Research Article Open Acces

Keywords Biomass; Community structure; Diversity indices; Jawaharlal Nehru Port; Pollution; Population density; Species composition; Uran

Introduction

Plants ecosystems are a habitat for a wide variety of species, some occurring in high densities and provide food and shelter for a large number of commercially valuable n sh and shell shes [1,2]. Mangroves are one of the biologically diverse ecosystems in the world, rich in organic matter and nutrients and support very large biomass of ora and fauna [3].

In India, 0.14% of the country's total geographic area is under mangroves and it account for about 5% of world's mangrove vegetation [4]. e Indian mangroves cover about 4827 Km^2, with about 57% of them along the east coast, 23% along the west coast, and 20% in Andaman and Nicobar Islands [5]. Anthropogenic activities involving development projects have resulted in depletion of coastal resources, destruction of mangrove habitats, disruption of ecosystem processes and loss of biodiversity [6].

Mumbai, a major metropolis and generates 0.85 million m^3/d of liquid e uent and 14,600 t/d of solid waste, which without any treatment are discharged in the coastal region in and around Mumbai [7]. Estimates of area of mangroves in Mumbai varied from 248.7 Km^2 [8] to 200 Km^2 [9] to 92.94 Km^2 [10] to 26.97 Km^2 [11,12] reported that Mumbai has lost 40% of all its mangroves in the past decade because of overexploitation and unsustainable demand for housing, slums, sewage treatment, and garbage dumps.

Mangroves are inhabited by a variety of macrobenthic invertebrates, which have a profound e ect on sediment structure and their biochemical processes by enhancing the porosity and water ow through the sediments [13]. Macrobenthic fauna have been studied more widely than others because of their high commercial value [14]. ey play an important role in the cycling of matter and energy in mangrove ecosystems [15,16]. Benthic communities are highly a ected by all the environmental parameters governing the distribution and diversity variation of the macrofaunal community in Pondicherry mangroves [17].

Investigation of the population density and biomass of the organisms in creeks and estuaries is useful for the environmentalists to get enough information about the life span of important resource fauna [18]. It gives a lot of information about the in ow of the young ones, the fry, total biomass, maturity, spawning, breeding and fecundity of the organisms of that region [19]. Understanding the structure of the benthic faunal communities in relation to the impacts of pollution is an important part of monitoring changes in mangrove ecosystems in India [20]. Pearson and Rosenberg [21] have demonstrated that diversity indices provide important insights into faunal communities at di erent stages in succession. In biodiversity investigations, assessment of diversity indices is essential to determine the community structure of a particular ecosystem [22,23].

e coastal environment of Uran [Navi Mumbai] has been under considerable stress since the onset of industries like Oil and Natural Gas Commission [ONGC], Liquid Petroleum Gas Distillation Plant, Grindwell Norton Ltd., Gas Turbine Power Station, Bharat Petroleum Corporation Limited Gas Bottling Plant, Jawaharlal Nehru Port [JNP, an international port], Nhava-Seva International Container Terminal [NSICT], Container Freight Stations [CFS], etc. ese activities a ect the quality of mangrove ecosystems [24]. Although many studies have been undertaken to evaluate the macrobenthos of mangrove ecosystems in India, no scienti c studies have been carried out on community structure of macrobenthos from mangroves of Uran, Navi Mumbai; hence, the present study is undertaken. Objective of the

present study is to evaluate the community structure of macrobenthos in relation to the impacts of pollution from mangrove ecosystems of Uran, Navi Mumbai with respect to population density, biomass and diversity indices.

