Diversity, Distribution and Population Ecology of marine molluscs along South Saurashtra Coast, Gujarat, India

SYNOPSIS

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INTRODUCTION & REVIEW OF LITERATURE

The study of molluscs, "Malacology", comes from the Greek word for soft, malacos. The term "Conchology" is also used for the study of Molluscan shells. Structurally Molluscs are a heterogeneous group of animals with different structural forms such as slugs, mussels, octopuses and snails. Majority of the molluscs are known by their shell, but in some forms the shell is absent. Molluscs have been classified based on their morphological, anatomical and biological features and they are second only to Arthropod in numerical abundance (Anandaraj, 2013). The number of species identified under phylum molluscs varied from 80,000 to 1,00,000 (Shanmugam and Vairamani, 2009). They are more abundant in the littoral zones of tropical seas. Phylum Mollusca plays an important role in ecosystem function by source as food in their habitats (Ghasemi et al, 2011). Typically, molluscan populations are richer than those comprised of other intertidal animals. The phylum Mollusca consists of seven classes namely Aculifora, Monoplacophora, Polyplacophora, Gastropoda, Bivalvia, Scapopoda and Cephalopoda (Arumugam et al., 2010). Among them, gastropods are the largest and well-known class of all the molluscs.

According to Joshi (2010) molluscs of the rocky shore disclose ecological succession from high to low water mark, each species being most substantial in a convinced horizontal substratum. Among these molluscs, gastropods are typically found on rocky coasts at the intertidal level, where they are subjected to harsh environmental conditions (Misra and Kundu, 2005). This circumstance makes it possible to correlate, in the field, the frequency of division, variations in abundance and biomass, growth, mortality, reproductive periods, and subsistence of phenotypes in different populations of gastropods in relation to complementary and changing environmental conditions (Bacci and Sella, 1970). Among the Molluscan, the gastropods are more distributed on the rocky substratum. Even though a huge number of marine gastropods have nutritional content that makes them ideal for human consumption, information on which members of the gastropods are edible is still sparse.

The gastropod molluscs, represented by snails, whelks, cowries, limpets, sea hares, and their allies are among the commonest epifaunal species that exist in the marine ecosystem. The varied macro habitats of the marine ecosystems are well adapted to the gastropods. The pulmonate snail and numerous other families have dominated marine environments with the elimination of the gills and conversion of the mantle chamber into lungs, and they can be found

on the bottoms as well as in bodies of water. The marine settings offer the best circumstances for better productivity of gastropods, which in turn provide food for many other animals, particularly the veliger larvae. Due to their predatory nature, gastropods play a crucial part in preserving the productivity and efficiency of marine habitats by clearing the roots of encrusting animals like barnacles. Thus, gastropods have a significant ecological role to play in the marine ecosystems (Sasekumar, 1974).

In India, studies on species diversity are very few Hornell, 1927; Gravely, 1941; Satyamurti, 1956; Appukuttan, 1972, 1980, 1989, 1996; Pinn, 1990; Narashima 1993; Sakthivel and Fernando, 2002. Ramesh et al. (1996) worked on gastropods and bivalves related to coral-reef and recorded 73 species of Molluscan, among them 46 gastropod and 27 bivalves were associated with coral-reef in Palk bay, India. On same coast, at Karaichally Island in Gulf of Mannar, distribution and abundance of Molluscan were studied by Jeyabhaskaran et al. (1996) regarding to Coral related molluscs. Investigation of ecology of intertidal molluscans on same coast was done by Rao and Sundram (1972). Narsimham (1993) described the importance of shell fishes for the benefits of fisheries.

As that of biodiversity assessment, length and weight relationship (LWR) also assume great significance in fishery resource assessment (Garcia et al. 1998; Haimovici and Velasco, 2000) and further the length and weight are the two basic components in the biology of species at the individual and population levels. In molluscs, the growth rate of various body characteristics is not uniform, with the results that the relative proportions of the body change in growth rate between one part and the whole organism is termed as allometry (Anandaraj, 2013). The concept of allometry is pointed out by Seed (1968), in as much as only two parameters are compared at any time.

