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## Influence of physicochemical parameters on gastropods diversity along the Saurashtra coast of Gujarat, India

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**Abstract**

The present study was carried out to assess the effects of different physicochemical parameters on the gastropods diversity along Veraval and Sikka coast. The samples were collected using random quadrat method and mean values were taken for estimation of different diversity attributes (density (%), abundance and frequency (%)) of gastropods species. The various physicochemical parameters viz. temperature, pH, salinity and dissolved oxygen were recorded. Correlation of different diversity attributes with physicochemical parameters showed that there exist a negative relationship between diversity attributes with temperature and salinity and positive with pH and dissolved oxygen. The present investigation confirmed that the environmental parameters are marginally important to understand the distribution and abundance of gastropods in the intertidal region of the Veraval and Sikka coast.

**Keywords:** Abundance, correlation, gastropods, physicochemical parameters, temperature

**Introduction**

Every single living organisms on this planet need water for their growth and continuity. Coastal environment is at interface between terrestrial environments and open oceans, it encompass many unique habitats and serve important human needs. Coastal habitats include estuaries, coastal wetlands, seagrass meadows, coral reefs, mangrove forests, kelp forests, and upwelling areas. It is highly complex, productive and wavering in relation to space and time. Characteristic of any hydro-ecosystem depends mostly on various factors like physical and chemical variables, the source of pollution load, nutrient content, and availability of biomass. To understand the dynamics in the ecosystem, continuous monitoring of these variables is necessary <sup>[1]</sup>. The variables like temperature, dissolved oxygen, pH and salinity play a significant role in influencing the gastropods diversity.

The world's oceans comprises almost between 5,00,000 and 10 million marine species. India is one of the recognized mega-diverse countries of the world, cherishing nearly 7-8% of the recorded species of the world, and representing 4 of the 34 globally identified biodiversity hotspots. India being the topical country is blessed with highly diverse marine fishery resources in its 2.02 million square km EEZ with a 530,000 square km of a continental shelf area and having a coastline of about 8118 Km. The undulation in environmental factors associated with extreme tidal fluxes, extreme weather events and complex topography create the intertidal zone most vulnerable and extreme than any environment. Most of the stranding phenomena of Cetaceans (Dolphins and Whales) along the Indian coast occur in different coastal regions <sup>[2]</sup>. Thus these areas are considered as important habitats of the biosphere <sup>[3]</sup>. Because of the mentioned reasons intertidal organisms encounter more rapid fluctuations in degree of physico-chemical parameters <sup>[4]</sup>. Among the rocky intertidal populations, one of the most important and fortunate groups are the gastropods. To date they are the largest group of molluscs, with more than 62,000 described living species, and they comprise about 80% of living molluscs. Estimates of total extant species range from 40,000 to over 1,00,000 <sup>[5]</sup>. They are one of the phyla of macrozoobenthos which can be used as bioindicators in coastal ecosystems. Apart from playing a role in the food chain cycle, there are also types of gastropods that have important economic values, such as various types of shellfish and various types of snails <sup>[6]</sup>. They have adequately high adaptability in various habitats as they can accumulate heavy metals without dying and act as an indicator of the environment.

They provide several benefits for humans including as a source of protein, animal feed ingredients, industrial materials, jewelry, fertilizers and medicine.

Furthermore, gastropods vary morphologically in relation to their surroundings. Individuals of the same species on the identical rocky shore may have different morphologies as a result of different microhabitats [7]. Distribution of gastropod species is influenced by abiotic (dissolved oxygen, temperature, salinity and pH) and biotic factors [8]. The temperature is one of the most important factor that influence the vertical and horizontal distribution of intertidal animals and has been studied by many researchers [9, 10, 4, 11]. Gastropods growth and continuity are completely depended on various physico-chemical stress, in which temperature shows more effect on the distribution of organisms due to desiccation [12]. There is no complete study on correlation of different gastropods species with physicochemical parameters along the Saurashtra region. To addresses the research gap, the current study was carried out to analyze the effects of physicochemical parameters on gastropod diversity along Veraval and Sikka coast of Gujarat.

