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Diversity and Distribution of Marine Gastropods at Rocky Intertidal Shore of Veraval coast of Gujarat

[1]Rahul B. Solanki*, [2]Dr. Jatin Raval, [3]Dr. Vibhuti Raval

[1]Department of Zoology, Faculty of Science, Noble University, Junagadh-362001, Gujarat State of India.

[2]Assistant Professor - Zoology, Department of Life Sciences, BKNM University, Junagadh-362263, Gujarat State of India

[3]Assistant Professor and Head, Department of Zoology, Faculty of Science, Noble University, Junagadh-362001, Gujarat State of India.

[1]Email – 9512450843rahulsolanki@gmail.com, [2]Email – drjatinraval@gmail.com

[3]Email - vibsraval@gmail.com

[1]Contact Number: 9265305536

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Abstract: *Intertidal zone contains a high diversity of species, and the zonation created by the tides causes species ranges to be compressed into very narrow bands. This zone is home of many several species from different taxa including porifera, annelids, coelenterates, molluscs and crustaceans. Gastropoda is the largest class of mollusca phylum. The present investigation has been done on the diversity and distribution of marine gastropods alongside at rocky intertidal shore of Veraval. The coastline has mostly steeply declined tidal flat that makes it difficult to access the lower littoral zone. Quadrate method was followed on monthly basis from July 2020 to March 2021. It was utilized for to appraise population density, abundance, and frequency of gastropods. In this study, gastropod fauna was recorded 32 species belonging to 7 Order and 16 Families. There was 2 km long belt intertidal rocky coastal area with 120 mt stretch taken for study. A study was carried out by visiting the coast at different time and tide also. Many photographs click of gastropods shell were captured. Identification was done by using of standard literature. Results showed that major molluscan population belonged to class gastropoda with dominating species like Cerithium caeruleum, Lunella coronate, Turbo intercostalis, Peronia verruculata, Astraea stellate and Cypraea eglantine.*

Key Words: *Diversity, Distribution, Marine, Gastropods, Intertidal zone*

1. INTRODUCTION:

The ocean is a treasure of enormous biodiversity. The molluscs evolved about 600 million years ago during the Cambrian period according to the geological timescale (Anandaraj, Balasubramanian, Murugesan, & Muthuvelu, 2012). The molluscs are a miscellaneous group of soft-bodied animals (M. Karthick, R. Saravanakumari, A. Selva Suvitha, T. Parvathi Kalyani, & R. Azhagu Raj, 2020). The vital physical elements affecting the life and activities of flora and fauna of the intertidal zone are the presence of waves and the duration in contact to sunlight (Pandey, Desai, & Mathew, 2017). These animals have soft bodied structures and are kept by a single, calcareous shell that differs in size, shape, and colour(Yunita, Rizka, Tatang, & Milade, 2021). The phylum Mollusca includes seven classes: Gastropoda, Polyplacophora, Aplocophora, Monoplachopora, Cephalopoda, Scaphopoda and Bivalvia (Shabdin, Azizil , & Syahidatul, 2014). Gastropoda is the major class of Mollusca containing 80% fauna of this phylum which comprise

10,000 species and have spread to nearly every continent (Hadisusanto, Susintowati, Puniawati, Poedjirahajoe, & Handayani, 2019; Dodiya & Poriya, 2024). They are an significant element of the intertidal lifeforms, with an exclusive combination of properties that make them suitable for studied like, (1) Shells of molluscans persist relatively intact for some time after the death of the organism, increasing the chances of sampling seasonal and rare species (2) Identification of species is mostly possible at any growing stage (3) They are all noticeable and collectable with the naked eye (David, 2013). Gastropods and bivalves are among the most exposed members of the macrofauna the live on sandy beaches (Agravat & Raval, 2019). The Saurashtra coast situated in the North piece of the Indian coastline, is described by sandy, rough and sloppy Intertidal zones, holding onto rich and different widely varied biota (Ravaliya & Raval , 2020). Hence, in the present study, an attempt was made to determine the diversity of marine gastropods, at the intertidal zone of Jaaleshvar site, Veraval coast of Gujarat.