The intertidal zone is the most dynamic zone because it connects the marine and terrestrial environments. They argued that because intertidal biota is constantly exposed to air, it is subjected to harsh physicochemical conditions (Senechal-Brown and Dean, 1996). Wave action, sediment composition, and beach slope all play important roles in the structure of the intertidal ecosystem (McLachlan, 1996; Borzone et al., 1996).

Intertidal habitats are particularly studied because the rise and fall of tides creates quite distinct habitats across a beach. As a result, researchers can shift from one environment to another in tens to hundreds of metres. Intertidal rocky shore animals and flora have been studied

extensively during the last 30-40 years. The species are often small and abundant, and they do not live long enough to allow for experiments (Underwood, 2000). Quantifying this heterogeneity at various scales is thus required before developing and testing explanatory theories for observed distributional patterns (Underwood, 2000). Molluscs have been rarely considered despite them consolidate taxonomic knowledge and their wide distribution in marine communities. Quantitative information on distribution patterns of Molluscan assemblages is mainly focused on soft substrates and coral reefs and derives from studies along Norwegian fjords (Buhl-Mortensen and Hosaeter, 1993) and tropical environments (Esqueda et al., 2000). Quantitative studies on Molluscan assemblages from hard sub tidal substrates are still scant (Milazzo et al., 2000). The intertidal zone of any biological area is thought to be the most prolific and diverse in terms of plant and animal life. The intertidal zone continues to be more thoroughly researched than any other area because of its accessibility (Vaghela et al., 2010). Among the diversity of animals found in the intertidal environment, molluscs are a very successful animal group in terms of ecological adaptation, and they can be found in nearly all habitats including freshwater, land, and the deepest ocean trenches (Vaghela and Kundu, 2011). Kardani et al. (2014) provided a brief introduction to the intertidal zone in their study of Diversity and distribution of gastropods in the northern gulf of Kachchh, Gujarat, India. One of the most accessible marine environments and a zone where land and sea meet are rocky coastlines. The organisms of rocky coastlines are heavily influenced by two phenomena: the tidal region and exposure to wave action during low tide. The phenomena of zonation manifest itself in the shape of horizontal bands or zones for intertidal species. Animals and plants on intertidal rocky coasts have long been researched extensively, and these ecological investigations not only provide a significant source of information about the status of the specific ecological area, but also contribute significantly in understanding other equivalent types of ecological habitats.

Intertidal benthic organisms are sensitive to environmental gradients and they may serve as indicators of changes occurring in coastal region (Warwick and Clarke, 2001). Benthic fauna on the sandy beaches shows a patchy distribution due to wave action and food concentration (Veloso and Cardoso, 2001; Frederico and Carlos, 2006). Three phyla contributing most of the intertidal benthic fauna are arthropods, annelids, and molluscs. Within each phylum there are generally a few dominant species (biomass, function, number etc.) and many more which are poorly represented (Kardani et al. 2014). The habitats from which marine molluscs have been documented in India are highly diverse. They can be found in a variety of environments,

including mangroves, coral reefs, rocky coasts, sandy beaches, sea grass beds, and at greater depths in the water; nevertheless, they are most diverse and plentiful in the rocky intertidal zone along the coast. Till present, 5,070 species of molluscs have been recorded in India, 3,370 of which are from marine habitat (Subba Rao, 1991).

Intertidal zone of Gujarat state till less explored, but some peculiar investigations were made for diversity and distribution viz., Apte recorded 188 Molluscan species at Gujarat coast line. Saurashtra coast of Gujarat was investigated by number of biologists, Prasad & Mansuri, 1982; Patel, 1984, Misra & Kundu, 2005; Bhadja, 2010, Vaghela, 2010; Dave 2011; Pandya 2015 etc. particularly at the Mangrol coast, work has been done by Raghunathan et al, 2003; Bhadja, 2010; Vaghela, 2010 and Gohil 2016. All these studies were more emphasize population ecology and influence on the intertidal zone and its organisms.