Materials and Methods

Study area

Geographically, Uran [Lat. 180 50' 5" to 180 50' 20" N and Long. 720 57' 5" to 720 57' 15" E] with the population of 23,254 is located along the eastern shore of Mumbai harbor opposite to Coloba. Uran is bounded by Mumbai harbor to the northwest, ane creek to the north, Dharamtar creek and Karanja creek to the south, and the Arabian Sea to the west. Uran is included in the planned metropolis of Navi Mumbai and its port the Jawaharlal Nehru Port [JNPT] (Figure 1).

e mangrove ecosystem of Uran is a tide-dominated and the tides are semidiuranal. e average tide amplitude is 2.28 m. e ood period lasts for about 6-7 h and the ebb period lasts for about 5 hrs. e average annual precipitation is about 3884 mm of which about 80% is received during July to September. e temperature range is 12–36°C, whereas the relative humidity remains between 61% and 86% and is highest in the month of August. Four species of true mangroves representing three genera and three families were recorded during present study. e dominant species are Avicennia marina, Avicennia o cinalis, Acanthus ilicifolius, and Ceriops tagal. e average tree height is 2.4 m and the canopy coverage is greater than 90%.

Sampling procedures

e present study was carried out for a period of two years, i.e., from April 2009 to March 2011. Two study sites, namely Sheva creek, site I [Lat. 18050'20" N and Long. 72057'50'' E] and Dharamtar creek, site II [Lat.18050'50" N and Long. 72057'10" E] separated approximately by 10 km, were selected along the coast. At each site, three sampling station separated approximately by 1 km were established for assessment o density, biomass and diversity indices of selected macrobenthos.

e selected sites were visited fortnightly at spring low tide from April 2009 to March 2011. e intertidal area was divided into 3 zones i.e. High water zone [HWZ], mid water zone [MWZ] and Low water zone [LWZ] following Bhatt [25] and Parulekar [26]. From selected sites, macrobenthos were collected and processed as per th recommendations of Holme and McIntyre [27]. Identi cation of macro benthos was done following the work of Hornell [28], Menon [29], Subrahmanyam [30-32], Chhapgar [33,34], Apte [35] and Khan and Murugesan [23].

Population study of selected macro fauna

e abundantly recorded macrobenthic fauna from mangrove ecosystem is considered for population studies and their density, biomass and diversity Indices were assessed following standard methods [27,36,37].

Population density: Number of selected macrobenthos present in one m^2 area was considered for assessment of population density. e macro benthos collected from xed transects of one m^2 area, each from upper, middle and lower littoral zones were counted and average number of each species was recorded. Density of each species wa expressed as average No/m^2 [36].

Biomass: Macrobenthos of di erent species collected from one m^2

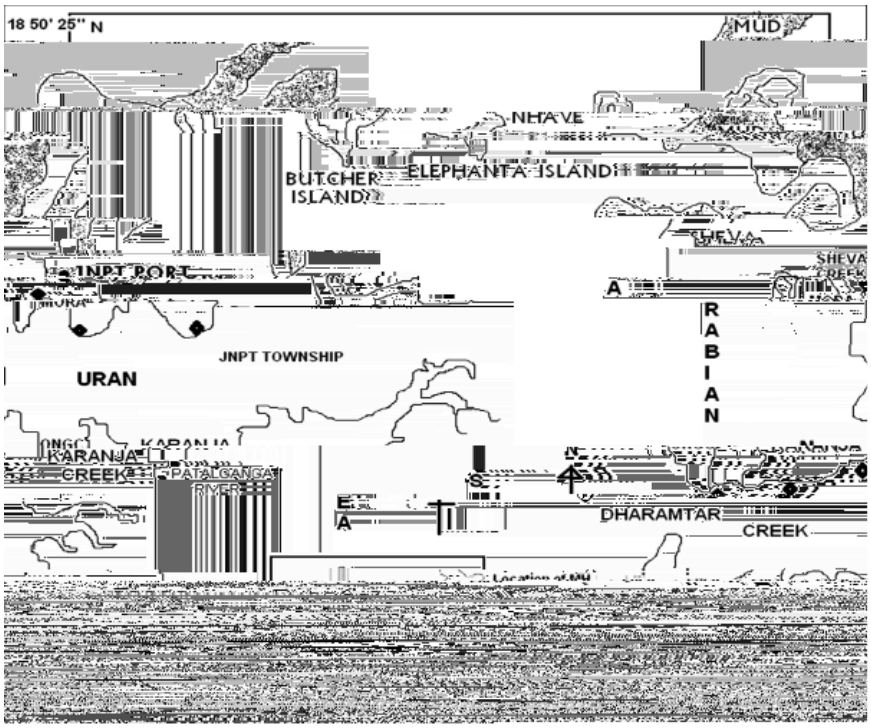

Figure 1: Location map of study area representing various sampling stations along Sheva creek and Dharamtar creek.

