

Abundance and Seasonal Distribution of Crabs and Shellfish along Saral Beach, Raigad District, Maharashtra

Aamod Thakkar¹, Rahul Patil², Shreya Sham Patil³, Dr. Sajid F. Shaikh⁴

^{1, 2, 3} Veer Wajekar Arts, Commerce & Science College, Phunde-Uran, Raigad, Maharashtra, India

⁴ Anjuman Islam Janjira, Degree College of Science, Murud-Janjira, Raigad, Maharashtra, India

sajidoshaikh@gmail.com

Abstract: Coastal ecosystems are among the most productive and biologically diverse environments, supporting a wide variety of benthic organisms such as crabs and shellfish. These organisms play crucial roles in nutrient cycling, sediment dynamics, and trophic interactions. The present study investigates the abundance and seasonal distribution of crabs and shellfish along Saral Beach, located in Raigad district, Maharashtra. Field surveys were conducted using transect and quadrat methods across different seasons, including pre-monsoon, monsoon, and post-monsoon periods. Environmental parameters such as temperature, salinity, and sediment type were also recorded. The results revealed significant seasonal variation in the abundance of both crabs and shellfish, with higher densities observed during post-monsoon and winter seasons. The study highlights the influence of environmental factors and monsoonal cycles on intertidal biodiversity. The findings provide baseline data for ecological monitoring, sustainable fisheries management, and conservation planning in the region.

Keywords: abundance and seasonal distribution of crabs and shellfish along saral beach, raigad district, Maharashtra

I. INTRODUCTION

Coastal and intertidal ecosystems are among the most productive and ecologically significant environments on Earth, supporting a wide diversity of marine flora and fauna. These ecosystems form a transitional zone between terrestrial and marine habitats and are characterized by dynamic environmental conditions such as tidal fluctuations, wave action, and variable salinity. Among the key biological components of these ecosystems are benthic organisms such as crabs (Order: Decapoda) and shellfish, including bivalves and gastropods. These organisms play a crucial role in maintaining ecological balance and contributing to overall ecosystem functioning.

Crabs are considered important ecological engineers within intertidal zones. They act as predators, scavengers, and detritivores, thereby regulating the population of smaller organisms and facilitating energy transfer across trophic levels. Their burrowing activities enhance sediment aeration and promote nutrient recycling within the substrate. On the other hand, shellfish such as bivalves (e.g., clams and oysters) and gastropods (e.g., snails) contribute significantly to ecosystem stability through filter-feeding and grazing activities. These organisms help in maintaining water quality by removing suspended particles and play a vital role in organic matter decomposition and sediment stabilization.

The abundance and spatial distribution of crabs and shellfish are strongly influenced by a range of environmental and ecological factors. Key determinants include physicochemical parameters such as water temperature, salinity, dissolved oxygen, and pH, as well as sediment characteristics like grain size, organic content, and moisture levels. Additionally, biological factors such as food availability, predation pressure, and interspecific competition also play a significant role. Among these, seasonal variation is particularly important in tropical and subtropical coastal regions, where environmental conditions undergo substantial changes throughout the year.



In the context of the west coast of India, the southwest monsoon exerts a profound influence on coastal ecosystems. The monsoon season brings heavy rainfall, freshwater influx, increased turbidity, and fluctuations in salinity and temperature. These changes directly impact the habitat conditions and biological processes within intertidal zones. As a result, many marine organisms, including crabs and shellfish, exhibit distinct seasonal patterns in their abundance and distribution. For instance, population peaks are often observed during the post-monsoon and winter seasons when environmental conditions stabilize, food availability increases, and reproductive activities are enhanced. Conversely, the monsoon season is typically associated with reduced abundance due to habitat disturbance, sediment displacement, and physiological stress caused by fluctuating salinity levels.

The west coast of India, bordering the Arabian Sea, is known for its rich biodiversity and diverse coastal habitats, including sandy beaches, rocky shores, mudflats, and mangrove ecosystems. Maharashtra's coastline, in particular, supports a variety of commercially and ecologically important marine organisms. However, increasing anthropogenic pressures such as coastal development, tourism, overexploitation of resources, and pollution have posed significant threats to these ecosystems. These disturbances can alter species composition, reduce biodiversity, and disrupt ecological processes.