The intertidal zone of Saurashtra coast is well studied for various aspects like ecology of few fauna and flora, biology of few common species, habitat analysis etc. But diversity study for particular phylum with various ecological aspects for larger area is not done. Moreover, diversity account is mainly based on morphology. Therefore, the current research work is diversity aimed to document diversity of marine molluscs for large area with its relation to habitat and micro-habitat level distribution. Also, an attempt is done to document molecular and phylogenetics for dominant Molluscan species. Observation on population ecology of such dominant species is done.

AIM:

To study Diversity, Distribution and Population ecology of marine Molluscs along South Saurashtra Coast of Gujarat.

OBJECTIVES:

(01) To study Diversity of marine Molluscs from selected sites of South Saurashtra Coast, Gujarat, India.
(02) To study distribution status/pattern of Molluscs on the basis of its substratum structure along South Saurashtra Coast on selected sites.
(03) To analyse Population ecology of Dominant species of marine Mollusca along South Saurashtra coast.

MATERIALS AND METHODS:

Study area

The Study area consist of the three coastal zones viz. Mangrol, Adri and Veraval along South Saurashtra. These three locations were chosen after a thorough investigation of the various coastal zones based on the availability of Molluscan species, accessibility to the study locations, and intertidal exposure.

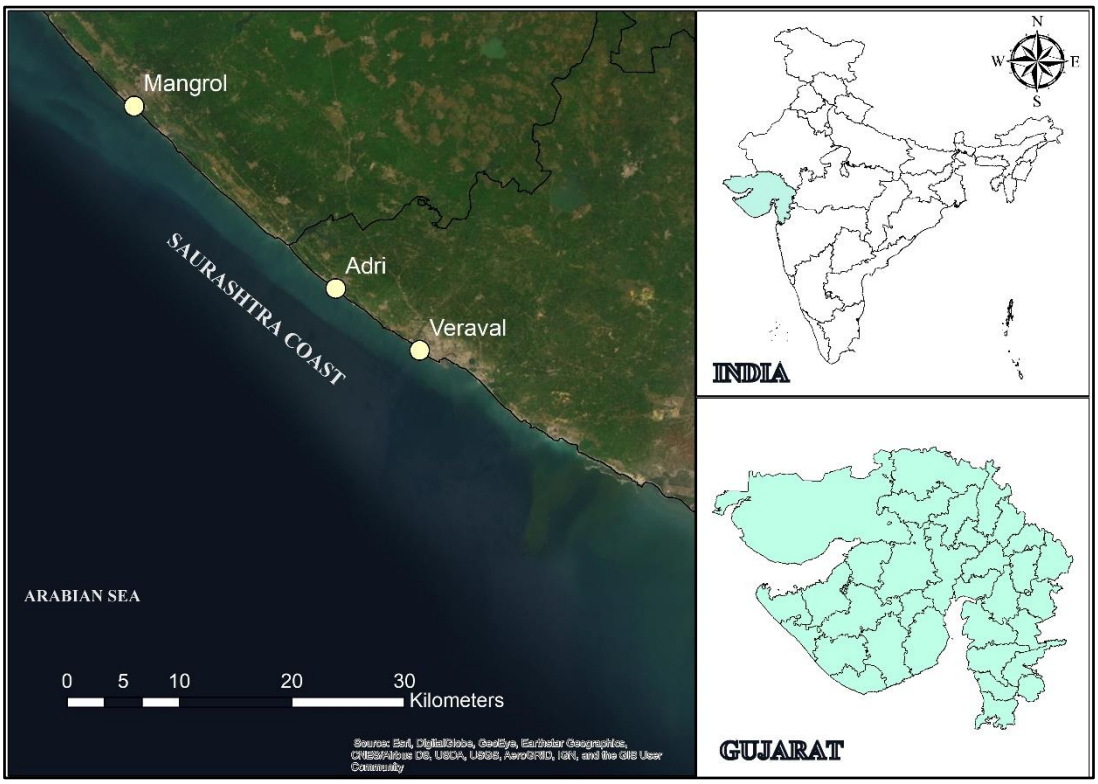

Fig 1: Map of the Study area

For the first objective, all the three study sites were surveyed extensively during lowest low tide. The field visits were done on monthly basis. The encountered Molluscan species were photographed, on field identification was done of the possible species. Observed Molluscans were identified up to species level by using Field Guide and standard references (Satyamurti, 1956; Fernando and Fernando, 2002; and Subba Rao, 2003). After identification the species were documented according to their taxonomic hierarchy.

Secondly, the intertidal coast of all the three study sites were divided into three different zones, namely upper intertidal zone, middle intertidal zone and lower intertidal zone. The distribution

status of molluscans along with its substratum were checked. The data was tabulated for the observed Molluscan species. GPS locations of all the sampling points were noted. Percentage composition of different classes at all the study sites was calculated.

