquaculture, Aquarium, Conservation & Legislation International Journal of the Bioflux Society, 5(2): 55-59.
Margalef R (1958). Temporal succession and spatial heterogeneity in phytoplankton. *In*: Perspectives in Marine biology. (Eds. Buzzati-Traverso), Univ. Calif. Press Berkeley, pp. 323-347.
Misra R (1968). Ecology Work Book. Oxford and IBH Publishing Co., Calcutta, India.
Misra S (2004). Studies on the biodiversity and the impact of anthropogenic pressre on the ecology and biology of certain intertidal macrofauna. *Ph. D. Thesis*, Saurashtra University, Rajkot, India.
Misra S, Kundu R (2005). Seasonal variations in population dynamics of key intertidal mollusks at two contrasting locations. *Aquatic ecology,* 39: 315 – 324.
Pielou EC (1966). The measurement of diversity in different types of biological collections. *J. Theoret. Biol.,* 13: 131-144.
Prasad MN, Mansuri AP (1982). Population density of the Limpet, *Cellana radiate* (Born) in polluted water at Porbandar, West coast of India. *Ind. J. Mar. Sci.,* 11: 180 -181.
Raghunathan C, Tewari A, Joshi VH, Sravan KGV, Trivedi HR, Khambhaty Y (2003). Impact of turbidity on intertidal macrofauna at Gopnath, Mahuva and Veraval coasts (west coast of India). Indian Journal of Marine Sciences, 32(3): 214 – 221.
Shannon CE, Wiener W (1949). The mathematical theory of communication. Urbana, University of Illinois Press, 177 p.
Thomas W, Melissa W, Mathew AV (2008). Population structure of turbinid gastropods on wave-exposed subtidal reefs: effects of density, body size and algae on grazing behaviour. *Marine Ecology Progress Series*, 362: 169–179.
Tonapi GT (1980). *In:* Freshwater animals of India, An ecological approach. Published by Oxford and IBH Publishing Company, New Delhi.
Vaghela A, Khundu R (2012). Spatiotemporal variations of hermit crab (crustacean: decapoda) inhabiting rocky shore along Saurashtra coast, western coast of India. *Indian Journal of Geo-Marine Sciences*, 41(2): 146-151.
Vaghela A (2010). Spatial and Temporal Variations in Population Dynamics of few Key Rocky Intertidal Macrofauna at Anthropogenically Influenced Intertidal shoreline. *Ph. D. Thesis*, Saurashtra University, Rajkot, India.
Vaghela A, Bhadja P, Ramoliya J, Patel N, Kundu R (2010). 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.