

Short Term Biodiversity Study of Shore Dwelling Organisms of South Mumbai Coast

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Abstract: Mumbai is one of the most populated coastal metropolitan cities in the world. Even with a high population density, the coastal ecosystem shows diverse organisms. However, due to the anthropogenic activities, this diversity is under threat. The present study aims to understand the diversity of sandy shore of Girgaon Chowpatty and rocky shore of Haji Ali. This work was carried out during the low tide in the intertidal region of both the sites. Combination of quadrant method and random walks was used to collect the data. The effect of human invasion was seen during the study. Despite the high footfall and anthropogenic activity, the intertidal region was thriving with organisms.

Index Terms: Coastal ecosystem, Anthropogenic activity, Girgaon Chowpatty, Haji Ali.

I. INTRODUCTION

India has mega-biodiversity, having rich and diverse regions. Even in terms of aquatic or marine life, India has so much to offer. Being a peninsular region, India is surrounded by water from all the three sides. Having a coastline of 7516.6 km (covering 9 states and 4 union territories), out of which, Maharashtra has a coastline of 720 km. In this, the city of Mumbai (18°58'30"N, 72°49'33"E) alone has a coastline of 149 km. Mumbai has such a vibrant marine ecosystem, it houses so

many creatures and some of them are revealed only during the low tide periods. The shores offer different habitats in which different inhabitants live. Some beaches have rocky substratum whereas some are sandy. While some beaches have fragments of both the substratum. Knowledge on species diversity of an ecosystem would help maximizing resource utilization in a sustainable manner besides preserving biodiversity (Pawar, 2021). The intertidal region is a zone of interaction between the sea, land and air, it is one of the most interesting regions of marine biota (Parulekar, 1982).

Marine ecosystem is the most diverse ecosystem in the world and special attention and information is required to understand its processes and function because it provides shelter to diverse and unique floral and faunal communities (Pawar, 2017a). In these intertidal zones some of the most magnificent lives are seen. For many years, there has been research going on in the intertidal zone, in and around Mumbai. A study done across India showed that the marine diversity is mainly made up of molluscs though the knowledge is far from complete (Venkataraman & Wafar, 2005). The macro benthic fauna shows dominance of gastropods and bivalves in the shores in and around Mumbai (Balasaheb et al., 2017). Even in the mangrove areas gastropods dominated followed by bivalves and then

polyplacophora were also recorded from Mumbai (Kantharajan et al., 2017). While brachyuran crabs were being recorded from the coast of Uran (Pawar, 2017a). The intertidal ecosystem around Mumbai was environmentally clean and rich in faunal composition but it has been disturbed and imbalanced due to ever increasing anthropogenic discharges from the city (Datta et al., 2010).

This study focuses on two selected shores of Mumbai. The purpose of this research was to: 1) Identify the types of fauna present in the intertidal zone of the selected sites, and 2) to check whether the anthropogenic activities are affecting the biodiversity in these sites. Both these places are known to have a large number of human activities.

II. MATERIALS AND METHODOLOGY

A. Study sites

Girgaon Chowpatty and Haji Ali are both located in the south of Mumbai, which were selected for this study. Girgaon Chowpatty is an intertidal area located in the popular region that constitutes a part of Queen's necklace shore. This area consists of rocks in the upper intertidal areas with patches of sand. The Haji Ali is area also located in the end of the south of Mumbai. The two sites selected include the sandy substratum of Girgaon Chowpatty (18.9519°N, 72.8166°E) and the rocky substratum of Haji Ali (18.9778°N, 72.8105°E).

B. Materials

PVC pipes were used to make quadrants (1m x1m), threads, Cameras (Nikon D3300, Redmi 6 Pro, Moto M).