For the third objective, quadrate sampling was done in zig-zag manner to cover the maximum exposed intertidal zone of selected Molluscan species in order to study its population ecology. The area covered for collection at fix time period; by hand picking method was taken into consideration and there by the abundance of Molluscan fauna was transformed into No/m^2 by appropriate conversions (Ksyunin, 2000). The obtained data was then calculated to check its Density, Abundance and Frequency for all the study sites. Length- Weight relationship of that particular dominant species was studied. To study gonadal cycle of selected dominant species; the individuals were collected bimonthly and dissected, gonads were removed and histological slides were prepared.

RESULTS

Objective 1

Total of 60 Molluscans were recorded from all the three study sites belonging to 4 classes, 14 orders and 31 families. Among all, class Gastropoda was dominated by 27 families and 51 species, followed by class Bivalvia, consisting of 2 families and 5 species, class Polyplacophora consisting of 1 family and 3 species and lastly class Cephalopoda with 1 family and 1 species only. Among all the study sites, maximum diversity was observed at Veraval coast with 51 species belonging to 4 classes, 13 orders and 28 families, followed by 37 species at Mangrol coast belonging to 3 classes, 13 orders and 26 families and with 32 species belonging to 3 classes, 10 orders and 19 families; minimum diversity was observed at Adri coast. Percentage composition of different classes from all the study sites revealed that class Gastropoda formed the dominant group by constituting 95% of the total organisms recorded followed by class Polyplacophora constituting 4% of the total organisms recorded and 1% of the total organisms recorded was by class Bivalvia. Among all the three study sites, maximum number of individuals were found from Veraval coast, where class Gastropoda formed the dominant group by constituting 94% of the total organisms recorded followed by class Polyplacophora constituting 5% of the total organisms recorded and 1% of the total organisms recorded was by class Bivalvia. Secondly Mangrol coast, where class Gastropoda formed the dominant group by constituting 95% of the total organisms recorded followed by class Polyplacophora constituting 4% of the total organisms recorded and 1% of the total organisms

recorded was by class Bivalvia; and lastly Adri coast where class Gastropoda formed the dominant group by constituting 95% of the total organisms recorded followed by class Polyplacophora constituting 3% of the total organisms recorded and 2% of the total organisms recorded was by class Bivalvia. The obtained diversity data was tabulated and diversity indices graphs were prepared using Past 4.03 software. The Molecular confirmation of the selected species is in the progress.