2. MATERIALS AND METHOD / METHODOLOGY:

Characteristics of the Study Area

The Veraval is one of the major fish landing sites of India situated (20º 54’ 36.210’’ N, 70º 21’ 09.090’’ E) in Saurashtra, surrounded by many chemical and cement factories. And also, many fish processing units found in Veraval. (Ravaliya & Raval , 2020; Chavda & Kundu, 2022). Veraval has a blistering semiarid environment with a warm and hot temperature over time. The shore has generally steeply declined salt marshes making it challenging to get to the lower littoral zone. The intertidal zone of Jaaleshvar coast is portrayed by its rough sandy intertidal zones holding on to rich and boundless of widely varied vegetation. The substratum of this coast is mainly rocky with a few sandy patches with small sized depressions scattered around several rocky pools and puddles. The sand portion of the coastline mainly consists of lime and shells, here spray zone is sandy.

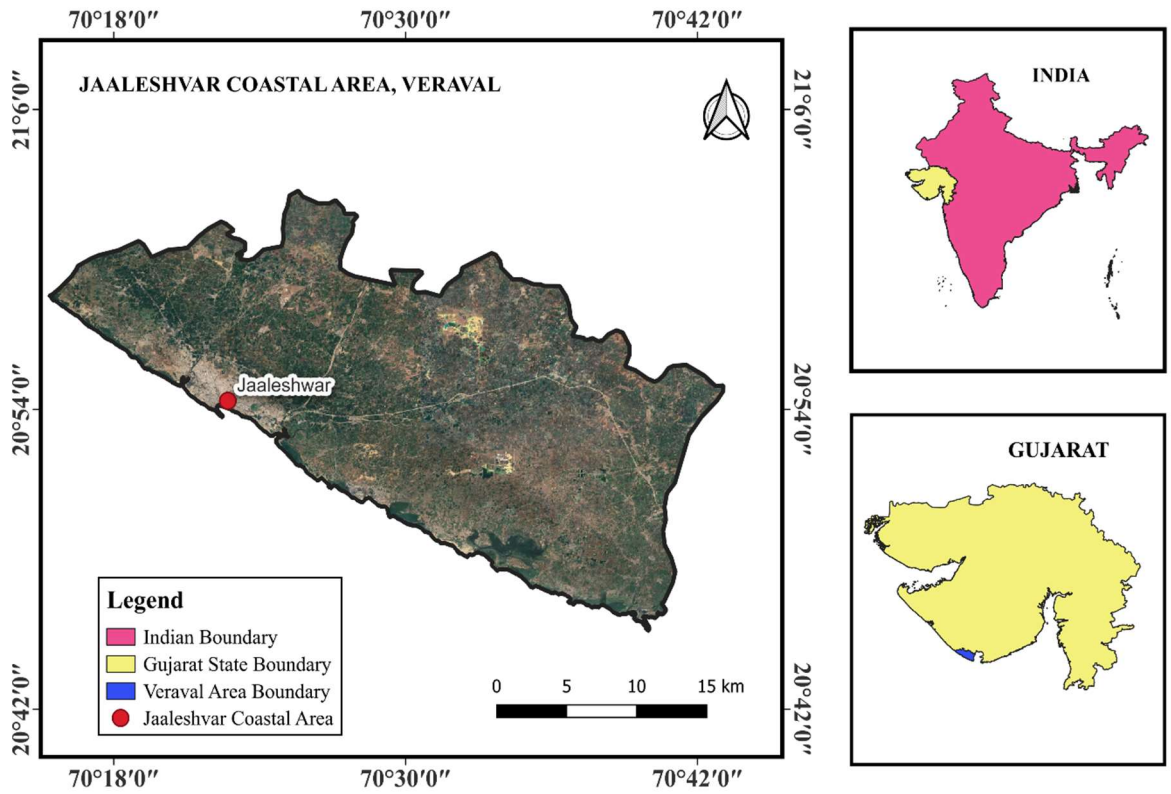

Figure-1: Map of Study area

Figure-2: Intertidal zone at Jaaleshvar coastline Veraval

Data collection

Quadrat techniques are tried and true testing method that are most appropriate for coastal zones where access to a territory is moderately simple (Misra, 1968). Quadrat testing is an essential strategy involved by the Natural Geography in Shore Regions project. The assortment and assignment in the intertidal belt at position were concentrated during the low tide by quadrat system. The distributional investigation of gastropods at Jaaleshvar coastal area was carried out from July 2020 to March 2021. Quadrat of 0.25 m^2 was laid along range on the intertidal region with ordinary stretch (Once in month). 30 quadrates (10 Quadrat in each intertidal zone) were laid a crisscross way at the upward intertidal zones to cover the best uncovered domain.