area were shelled and average wet weight was measured [38]. Biomass of each species was obtained by multiplication of average wet weight with average density and was expressed as g/m^2

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Results

Species composition of macrobenthos

A total of 86 species of macrobenthos representing 61 genera and 45 families were recorded from the mangroves of Uran coast. Varied diversity of macrobenthos belonging to gastropods, pelecypods, cephalopods, polychaetes, sponges, crabs, prawns and shrimps is recorded from both sites. Of the recorded species, 44.19% belonged to gastropods, 15.12% each to pelecypods, crabs and prawns and shrimps 4.65% each to cephalopods and polychaetes and 1.16% to sponge (Figure 2).

Population studies of selected macrobenthos

Among the recorded macrobenthos, abundantly recorded species like ais carinifera, Perinereis cultrifera and Uca annulipes were selected for assessment of density, biomass and diversity Indices following standard methods [27,36,37].

Population density

Population density of macrobenthos in mangroves of Uran is high during pre-monsoon and post-monsoon than the monsoon (Figure 3 and Table 1). Maximum density of P. cultrifera in the range of 164 ± 8 to 222 ± 25 no/m^2 was recorded at site I and 188 ± 5 to 270 ± 17 no/m^2 at site II. Minimum density was noted for T. carinifera in the range of 24 ± 4 to 33 ± 2 at site I and 34 ± 4 to 50 ± 4 at site II. U. annulipes has moderate density in the range of 37 ± 4 to 55 ± 6 at site I and 46 ± 2 to 66 ± 3 at site II.