### Materials and Methods

Saurashtra region is located along south-western part of Gujarat state (India), part of the semi-arid to arid Kathiawar Peninsula. The terrain are forms of rocky or sandy or rocky-sandy beaches. The beaches are usually calcareous and dominated by bioclasts, the consolidated ancient equivalent of these biogenic sands are milliolite rocks. Tides in Saurashtra coast are mixed, predominantly semidiurnal type with a large diurnal inequality. The study was conducted on two different stations of Saurashtra coastline, at Veraval (20°54' 35.31"N, 70°21' 7.72"E) and Sikka coast (22°27' 24"N, 69°4' 26"E) during September 2019 to February 2020. Each sampling stations were visited monthly and at least three samples of surface seawater were collected from different locations of the same coast. However, the locations for the collection of samples in a particular coast were fixed. The randomly quadrant method was used to study the ecological attribute of gastropod species in the intertidal zone. The quadrant of 1 m<sup>2</sup> size was placed at an interval to cover the maximum area of the intertidal zone during low tide. The gastropod species samples were collected by handpicking and preserved in 5% formalin for further analysis. The physicochemical parameters like temperature, salinity, pH and dissolved oxygen were taken to assess the influence of abiotic factors on the population density (%), abundance, frequency (%) and distribution of gastropod species. The sea surface temperature was recorded using mercuric thermometer, pH was recorded using pH meter and salinity was measured using hand Refractometer. Dissolved oxygen was measured by Winkler's method [13]. The collected monthly data of physico-chemical parameters were presented as mean  $\pm$  standard deviation and correlated with different gastropods diversity attributes (density (%), abundance, frequency (%) and total species) using DATA ANALYSIS TOOL PACKAGE. All the collected data were analyzed using Microsoft office Excel ver. 2013 package.

### Results and Discussion

#### Water quality parameters

The water quality parameters of seawater from Veraval

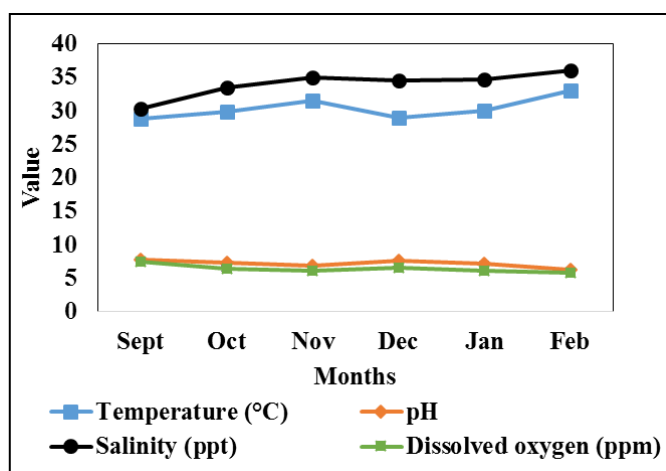
(Figure 1) and Sikka (Figure 2) coast showed wide temporal and spatial variations. Environmental factors such as temperature, salinity, pH, wave action, etc. directly influence the distribution patterns and population of gastropods by imposing physical constraints on their living [14]. Temperature is one of the most important factors in the coastal ecosystem, which influences the other physical and chemical characters of coastal water [15].

The water column temperature is always influenced by the intensity of solar radiation, evaporation, freshwater influx, and cooling. Therefore, analysis of temperature is crucial to understand ecological changes in the coastal ecosystem. In the present study, the water temperature of Veraval coast varied between  $28.83 \pm 0.49$  and  $33.00 \pm 0.25$  °C with highest temperature recorded during February (summer) which may be due to the increased solar radiation [16].

The pH is always taken as the function of the salinity in marine systems and was governed by the amount of free CO<sub>2</sub> and HCO<sub>3</sub><sup>-</sup> [17]. The pH values of Sikka coast were slightly higher than Veraval coast with values ranged between  $7.68 \pm 0.15$  and  $8.33 \pm 0.15$ . The high pH values may be due to the uptake of CO<sub>2</sub> by photosynthesizing organisms and high biological activity [18].

The monthly variations in the salinity may be attributed due to precipitation and evaporation, which is most likely to influence the faunal distribution in the intertidal zone [19]. In the present study higher salinity in the February (summer) month may be due to decreased fresh water inflow, high temperature and evaporation [20]. Dissolved oxygen (DO) is essential to most aquatic organisms and is greatly affected by their metabolism [21].

Prime sources of DO in seawater are the photosynthetic activity of marine flora and diffusion of oxygen from atmosphere [22]. Desa *et al.* [23] reported that a spatial and temporal variation of dissolved oxygen (DO) with a wide range of DO (3.5–7.8 mg L<sup>-1</sup>) was reported along the near shore waters of Gujarat. The high dissolved oxygen observed in the present study may be attributed to the cumulative effects of higher wind and strong wave action [1]. Similar studies on physico-chemical parameters was done along Veraval coast [1, 10, 24] and Sikka coast [9, 25, 26].