Objective 2

The south Saurashtra coast was surveyed extensively and three sites viz, Mangrol, Adri and Veraval were selected as diversity and distribution of intertidal molluscans were abundant at all the three study sites. The first site, the Mangrol coast has a very extended rocky intertidal zone which provides an ideal habitat for molluscs and other fauna. Mangrol has an entirely rocky intertidal coast, and a very distinct border between the sand and the rocky substratum, which is a significant coastal characteristic. Furthermore, the bottom of small rocky water bodies like pools and puddles are filled with sand. The exposure intertidal zone of Mangrol coast from upper littoral zone to lower littoral zone during lowest low tide, varied from 80 – 85 m. The second study site; Adri coast has horizontal and straight rocky intertidal habitat with patches of sand on its upper littoral zone and spray zone. The exposure of the intertidal zone of Adri coast from upper littoral zone to lower littoral zone during lowest low tide, varied from 60 – 70 m. The intertidal zone of third study site, Veraval coast is rocky mostly broken up by tide pools, puddles, cracks, and small channels. The tidal exposure here is between 86 - 95 m. The intertidal region of all the three study sites were divided into different zones and the molluscan species along with its substratum structure were studied. It was observed that different species had particular substratum selection and were mostly observed in that particular zone only. The dominating species on the upper intertidal zone were *Cellana radiata* and *Patella vulgata*, whereas the middle intertidal region was dominated by *Cerithium caeruleum*, *Cerithium scabridum*, *Trochus radiatus* and *Chiton granoradiatus.* The lower intertidal zone was dominated by *Aplysia oculifera* and other gastropod species. Additionally, *Lunella coronatus* was dominating in upper intertidal zones but it was also observed sparsely in middle and lower intertidal zone. Similarly, *Peronia verruculata* was found abundantly in lower and middle intertidal zone, but sparsely in upper intertidal zone. The GPS locations from all the three study sites were noted along the coastal stretch from the zone in which they were observed.

Objective 3

To investigate the population ecology, four molluscan species *Cerithium caeruleum, Lunella coronatus, Peronia verruculatum* and *Trochus radiatus* were selected. The primary criterion for their selection was their consistent and abundant presence throughout all seasons. Quadrate sampling was systematically conducted in a zigzag pattern, encompassing the entire coastal belt to ensure comprehensive coverage of the maximum intertidal area. The collected data was meticulously tabulated, and metrics such as density, abundance, and frequency were recorded for all four species across the three designated study sites. The population ecology data of *Cerithium caeruleum* which shows mean and standard deviation from all the three study sites and in different zones is presented in the following table, the same is been calculated for other three species.

Table 1: Zone wise **density** of *Cerithium caeruleum* along different study sites

Site	**Upper intertidal Zone**	**Middle intertidal Zone**	**Lower intertidal Zone**
Mangrol	4.58 ± 3.74	11.71 ± 7.40	4.89 ± 4.50
Adri	1.94 ± 3.59	7.23 ± 3.28	2.21 ± 2.06
Veraval	2.08 ± 1.31	14.37 ± 10.22	5.88 ± 6.19

Table 2: Zone wise **abundance** of *Cerithium caeruleum* along different study sites

Site	**Upper intertidal Zone**	**Middle intertidal Zone**	**Lower intertidal Zone**
Mangrol	7.40 ± 6.09	19.12 ± 8.27	11.14 ± 8.27
Adri	7.13 ± 9.58	12.40 ± 4.82	6.52 ± 4.95
Veraval	5.88 ± 3.13	20.76 ± 12.18	16.48 ± 17.94

Table 3: Zone wise **frequency** of *Cerithium caeruleum* along different study sites

Site	Upper intertidal Zone	Middle intertidal Zone	Lower intertidal Zone
Mangrol	44.22 ± 26.26	57.66 ± 16.40	43.74 ± 19.17
Adri	12.81 ± 13.65	57.66 ± 16.48	29.16 ± 19.62
Veraval	35.89 ± 18.06	67.66 ± 16.22	39.58 ± 19.50

The investigation included the determination of the length-weight relationship for selected dominant species. A regression equation was established, indicating a negative allometric growth pattern, signifying that weight gain occurred at a slower rate than length increase. Furthermore, Fulton's condition factor (K) was computed for these selected gastropods, unveiling a suboptimal condition for these particular specimens. Additionally, a comprehensive gonadal study was conducted on the chosen species. The specimens were carefully transported to the laboratory, where histological slides were meticulously prepared. Photomicrographs were captured utilizing a light microscope equipped with a CC:130 catcam. The results of the gonadal study unveiled distinct seasonal variations in the development of sperms and ova within these organisms.