Data analysis

Photography was done for the identification of animal species with the assistance of identification keys, literature like books (Apte, 1998), reports, research articles (Mohamed & Venkatesan; Høisæter, 2009; Paul, Panigrahi, & Tripathy, 2014; Soni & Thakur, 2015) and huge utilization of web (WoRMS, n.d.). Among the ecological features, seasonal variations in the population density and abundance of major prominent gastropod species in study site were calculated (Misra, 1968). The collected data of ecological traits were calculated by below formula were treated as raw data from which the total density, total abundance and total frequency standards.

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

$$\text{Abundance} = \frac{\text{Total number of individuals recorded}}{\text{Total number of sample plot where the individuals occurred}}$$

$$\text{Frequency} = \frac{\text{Total number of sampled plot where the individual occurred}}{\text{Total number of sample plot studied}} \times 100$$

3. RESULT AND DISCUSSION:

The distribution of marine gastropods was examined along the intertidal belt of Jaaleshvar, Veraval coast of Gujarat. For the study, 32 species of gastropods were recorded. The distributional data was carried out for nine months i.e., from monsoon to spring season (July 2020 to March 2021) and the following check list prepared.

Table-1: Checklist of the diversity of Gastropod species with sub-class, Order and family.

Class	Subclass	Order	Family	Species
Gastropoda	Caenogastropoda	Caenogastropoda	Cerithiidae	*Cerithium columna* (G. B. Sowerby I, 1834)
				Clypeomorus bifasciata (G. B. Sowerby II, 1855)
				Cerithium scabridium (Philippi, 1848)
				Cerithium caeruleum (G. B. Sowerby II, 1855)
		Littorinimorpha	Littorinidae	*Echinolittorina malaccana* (Philippi, 1847)
			Cypraeidae	*Cypraea eglantine* (Duclos, 1833)
			Bursidae	*Bursa tuberculata* (Broderip, 1833)
			Rostellariidae	*Tibia curta* (G. B. Sowerby II, 1842)
		Neogastropoda	Conidae	*Conus mutabilis* (Reeve, 1844)

				Conus coronatus (Gmelin, 1791)
			Mitridae	*Strigatella scutulata* (Gmelin, 1791)
				Scabricola guttata (Swainson, 1824)
			Muricidae	*Murex tribulus* (Linnaeus, 1758)
				Purpura persica (Linnaeus, 1758)
				Thais (Thisella) sacellum (Gmelin, 1791)
				Stramonita haemastoma (Linnaeus, 1767)
				Chicoreus ramosus (Linnaeus, 1758)
			Pisaniidae	*Cantharus fumosus* (Dillwyn, 1817)
			Olividae	*Oliva caerulea* (Roding, 1798)
				Oliva elegans (Lamarck, 1811)

				Oliva sayana (Ravenel, 1834)
	Vetigastropoda	Trochida	Turbinidae	*Astraea stellate* (Roding, 1798)
				Lunella coronate (Gmelin, 1791)
				Turbo intercostalis (Menke, 1846)
				Turbinella pyrum (Linnaeus, 1767)
				Turbo bruneus (Röding, 1798)
	Neritomorpha/ Patellogastropoda	Cycloneritida	Neritidae	*Nerita undata* (Linnaeus, 1758)
			Nacellidae	*Cellana karachiensis* (Winckworth,1930)
				Cellana radiata (Born, 1778)
			Patellidae	*Patella vulgate* (Linnaeus, 1758)
	Heterobranchia	Aplysiida	Aplysiidae	*Aplysia juliana* (Quoy & Gaimard, 1832)

		Systellomma-tophore	Onchidiidae	*Peronia verruculata* (Cuvier, 1830)

In this investigation 32 species belonging to 7 orders, 16 families of Gastropods were recorded during study period. This shows that there is great diversity of Gastropods observed along Veraval coast. Checklist was prepared of the diversity found at coast and the species which were found was frequently was counted for single time for maintain accuracy of the number of species observed at coast.