C. Method

The study in each site was done on a monthly basis during low tide from November 2019 to February 2020. A quadrant (1m x1m) (Kantharajan et al., 2017) was fixed at a distance of 72 meters in between two points of study. Random walks were also done during the study. Identification was done by photographing the specimen and compared using field reference books (Apte, 1998, 2012, 2014). Bivalves (Pawar, 2017b, 2021) and crabs (Chhapgar, 1957; Pawar, 2017a) were identified also using android based application (*INaturalist Android App*, 2019)

D. Data analysis

The data analysis was done using Excel 2019 and Ayoung.com site (Young, 2020). The data recorded from these shores were considered for diversity indices (Pawar, 2015). Indices like Shannon-Wiener index, Reciprocal Simpson index, Dominance index and Margalef's richness index were calculated which were used as an indicator of the ecosystem health.

III. RESULT

A pie plot of the organisms showed that the dominating group was Gastropods (47.1%), second dominating group was Crustaceans (29.4%) and following with followed by Cnidaria (5.9%); Polychaeta (5.9%); Bivalvia (5.9%) and Pisces (5.9%) in the shore of Girgaon.

In Haji Ali rocky shore, we found, in the decreasing order the dominating group in was Gastropods (50%), Crustaceans (13%) and Pisces (13%) by Calcara (6%) and Hydrozoa (6%). The rest of the classes were Anthozoa, Turberlaria, Bivalve and Polychaeta were all 3%.

The macrobenthic species found on both the sites are given in Table 2. During this study 18 species in Girgaon Chowpatty and 32 species were found in Haji Ali. According to the observations shown, above the dominating species in both the sites were Gastropods followed by Crustaceans and then the other organisms. The data recorded from these shores were considered for diversity indices (Pawar, 2015). These indices were performed using a website (Young, 2020). The following indices were used to quantify biodiversity Shannon's index, Reciprocal Simpson index, Dominance index, Margalef's richness index (Table 1).

Table 1 Diversity indices in the two beaches of Mumbai.

	Girgaon Chowpatty	Haji Ali
Shannon's index	1.38	2.54
Reciprocal Simpson index	3.14	9.94
Dominance index	0.68	0.89
Margalef's richness index	2.22	3.97

IV. DISCUSSION

Girgaon Chowpatty is a popular recreational beach as it constitutes a part of Queen's necklace shore. 18 species were observed during this study. There was dominance of Gastropods

on this shore. Carrot sea anemone (*Paracondylactis sinensis*) was unique to that shore because of sandy substratum. Previous study showed dominance of clams *Paphia textile* and blood clams, *Arca* sp. The dominating species was *Babylonia spirata* (Balasaheb et al., 2017). Broken shells of these species were also observed during this study. *Diopatra* sp and *Indothais lacera* were found in abundance. We also found sand bubbler crabs which were also present in a larger amount while other macrobenthic species presence was sparse.

Haji Ali is a popular tourist place with large number of visitors. It has a rocky shore and there are small tidal pools. We observed 32 species during the study. The area is dominated by Gastropods and sea anemones. According to the previous data, the shore was dominated by *Euchelus asper* followed by *Bursa tuberculata* and *Trochus radius*, *Gastrina polygona* was a unique organism observed. Some other edible bivalves like *G. divaricatum*, *Dosinia gibba* and *Crassostrea cucullata* were sighted (Balasaheb et al., 2017). During our study, the shore was dominated by *Euchelus asper*, *Bursa tuberculata*, *Trochus radius* and also *Semiricinula konkanensis*. We also observed edible bivalves like *G. divaricatum*, *Dosinia gibba* and *Crassostrea cucullata*. Sightings of *Gastrea polygona* was mentioned in previous studies however, we did not sight them during our course of study (Balasaheb et al., 2017). Heavy anthropogenic activities, uncontrolled harvesting of organisms by local residents affect their population density and excessive practise may lead to ecological imbalance.

Comparing both the study sites' indices showed that Haji Ali had more diverse and rich fauna than Girgaon Chowpatty. The difference in the substratum might be contributing to harbour different organisms but gastropods were dominant in both the sites the Margalef's richness index was 2.22 and 3.97 in Girgaon and Haji Ali respectively, this is lower than the studies done in the nearby cost of Mumbai (Datta et al., 2010) indicating the loss of diversity during the past decade. We attribute this to the construction activity around the shore line in both the sites.