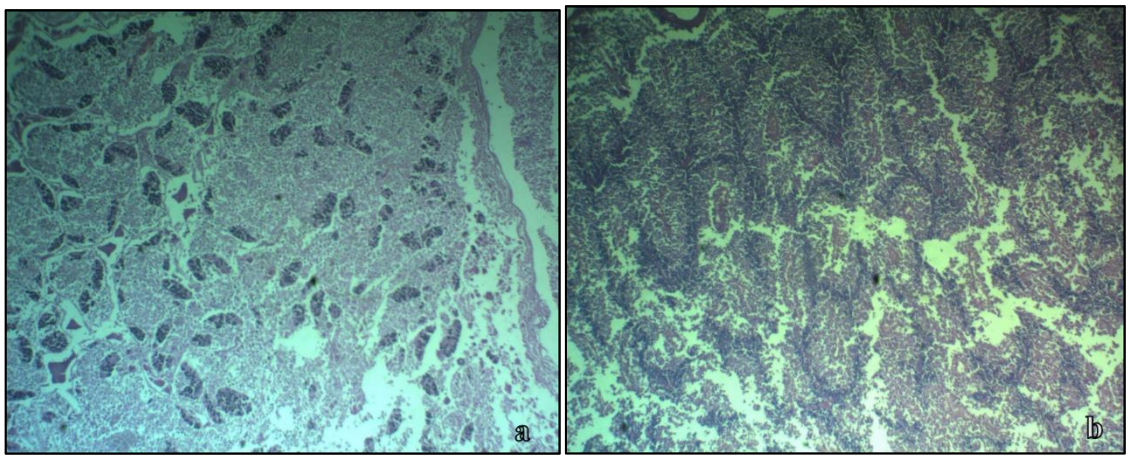

Fig 2: Gonadal sections of *Lunella coronatus* a) Female b) Male

DISCUSSION

The Saurashtra coast, which encompasses a significant portion of the coastline of Gujarat, has been the subject of several studies aimed at assessing the diversity of molluscs in the region (Gohel, 2016; Parmar, 2018; Poriya, 2015). The findings of this study are consistent with previous research, which collectively highlights the rich biodiversity of molluscs in the study sites. For instance, Gohel (2016) documented 59 species from the Mangrol coast, while Parmar (2018) recorded 42 species from the Adri coast. This consistency across different locations along the Saurashtra coast underscores the robustness of these findings. It's noteworthy that while there is general consistency in the diversity of molluscs along the Saurashtra coast, some variations exist. Poriya (2015) reported 53 species from a different location. These differences may be attributed to variations in habitats, collection methods, and the specific areas studied. It would be valuable for future research to investigate the factors contributing to these differences in diversity. The Saurashtra coast offers a wide range of habitats, including rocky shores, sandy beaches, estuaries, and mangrove ecosystems. This diversity of ecosystems likely contributes to the overall molluscan diversity, as different species are adapted to specific ecological niches (Gohel, 2016; Parmar, 2018). Understanding how different habitats influence the distribution of mollusca can provide valuable insights into their ecology and conservation. The consistent findings from multiple studies over the years underscore the importance of long-term monitoring of coastal biodiversity (Poriya, 2015). Tracking changes in molluscan diversity over time can help identify trends, threats, and the efficacy of conservation efforts. The documented diversity of mollusca in the Saurashtra region is not only scientifically valuable but also has practical implications for conservation. It emphasizes the need for habitat preservation, sustainable fisheries management, and measures to protect these ecologically and economically important species.