Table-2: Checklist of the Gastropod species recorded month wise during the study period. (+ or - signs denote presence or absence of species)

No.	Species	Month								
		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1	*Cerithium columna* (G. B. Sowerby I, 1834)	+	-	-	-	+	-	-	-	-
2	*Clypeomorus bifasciata* (G. B. Sowerby II, 1855)	-	-	-	-	+	-	-	-	+
3	*Cerithium scabridium* (Philippi, 1848)	-	+	-	-	-	-	-	-	-
4	*Cerithium caeruleum* (G. B. Sowerby II, 1855)	+	+	+	+	-	+	+	+	+
5	*Echinolittorina malaccana* (Philippi, 1847)	+	-	+	+	+	+	+	+	+
6	*Cypraea eglantine* (Duclos, 1833)	+	+	+	+	+	+	+	-	+
7	*Bursa tuberculate* (Broderip, 1833)	+	+	-	+	-	+	+	-	-
8	*Tibia curta* (G. B. Sowerby II, 1842)	-	+	+	+	+	-	+	-	+
9	*Conus mutabilis* (Reeve, 1844)	+	+	-	+	-	+	+	+	+
10	*Conus coronatus* (Gmelin, 1791)	-	-	+	+	-	+	-	+	+
11	*Strigatella scutulata* (Gmelin, 1791)	-	-	+	+	+	+	+	-	+
12	*Scabricola guttata* (Swainson, 1824)	-	+	-	-	-	-	-	-	-
13	*Murex tribulus* (Linnaeus, 1758)	+	-	-	-	+	-	+	-	+
14	*Purpura persica* (Linnaeus, 1758)	+	+	-	+	+	-	-	-	+
15	*Thais (Thisella) sacellum*	+	-	+	+	-	-	+	-	+

	(Gmelin, 1791)									
16	*Stramonita haemastoma* (Linnaeus, 1767)	+	+	-	+	+	-	-	-	+
17	*Chicoreus ramosus* (Linnaeus, 1758)	-	+	-	-	-	-	-	-	-
18	*Cantharus fumosus* (Dillwyn, 1817)	+	-	+	-	-	-	-	-	-
19	*Oliva caerulea* (Roding, 1798)	+	-	-	-	+	-	-	+	-
20	*Oliva elegans* (Lamarck, 1811)	-	-	+	-	-	+	-	-	-
21	*Oliva sayana* (Ravenel, 1834)	-	-	-	+	-	-	-	-	-
22	*Astraea stellate* (Roding, 1798)	+	+	+	+	+	-	-	+	+
23	*Lunella coronate* (Gmelin, 1791)	+	+	+	+	-	+	+	+	+
24	*Turbo intercostalis* (Menke, 1846)	+	+	+	+	+	+	+	+	+
25	*Turbinella pyrum* (Linnaeus, 1767)	+	-	-	-	-	-	-	-	-
26	*Turbo bruneus* (Röding, 1798)	+	+	-	+	+	+	+	+	+
27	*Nerita undata* (Linnaeus, 1758)	+	+	-	+	+	-	+	+	+
28	*Cellana karachiensis* (Winckworth, 1930)	+	+	-	-	+	+	-	+	+
29	*Cellana radiata* (Born, 1778)	+	+	+	+	+	-	+	+	+
30	*Patella vulgate* (Linnaeus, 1758)	+	+	+	+	+	+	-	-	+
31	*Aplysia juliana* (Quoy & Gaimard, 1832)	-	-	-	-	-	-	+	-	-
32	*Peronia verruculata* (Cuvier, 1830)	+	+	+	+	+	-	+	+	+

All over 9 months of study period, total 414 number of gastropods recorded during July 2020 to March 2021. During this investigation period in monsoon season recorded 7 families of gastropods in high-density value like Turbinidae, Muricidae, Bursidae, Olividae, Nacellidae, Cerithidae and Onchidiidae. In summer season recorded 4 families of gastropods in high-density value like Turbinidae, Cerithiidae, Littorinidae and Nacellidae so that a highest density of gastropods and families found during monsoon season and lowest density of gastropod families found during summer season. Hence, most favorable climatic and habitat condition of gastropods families during monsoon season while less

favorable condition in summer season.