The most important physical factor that influences the life and activities of organisms of the intertidal zone is the existence of waves and duration of exposure to sunlight, the immense environmental problems leads to deterioration of water quality

and reduction in flora and fauna (Datta et al., 2010). The effect of increasing anthropogenic pressure is evident in these shores (Kantharajan et al., 2017). In Haji Ali, pollution from the domestic discharge, tourists or locals harvesting edible organisms which can affect the diversity (Shirke et al., 2015), tourist litter and recent coastal road project may be harming the biodiversity. In Girgaon Chowpatty, due to the pollution, the deposition of silt and organic matter leads to depletion of oxygen, which forms a black sulphate layer. This layer reacts with alluvium to cause hydrogen sulphite black layer which is seen as patches on the shore and on the gastropod shells (Balasaheb et al., 2017). The sandy substratum of Girgaon had a large number of hermit crabs, marine gastropods.

In the tidal pools in Haji Ali, we observed coral and polyps thriving, sea slugs, mudskippers and other fishes were also observed.

Mumbai sea coast as many other coasts is known for its anthropogenic activity. We observe many such instances of pollution. We here would like to mention some instances. We observed plastic bags entangled in the tentacles of sea anemones Figure A (1). *Diopatra* sp (Decorator worms) are known as biomarker of pollution (Won et al., 2008). Even with such hostile conditions we found organisms inhabiting these shores.

CONCLUSION

During this study, the diversity observed in both the sites was less compared to previous records. Even though we observed a reasonably rich diversity, but it calls for a sustained effort in preserving and enhancing the biodiversity. Present study gives a baseline data for the diversity that is present at Girgaon Chowpatty and Haji Ali which can help further for the monitoring of these shores.

ACKNOWLEDGEMENT

The authors would like to thank Marine Life of Mumbai for the help. The Principal Dr Uma Shankar, Head, Zoology Dr Satish Sarfare of SIES College of Arts, Science and Commerce, Mumbai for allowing us to conduct this work. Dr Rupali Vaity of Department of Zoology, SIES College of Arts, Science and Commerce, Mumbai, for her valuable comments.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

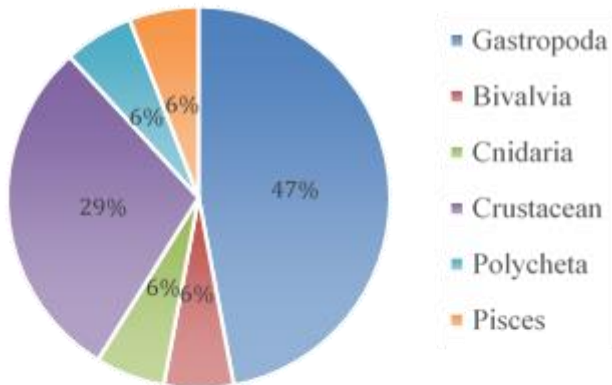


Figure 1 Diversity of Intertidal organisms in Girgaon



Figure 6 *Pugilina cochlidium*

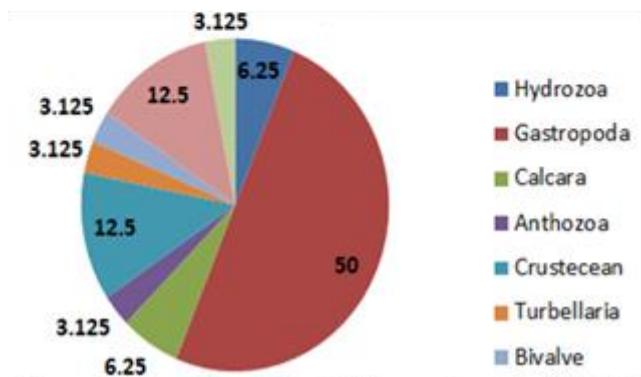


Figure 2 Diversity of Intertidal organisms in Haji Ali



Figure 5 *Babylonia spirata* (Spiral babylon)