Saral Beach, located in the Alibag region of Raigad district, Maharashtra, represents a typical sandy intertidal ecosystem influenced by tidal cycles and seasonal monsoonal variations. The beach provides suitable habitat conditions for a variety of benthic organisms, including crabs and shellfish. Despite its ecological importance, Saral Beach remains relatively underexplored in terms of scientific research. There is a lack of comprehensive, site-specific data on the seasonal dynamics, abundance, and distribution patterns of intertidal fauna in this region.

Understanding the seasonal abundance and distribution of crabs and shellfish is essential for several reasons. Firstly, these organisms serve as bioindicators of environmental health, as their population dynamics are sensitive to changes in habitat conditions. Secondly, they contribute to local fisheries and coastal livelihoods, making their sustainable management economically important. Thirdly, baseline ecological data are crucial for assessing the impacts of climate change, pollution, and human activities on coastal ecosystems.

Therefore, the present study aims to systematically investigate the abundance and seasonal distribution of crabs and shellfish along Saral Beach using standardized sampling methods. The study seeks to generate baseline data that will contribute to ecological monitoring, biodiversity conservation, and sustainable coastal resource management. The findings will also help in identifying seasonal trends and environmental factors influencing species distribution.

II. HYPOTHESIS

The present study is designed to test the influence of seasonal variation on the abundance and distribution of crabs and shellfish along Saral Beach. The **null hypothesis (H_0)** states that there is no significant seasonal variation in the abundance of crabs and shellfish at Saral Beach, implying that environmental fluctuations associated with seasonal changes do not significantly affect population dynamics. In contrast, the **alternative hypothesis (H_a)** proposes that there is a significant seasonal variation in the abundance of these organisms, suggesting that changes in environmental factors such as temperature, salinity, sediment characteristics, and monsoonal influence play a crucial role in shaping their distribution patterns. Testing these hypotheses is essential to understand whether seasonal environmental variability has a measurable ecological impact on intertidal fauna.

III. LITERATURE REVIEW

Marine benthic organisms, particularly crabs and molluscs, are integral components of coastal ecosystems due to their involvement in fundamental ecological processes. These organisms contribute to nutrient cycling, sediment reworking, and energy transfer within food webs, thereby maintaining ecosystem stability and productivity. Crabs, as active benthic organisms, play a significant role in bioturbation, enhancing sediment aeration and nutrient exchange, while molluscs such as bivalves and gastropods regulate water quality through filter-feeding and grazing mechanisms.



Several studies have demonstrated that crustacean populations exhibit distinct seasonal variations influenced by environmental cues such as temperature fluctuations, salinity changes, and reproductive cycles. Seasonal breeding patterns and larval recruitment often result in population peaks during favorable environmental conditions. Similarly, the distribution and abundance of molluscan species are closely linked to sediment characteristics, organic matter availability, and physicochemical properties of water, including dissolved oxygen and pH.

Research conducted along the Indian coastline highlights the significant role of monsoonal cycles in shaping intertidal biodiversity. The southwest monsoon, characterized by heavy rainfall and strong wave action, leads to habitat disturbance, sediment displacement, and fluctuations in salinity levels, which negatively impact benthic organism abundance. Consequently, many studies report reduced crab and shellfish populations during the monsoon season. In contrast, the post-monsoon and winter seasons provide relatively stable environmental conditions, enhanced primary productivity, and increased food availability, resulting in higher organism abundance and diversity.

Intertidal organisms are widely regarded as reliable bioindicators of environmental health due to their sensitivity to ecological disturbances. Changes in their population dynamics can reflect alterations in environmental quality, including pollution and habitat degradation. While extensive research has been conducted along major coastal regions of India, smaller and less-studied beaches such as Saral Beach remain underrepresented in scientific literature. This lack of site-specific data highlights the need for detailed ecological investigations to better understand local biodiversity patterns and environmental influences.

IV. OBJECTIVES

The primary objective of the present study is to systematically investigate the abundance and seasonal distribution of crabs and shellfish along Saral Beach. Specifically, the study aims to quantify the population density of these organisms across different seasons, including pre-monsoon, monsoon, and post-monsoon/winter periods. It also seeks to identify spatial and temporal distribution patterns along intertidal transects, providing insights into habitat preferences and zonation.

Another important objective is to evaluate the relationship between organism abundance and environmental factors such as temperature, salinity, and sediment characteristics. Understanding these relationships will help in identifying the key drivers influencing population dynamics. Additionally, the study aims to compare the observed findings with existing literature on coastal biodiversity, thereby placing the results within a broader ecological context and contributing to regional scientific knowledge.