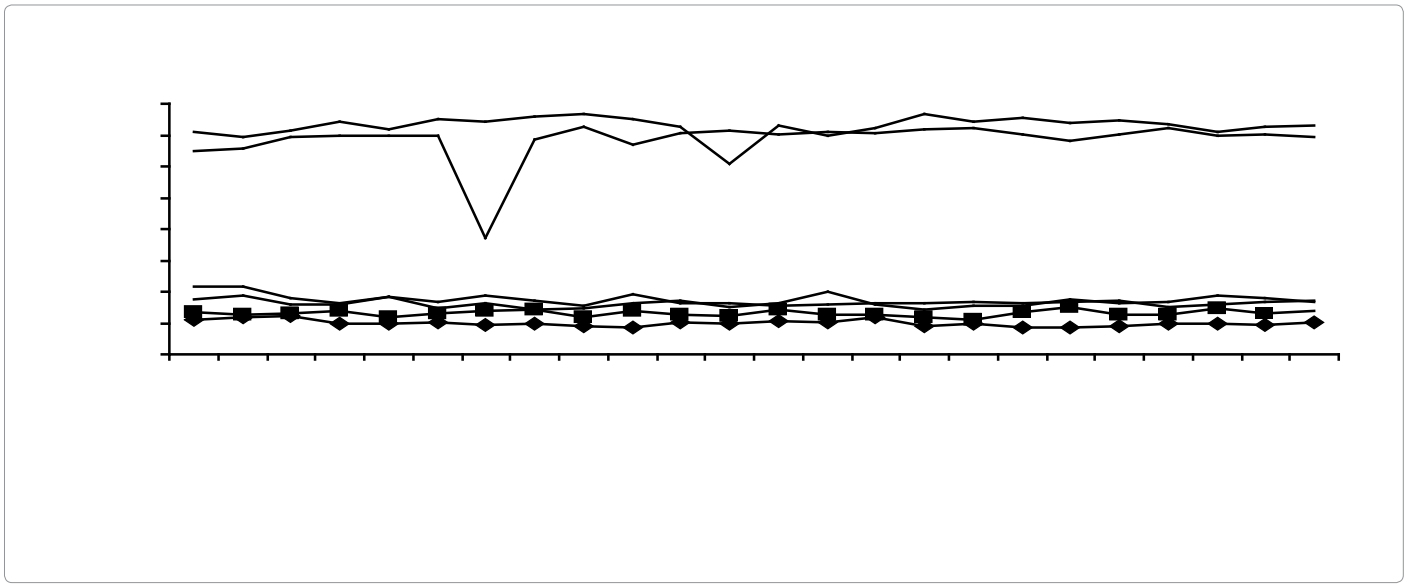
Biomass

e biomass follows the trend of population density with lowest value in monsoon and highest values in pre-monsoon and post-monsoon (Figure 4 and Table 2). Biomass of T. carinifera was highest in the range of 36.60 ± 5.81 to 48.47 ± 2.24 g/m^2 at site I and 54.90 ± 6.97 to 81.25 ± 8.08 g/m^2 at site II. P. cultrifera shows moderate biomass in the range of 30.80 ± 1.48 to 49.20 ± 5.19 g/m^2 at site I and 44.58 ± 3.74 to 70.39 ± 2.75 g/m^2 at site II. Lowest biomass in the range of 14.33 ± 1.58 to 26.96 ± 5.63 g/m^2 at site I and 22.13 ± 3.82 to 39.48 ± 1.66 g/m^2 at site II was recorded for U. annulipes. e degree of biomass can be put as T. carinifera > P. cultrifera > U. annulipes.

Citation: Pawar PR (2015)

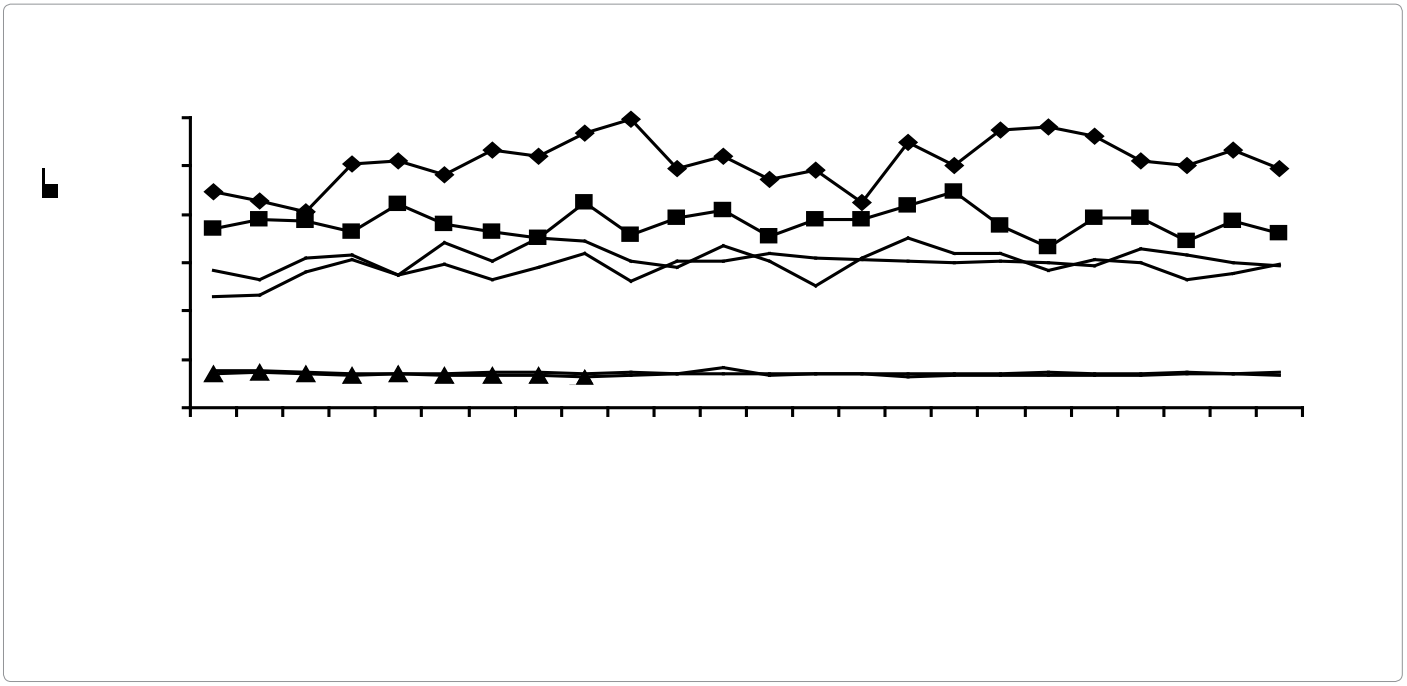
Macro-benthos	Site	Pre-monsoon 2009	Monsoon 2009	Post-monsoon 2010	Pre-monsoon 2010	Monsoon 2010	Post-monsoon 2011
Thais carinifera	I	47.24 ± 3.26	37.99 ± 4.76	42.46 ± 2.00	48.47 ± 2.24	36.6 ± 5.81	40.59 ± 2.98
	II	70.52 ± 8.53	57.98 ± 2.85	71.57 ± 6.89	81.25 ± 8.08	54.90 ± 6.97	76.11 ± 4.05
Perinereis cultrifera	I	49.2 ± 5.19	30.8 ± 1.48	44.76 ± 4.07	39.31 ± 2.36	37.45 ± 6.99	43.05 ± 7.09
	II	64.18 ± 7.32	44.58 ± 3.74	53.58 ± 6.34	62.69 ± 6.02	48.22 ± 5.75	70.39 ± 2.75
Uca annulipes	I	26.96 ± 5.63	14.33 ± 1.58	16.89 ± 1.89	22.96 ± 2.75	17.58 ± 2.15	22.36 ± 6.10
	II	39.48 ± 1.66	22.13 ± 3.82	27.56 ± 2.63	31.97 ± 1.16	25.16 ± 3.47	33.65 ± 3.13