In general, rocky sea shore is always more diversified by Mollusc (Vanmali and Jadhav, 2015) mainly Gastropods (Menez et al., 2003) group, because of their high adaptive ability. The high occurrence of Gastropods on the intertidal belt of the Saurashtra coastal region has been previously documented by Joshi, 2010; Vaghela, 2010; Gohel 2016; Parmar 2018 and many other researchers; the similar observation is done in the present study. Other than Gastropods, class Bivalvia was observed mostly in middle intertidal zone and sparsely in lower intertidal zone. Along all the three study sites the distribution of Gastropods and Bivalvia was similar in their respective zone as stated above. Whereas class polyplacophora was found in upper and middle intertidal zone. Only single individual of class cephalopoda was observed from the lower intertidal zone of Veraval coast. The seasonal variation was less (Misra and Kundu, 2005; Gohel

2016) rather than that of average variation except some species like Aplysia. Highly populated species were recorded with minute fluctuation as per seasons except their breeding seasons for Peronia and Cerithids (Gohel, 2016). During the study period, all the study sites were surveyed to confirm the key species for population ecology study. It was observed that *Cerithium caeruleum*, *Lunella coronatus*, *Peronia verruculatum* and *Trochus radiatus* were abundant and thus these four species were finalized for population ecology study. Rocky seashores are renowned for their high molluscan diversity, primarily in the Gastropods group (Menez et al., 2003), owing to their remarkable adaptive capabilities (Vanmali and Jadhav, 2015). The intertidal belt of the Saurashtra coastal region has consistently demonstrated a prevalence of Gastropods, as established by earlier researchers, including Joshi (2010), Vaghela (2010), Gohel (2016), and Parmar (2018). This study reaffirms these findings, further substantiating the robust presence of Gastropods within the intertidal areas of the region. Apart from Gastropods, the Bivalvia class exhibited a greater presence in the middle intertidal zone and was sparsely distributed in the lower intertidal zone. This distribution pattern mirrors the previous studies conducted by Gohel (2016) and Parmar (2018). The Polyplacophora class was identified in the upper and middle intertidal zones. However, the Cephalopoda class was notably limited, with a single individual observed in the lower intertidal zone of the Veraval coast.

The seasonal dynamics within molluscan populations demonstrated a reduced amplitude of variation in contrast to the mean fluctuations, while specific species, notably Aplysia, manifested heightened and discernible oscillations, as evidenced in studies conducted by Misra and Kundu (2005) and Gohel (2016). Highly populated species exhibited minimal seasonal fluctuations, except during their respective breeding seasons, aligning with the observations made by Gohel (2016). During the study period, a comprehensive survey of all study sites was conducted to identify key species for population ecology studies. This survey revealed the abundance of *Cerithium caeruleum*, *Lunella coronatus*, *Peronia verruculatum*, and *Trochus radiatus*. Consequently, these four species were selected as the focal points for subsequent population ecology research (Gohel, 2016). The rich molluscan diversity along the Saurashtra coast, as observed in this study and corroborated by previous research, provides valuable insights into the ecological dynamics of this region and underscores the importance of continued monitoring and conservation efforts (Joshi, 2010; Vaghela, 2010; Gohel, 2016; Parmar, 2018). These findings contribute to our understanding of the adaptive capacities and distribution patterns of mollusca in varied intertidal habitats, enriching the broader field of marine ecology.