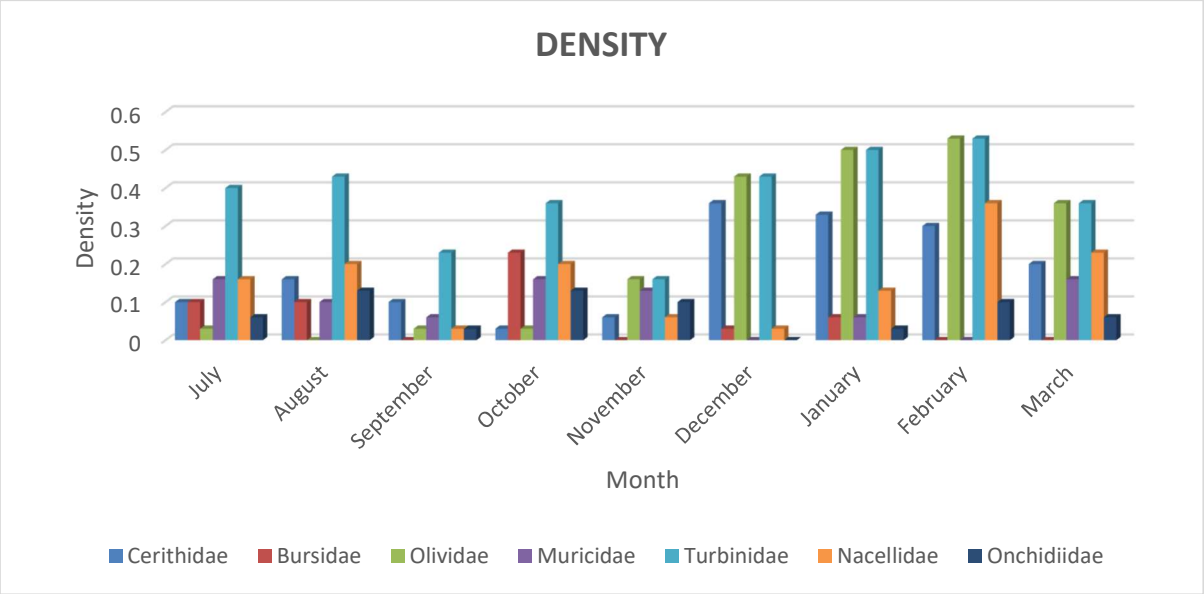

Figure-3: Density of 7 prominent families of gastropods during study period

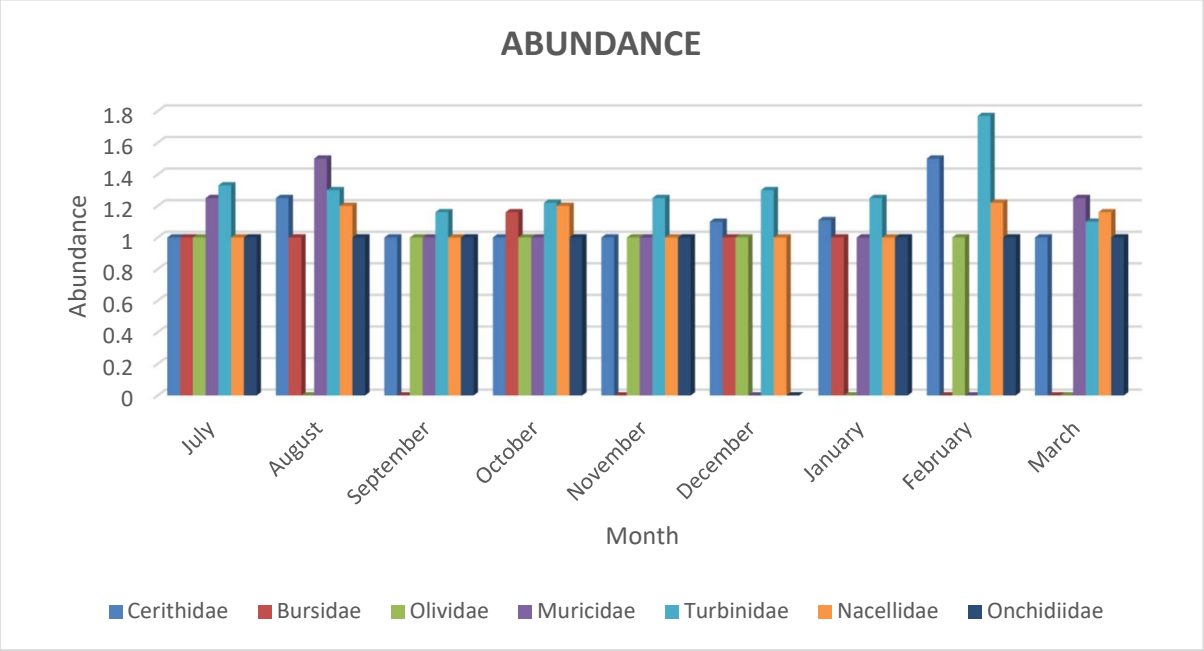

Figure-4: Abundance of 7 prominent families of gastropods during study period

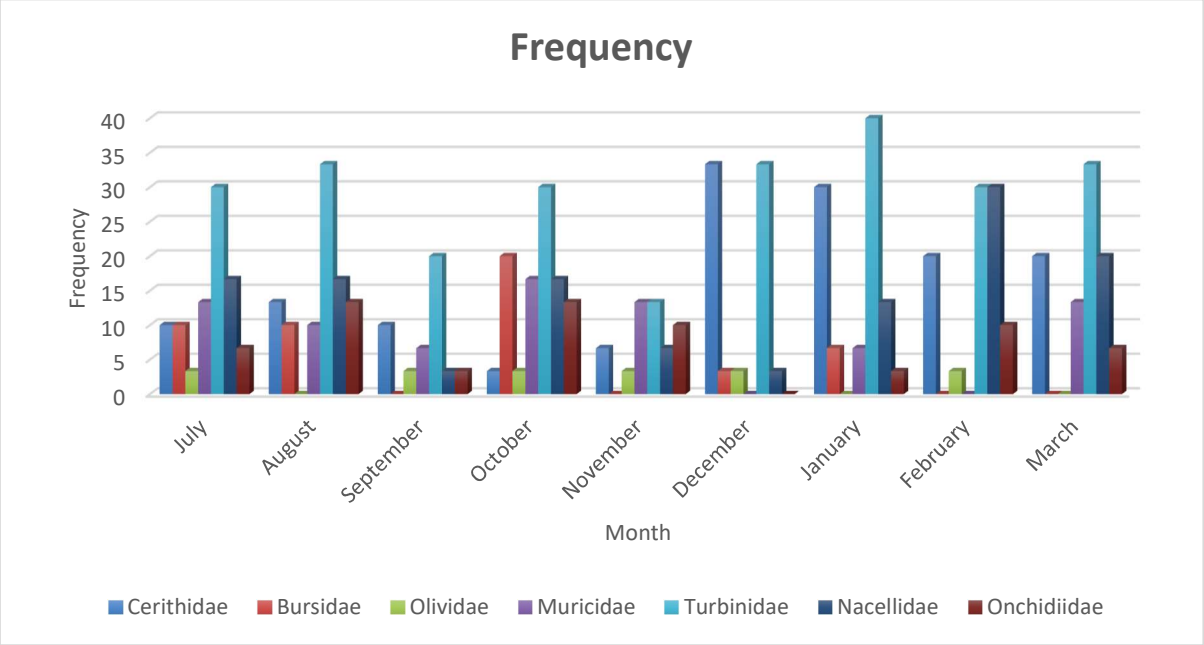

Figure-5: Frequency of 7 prominent families of gastropods during study period

In Gastropods a higher number of Average (11.44) reported of Turbinidae family and lowest number of Average (0.11) reported of Aplysidae family. Altitudinal as well as time-based variation in the population ecology of gastropods species, was studied at one location along with those numerous anthropogenic actions and its effects on the coastal area was also observed.

4. CONCLUSION:

The gastropod molluscs dominant element of marine water. The present investigation deals with the diversity and distribution of marine gastropods at rocky intertidal shore of Veraval coast of Gujarat. The study of population ecology is based on the seasonal abundance, population fluctuation and measurement of alive gastropod species collected in selected study tract. The Jaaleshvar site of Veraval coast observed of different varieties of habitats and also small amount of seasonal variation in temperature and wave action was observed. Although the examination of diversity at coast was done by monthly basis single visit, greatness of various gastropod species was observed. The review study area was distinguished and make a note of the kind of different anthropogenic movements, for example, the travel industry, fisheries, port action, industry, sewage squander, unfavorably influence marine environment. Intertidal zone of study site has sea line, some rocky pools and puddles and moderately mud flats. Thus, it provides diversification in environment suitable for many different kinds of marine gastropods.

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Full Home Address with Pin code / Zip code : (First Author) :-
Name: - Solanki Rahulkumar Babubhai
S/O: - Solanki Babubhai Jivabhai
Street: - Vadi-Vistar
Nearby place: - Omnath Mahadev Temple
Village: - Malondha
Taluka: - Veraval
District: - Gir Somnath
State: - Gujarat
Country: - India
Pin Code: 362255
Mobile Number with country code: +91 9265305536