V. MATERIALS AND METHODS

5.1 Study Area

The study was conducted at Saral Beach, located in the Raigad district of Maharashtra along the west coast of India. This beach represents a typical intertidal ecosystem influenced by tidal fluctuations and seasonal monsoonal changes. The area is characterized by sandy substrates and supports a variety of benthic organisms. Its ecological conditions are shaped by periodic freshwater influx during the monsoon and relatively stable marine conditions during other seasons.

5.2 Sampling Design

A systematic sampling approach was adopted using transect and quadrat methods. Transects were established along the intertidal zone perpendicular to the shoreline to capture variations across different tidal levels. Quadrats of fixed dimensions were placed at regular intervals along each transect to ensure uniform sampling coverage. This method allowed for accurate estimation of organism abundance and spatial distribution.

5.3 Data Collection

Field sampling was conducted during low tide conditions to maximize accessibility to intertidal zones. Within each quadrat, crabs were counted, and shellfish were collected and identified. Observations were recorded across multiple



seasons, including pre-monsoon, monsoon, and post-monsoon/winter, to capture seasonal variability. Care was taken to minimize disturbance to the habitat during sampling.

5.4 Environmental Parameters

Simultaneously, key environmental parameters were measured at each sampling site. These included water temperature, salinity, and sediment characteristics such as texture and composition. These parameters were recorded to assess their influence on the abundance and distribution of crabs and shellfish.

5.5 Data Analysis

The collected data were analyzed quantitatively to determine organism abundance, expressed as the number of individuals per unit area. Seasonal comparisons were conducted to identify variations in population density across different time periods. Statistical analyses were performed to examine correlations between biological data and environmental parameters, providing insights into the factors influencing distribution patterns.

VI. RESULTS AND DISCUSSION

6.1 Seasonal Variation

The results of the study revealed a clear pattern of seasonal variation in the abundance of crabs and shellfish. The highest abundance was observed during the post-monsoon and winter seasons, followed by moderate abundance during the pre-monsoon period. The lowest abundance was recorded during the monsoon season. This pattern can be attributed to environmental conditions associated with each season. Post-monsoon periods provide stable salinity, optimal temperature, and increased food availability, which support population growth and recruitment. In contrast, monsoon conditions characterized by strong wave action, high turbidity, and fluctuating salinity create unfavorable conditions for benthic organisms.

6.2 Influence of Environmental Factors

Environmental parameters such as salinity and temperature showed a strong positive correlation with organism abundance. Stable salinity levels during non-monsoon periods favored the survival and reproduction of both crabs and shellfish. Sediment type also played a significant role, with sandy substrates supporting higher densities of shellfish due to better burrowing conditions and availability of organic matter.

6.3 Ecological Significance

Crabs and shellfish were found to contribute significantly to ecosystem functioning. Their activities enhance nutrient cycling, improve sediment aeration, and support food web interactions. The presence and abundance of these organisms indicate the ecological health of the intertidal environment and highlight their importance in maintaining ecosystem stability.

6.4 Comparison with Previous Studies

The findings of the present study are consistent with previous research conducted along the Indian coastline. Similar patterns of higher abundance during post-monsoon and winter seasons have been reported, confirming the influence of seasonal environmental stability on benthic populations. The results reinforce the importance of monsoonal cycles as a key driver of coastal ecosystem dynamics.

VII. CONCLUSION

The present study confirms that seasonal variation plays a significant role in influencing the abundance and distribution of crabs and shellfish along Saral Beach. Environmental factors such as temperature, salinity, and sediment characteristics were found to be critical determinants of population dynamics. The observed seasonal patterns highlight



the sensitivity of intertidal organisms to changes in environmental conditions, particularly those associated with monsoonal cycles.

The study provides valuable baseline data that can be used for long-term ecological monitoring, assessment of environmental changes, and sustainable management of coastal resources. Furthermore, the findings contribute to a better understanding of intertidal biodiversity and its response to natural and anthropogenic influences.

VIII. RECOMMENDATIONS

Based on the findings of the study, it is recommended that regular monitoring of intertidal biodiversity be conducted to track changes in species abundance and distribution over time. Sustainable harvesting practices should be promoted to prevent overexploitation of commercially important species. Conservation efforts should focus on protecting coastal habitats from degradation caused by human activities such as pollution, tourism, and coastal development.

Additionally, long-term ecological studies are necessary to assess the impacts of climate change and environmental variability on coastal ecosystems. Such studies will provide deeper insights into ecosystem resilience and support the development of effective conservation and management strategies.

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