Table 2: Seasonal variation of biomass of selected macrobenthos from mangroves of Uran.



annulipes> T. carinifera. e data on index of dominance shows that the gastropod species T. carinifera is dominated over by other species (Figure 6).

e rarity index was according to the index of dominance. In this case,T. carinifera shows highest rarity index and found to be rare with respect to population density and biomass. Rarity index R. of cultrifera, found to be very common at both sites. Lower Rarity index of polychaetes marks the higher density of it. Among other species, U. annulipesfound to be dominant over T. carinifera species assessed. e pattern of Rarity index was not signi cantly varied throughout the period of investigation, although, slight seasonal variation of Rarity index was recorded for all macro benthos (Figure 7).



e Shannon's Index of General Diversity ['], was found to be uniform during the period of investigation. Maximum ' was observed for U. annulipes, which was followed by T. carinifera and P. cultrifera. e ' of all the species studied was uniform throughout the period of investigation. e data on ' shows that species richness of P. cultrifera, U. annulipes and T. carinifera was more or less same. ese results of ' are in agreement with index of frequency, index of dominance and rarity index and did not varied signi cantly (Figure 8).

Discussion

Benthic macro fauna of the gastropods is dominant in Uran mangroves and is followed by pelecypods, crabs, prawns and shrimps, cephalopods, polychaetes and sponges. Similar results on specie composition of macrobenthos in mangrove ecosystems were reported by Ngo-Massou e [42], ilagavathi [1], Pravinkumar [13] and Kumar and Khan [17].

Higher density of macrobenthos recorded during pre-monsoon and post-monsoon is attributed to higher total organic carbon coupled with a stable environment [1]. e results of the study are in agreement with Kurian [43], Saravanakumar [44] and Praveen kumar [13]. Results of dominance of gastropods, pelecypods, crustaceans and polychaete in mangrove environment were also reported by Zhou [45] and Huang [46]. Low species diversity recorded during monsoon is attributed to the in ux of freshwater, low temperature and lowered salinity. is