Figure 7 *Haliclona sp.* (White sea sponge)



Figure 8 *Cratena peregrina* (Pilgrim hermia or Sea slug)



Figure 9 *Pseudosiderastrea tayami* (Stony coral)



Figure 10 *Haliclona sp.*

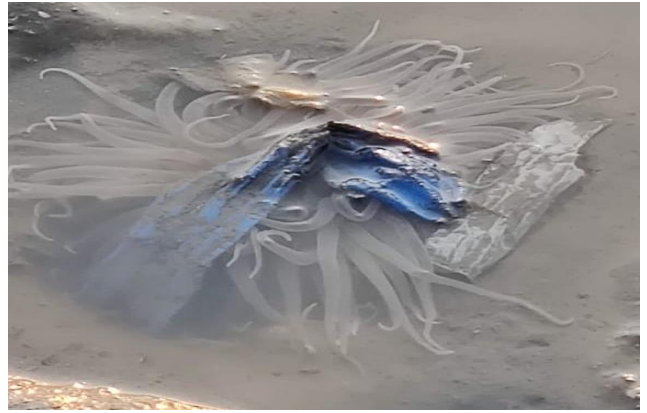


Figure A (1)



Figure A (2)



Figure B (1)



Figure B (2)

Anthropogenic activity. A (1): Tarpaulin entangled with tentacles of sea anemone, A (2): Sea anemone adhered to clay pot. B (1): *Diopatra sp* surrounded by waste, B (2): Tubes of *Diopatra sp*.

Table 2 List of marine fauna in the coast of Mumbai, Girgaon and Haji Ali

Organisms	Girgao n	Haji Ali	Organisms	Girgao n	Haji Ali
Barnacle		445	<i>Babylonia spirata</i>	22	
<i>Chicoreus bruinneus</i>	1	11	<i>Paracondylactis sinensis</i>	15	
<i>Clypeomorus bifasciata</i>		155	<i>Casmaria sp.</i>	20	
<i>Cratena sp.</i>		13	<i>Diopatra sp</i>	1380	
<i>Cronia subnodulosa</i>		311	<i>Indothais lacera</i>	120	
<i>Echinolittorina pascua</i>		1	<i>Maetra turgida</i>	1	
<i>Euchelus asper</i>		24	Mantis shrimp	4	
Flatworm		4	<i>Muricodrupa anaxares</i>	3	
<i>Gafrarium divaricatum</i>		1	<i>Chicoreus brunneus</i>	1	
<i>Gobiidae</i>	20	51	<i>Nactica vitellus</i>	17	
<i>Grapsus strigosus</i>		1	<i>Nassarius stolatus</i>	21	
<i>Gyrineum natator</i>		64	<i>Peristernia pulchella</i>	12	
<i>Haliclona sp.</i> (Pink)patch		6	Pistol Shrimp	4	
<i>Haliclona sp.</i> (White)patch		37	<i>Portunus sanguinolentus</i>	16	
<i>Pseudosiderastrea tayami</i>		28	<i>Pugilina cochlidium</i>	19	
Hermit Crab	978	122	<i>Scopimera sp.</i>	541	
<i>Littoraria undulata</i>		5	Shrimp	23	
Loach		3	Total	3218	
Neries		247			
<i>Nerita oryzae</i>		44			
<i>Nerita polita</i>		5			
<i>Neritodryas dubia</i>		13			
<i>Orania subnodulosa</i>		7			
<i>Anthopleura anjunae</i>		99			
<i>Anthopleura dixoniana</i>		211			
<i>Semiricinula konkanensis</i>		308			
<i>Sunetta donacina</i>		3			
Target perch		2			
<i>Thais rugosa</i>		5			
<i>Trochus erythraeus</i>		1			
<i>Turbo bruneus</i>		203			
<i>Xantho incisus</i>		2			
Total		2432			

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