**Fig 1:** Monthly variations in the water quality parameters of seawater from Veraval coast during September 2019 to February 2020

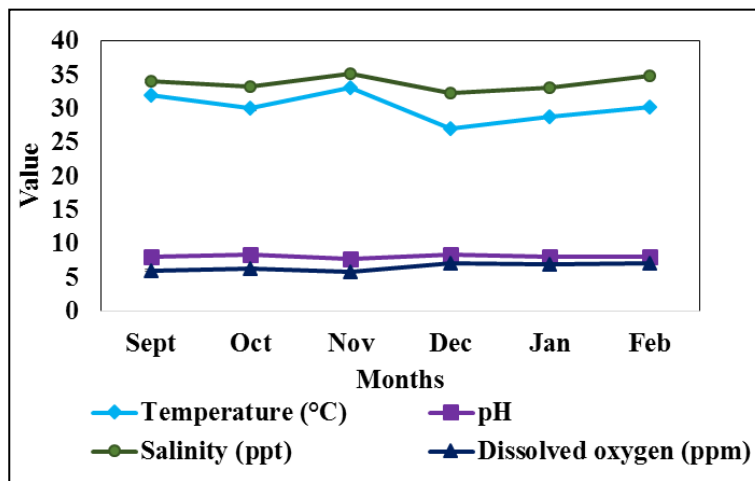


Fig 2: Monthly variations in the water quality parameters of seawater from Sikka coast during September 2019 to February 2020

**Correlation of different diversity attributes with physicochemical parameters**

The correlation analysis was performed to elucidate the interrelationship between the water quality and different diversity attributes. Considerable monthly variations among gastropods species in Veraval and Sikka coast was observed. A total of 32 species were identified from Veraval and Sikka coast belonging to three sub-classes, five orders, eleven super-families, sixteen families, eighteen sub-families and twenty eight genera. The correlation of different intertidal organisms with physico-chemical parameters provide information on the influencing capacity of abiotic factors on the biological life. Different studies on correlation has been conducted by Bharda *et al.* [26] from Veraval, Okha and Sikka coast on Limpet

diversity and Dave and Chudasama [4] on gastropods diversity. The correlation analysis of the present study revealed that physico-chemical parameters significantly impacted the gastropods diversity (Table 1). A positive relationship was observed between diversity attributes and pH and dissolved oxygen (Figure 3), which explains that the gastropods community can better survive in the optimum concentrations. While, a negative relationship was observed with temperature and salinity (Figure 3) which shows that rise in the surrounding environment temperatures especially during low tides, less dissolved oxygen holding capacity of tidal seawater, and higher salinities given a direct effect on the distribution and density of intertidal gastropods species.

Table 1: Correlation of the density, abundance, frequency distribution and total species of gastropods with physico-chemical parameters (Temperature, Salinity, pH and DO)

Parameter	Density (%)	Abundance	Frequency (%)	Total species	Temperature	pH	Salinity	DO
Density (%)	1.00							
Abundance	0.59	1.00						
Frequency (%)	0.92	0.40	1.00					
Total species	0.74	0.93	0.67	1.00				
Temperature	-0.59	-0.25	-0.83	-0.55	1.00			
pH	0.28	0.40	0.47	0.57	-0.75	1.00		
Salinity	-0.59	-0.59	-0.68	-0.74	0.86	-0.76	1.00	
DO	0.26	-0.16	0.62	0.20	-0.85	0.60	-0.50	1.00

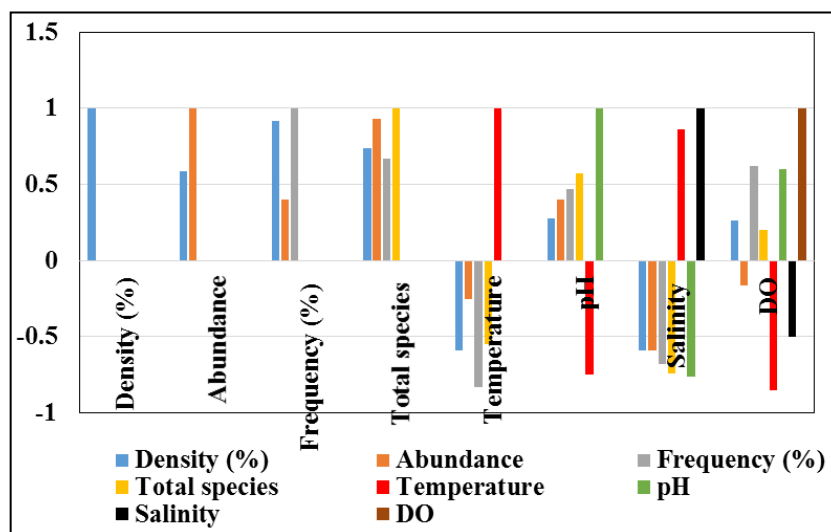


Fig 3: Correlation analysis of different diversity attributes (density (%), abundance, frequency (%) and total species) of gastropods with physico-chemical parameters

## Conclusion

The physicochemical parameters of seawater reveal pertinently wide variations over the study period. The diversity of gastropods shown a declining trend in terms of temperature and salinity indicating that rise of surrounding environment temperatures especially during low tide conditions having less dissolved oxygen holding capacity of tidal seawater given a direct effect on the diversity attributes of intertidal gastropods species distribution. From above observations, it can be inferred that most of the physicochemical parameters play a significant role in growth and survival of gastropods population along the Saurashtra region.

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