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CONFERENCE PRESENTATIONS

- (2023) **Agravat PA**, Raval JV, and Mankodi PC. Length-weight relationship of selected Gastropods along coastal Saurashtra, Gujarat, India. Paper presented at 13th National Science Symposium on Recent Trends in Science and Technology organized by Christ College Rajkot, Gujarat, India. **Awarded First Prize in Oral Presentation**.
- (2022) Vegdani H H, **Agravat P A**, Raval J V, and Mankodi P C. A study on Diversity of Order Zoantharia along Coastal zones of Saurashtra, Gujarat. Poster presented at National conference on PANORAMA of Life Sciences organized by Department of Life sciences, Maharaja Krishnakumarsinhji Bhavnagar University and Association of Zoologists, Bhavnagar, Gujarat, India. **Awarded First Prize in Poster Presentation**.
- (2021) **Agravat PA**, Raval JV, and Mankodi PC. Microhabitat Occupancy: A Competition among marine invertebrates. Paper presented at National Conference in Present-day Biology: Recent Advances in Biological Sciences organized by St. Xavier's College (Autonomous)Ahmedabad, Gujarat, India.
- (2021) **Agravat PA**, Raval JV, and Mankodi PC. A Comparative Account on Shellfish Diversity along two different Saurashtra Coast, Gujarat, India with Distribution of Selected Species. Paper presented at International Science Symposium on Recent Trends in Science and Technology organized by Christ College Rajkot, Gujarat, India. **Awarded First Prize in Oral Presentation**.

TRAINING/WORKSHOPS AND SEMINAR

- ❖ (2022) Successfully completed hands on training programme on “Basic Molecular Biology Techniques” jointly organized by Gujarat Biotechnology Research Institute (GBRC) and Ganpat University (GUNI), Mehsana, Gujarat, India.
- ❖ (2022) Attended five days online Faculty Development Workshop on “Advanced Integrated Tools for Research in Marine Biology and Biotechnology”, organized by Satyabhama Institute of Science and Technology, Tamilnadu.
- ❖ (2021) Attended Webinar on “Avifaunal and Coral Diversity of Gujarat”, organized by Ashok & Rita Patel Institute of Integrated Study & Research in Biotechnology & Allied Sciences and Association of Zoologists.
- ❖ (2021) Attended two days online training workshop on “DNA Barcoding- A challenge to Linnaeus Classification”, organized by Cytogene Research and Development, Lucknow.
- ❖ (2021) Attended Webinar on World Ocean Day, with theme of “Marine Ecosystem, Conservation and Challenges” jointly organized by Shri R.R Lalan college and Association of Zoologist.
- ❖ (2021) Attended Webinar on “Fantastic animals and How to Identify them” organized by AOZ- Association of Zoologists.
- ❖ (2021) Attended Webinar on “Mendeley, Citation and Reference Manager” organised by AOZ- Association of Zoologists.

PUBLICATIONS

- ✓ **Agravat, P. A**., Chavda, A. R., Upadhyay, K. H., Raval, J. V., & Mankodi, P. C. (2022). Deciphering the Taxonomy, Phylogeny and Distribution of the Marine Polychaete Eulalia viridis (Linnaeus 1767) from Saurashtra Coast, Gujarat, India. Environment and Ecology, 40(4A), 2331-2336.

- ✓ **Agravat, P. A**., Mankodi, P. C., & Raval, J. V. (2022). New distributional record of Evelineus mcintoshii (Langerhans, 1880) (Nemertea: Pilidiophora: Heteronemertea) from Gujarat, India. Indian Journal of Applied & Pure Biology, 37(3), 795-800.

- ✓ **Agravat, P. A**., Parmar, H. B., Bhatt, D. M., Raval, J. V., & Mankodi, P. C. (2022). Diversity of intertidal Macrobenthic Flora and Fauna along the South Saurashtra Coastal zone, Gujarat, India. International Journal of Entomology Research, 7(4), 130-142.

- ✓ **Agravat, P. A**., Mankodi, P. C., & Raval, J. V. (2022). A Comparative Account on Shellfish Diversity along two different Saurashtra Coast, Gujarat, India with Distribution of Selected Species. Proceedings papers published in International Science Symposium on Recent Trends in Science and Technology organized by Christ College Rajkot, Gujarat, India.

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