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Assessment of Coastal Pollution Using Faunal Composition of Macrobenthos from Panvel Creek, Navi Mumbai, West Coast of India

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Abstract

Diversity of macrobenthos from Panvel creek remain poorly known. Here, the species composition and abundance of macrobenthos is explored from June 2018 to May 2019 to assess the ecological status of the creek. 18 species of macrobenthic fauna consisting of 14 genera, 12 families, 06 orders and 05 classes were recorded. The most abundant taxa were polychaetes, crustaceans, gastropods and pelecypods. Species belonging to Polynoidae, Cerithiidae, Potamididae, Neritidae and Trapezidae shows highest distribution and abundance. The creek is dominated by *Perinereis cultrifera*, *Clypeomorus bifasciata*, *Potamides cingulatus*, *Nerita oryzarum* and *Neotrapezium sublaevigatum*. *N. sublaevigatum* of the family Trapezidae from the class Bivalvia is recorded as an opportunistic taxa which exploits disturbed condition due to environmental stress. This study showed that at present though the creek is resourceful and supports the coastal marine life, is under considerable stress of anthropogenic inputs. Coastal environment of Panvel creek is deteriorating due to ongoing construction of Navi Mumbai International Airport and unplanned development activities. Present information could be helpful as a baseline data for further study of anthropogenic inputs on coastal ecosystem of Panvel creek.

Key Words: Macrobenthos, Navi Mumbai International Airport, Panvel creek, Pollution

Introduction:

Anthropogenic impacts produced by chronic or acute sources of pollution due to rapid development of industrial and urban activities causes disturbances in the marine ecosystems (Croquer et al., 2016). Pollution due to various anthropogenic, industrial, and maritime discharges renders the environment hostile for native species and opens a window for the proliferation of opportunistic native and exotic species (Haifeng et al., 2015).

Ecological indicators emerged as powerful tools to measure and synthesize information from specific biological or habitat components (Natesan et al., 2017). Bioindicators are living organisms which are utilized to screen the health of the natural ecosystem in the environment. They are used for assessing environmental health and biogeographic changes taking place in the environment (Parmar et al., 2016). Khatri and Tyagi (2015) have noted that macrobenthos may be powerful indicators of watershed health as they are not difficult to distinguish in a lab, frequently live for more than one year,

have restricted mobility, and are integrators of ecological condition.

Macrobenthos are metazoans with a proximate body size ranging from 0.5 to 5 cm, constitute a diverse and functionally important component of marine ecosystems (Gray and Elliot, 2009; Armenteros et al., 2018). Macrobenthos plays a significant role in mineralization, mixing of sediments, flux of oxygen into sediments, and cycling of organic matter. The macrobenthos community structure can change in relation to both natural and anthropogenic gradients (Haifeng et al., 2015; Putro et al., 2017). Due to their reduced mobility and short life cycles, benthic communities are often used as indicators in biomonitoring studies (Gray and Elliot, 2009; Haifeng et al., 2015).

Bibliographic work suggests that many investigators have used species composition of macrobenthos as an effective tool for assessment of environmental disturbances in marine ecosystem like Koo et al. (2004), Terlizzi et al. (2005), Ingole et al. (2009), Sejr et al. (2010), Tabatabaie and Amiri (2010), Athalye (2013), Pawhestri et al. (2015), Croquer et al. (2016), Khalil et al. (2016), Parmar et al. (2016), Sarker et al. (2016), Kale (2017), Natesan et al. (2017), Putro et al. (2017) and Matin et al. (2018).

Mumbai, a megacity in India, bordered by the Arabian Sea along the west coast with a population of 18.41 million (Kantharajan et al., 2018). The coastal environment of Mumbai and regions around receives about 2200 million litres of domestic wastewater per day (mld), mostly untreated (Zingde and Govindan, 2001; Singare et al, 2014). Similar conditions are likely to occur in Navi Mumbai coastal area due to wastes from chemical industries of Thane-Belapur Industrial Belt, Vashi, Navi Mumbai and Taloje Maharashtra Industrial Development Corporation (Pawar, 2013; Pawar and Inamdar, 2018).

Ongoing construction of Navi-Mumbai International Airport (NMIA) by the City and Industrial Development Corporation (CIDCO) in the vicinity of Panvel creek has resulted into encroachment, reclamation and urbanization in the study area. Construction of NMIA have affected the livelihood of local fishermen and coastal community along with anthropogenic stress on coastal ecosystem of Panvel creek. Hence the present study is undertaken to assess the impact of ongoing NMIA on coastal diversity of Panvel creek.

Literature review suggests that baring the work of Kale (2017) on benthic foraminifera of Panvel Creek and adjoining river estuaries, no information is available on species composition of macrobenthos from Panvel creek. The main objective of this study was to record the species diversity and abundance of macrobenthos from Panvel creek, Navi Mumbai.

Materials and Methods

- **Study Area**

Navi Mumbai is basically a satellite township on the west shore of Maharashtra. It was made in 1971 to be another urban township of Mumbai by Government of Maharashtra. As per Census India 2011, it had a population of 1,119,477. Panvel is located in Raigad district of Maharashtra in Konkan region and is a node of Navi Mumbai city. Geographically, Panvel is near Panvel creek which opens up in Thane creek. Kalundre river flows across the city in the south-west region and opens up into Panvel creek. Panvel with a population of 180,464 (Census India 2011) is a highly

populated city due to its closeness to Mumbai. It is located in the Mumbai Metropolitan Region. Panvel is situated on the banks of Panvel Creek. It is also surrounded by mountains on 2 sides.

The Panvel creek (Lat 18º 58' 26.895" N to 18º 59' 58.432" N & 73º 1' 43.74" E to 73º 6' 48.269" E) is about 7 km long tributary of the Thane creek (Fig. 1 and 2). The creek is characterized by extensive mud flats with sparse mangrove vegetation and less rocky stretches. Major area of the creek is dominated by the marshy areas and mud flats.

- **Study Location**

For the present study, three sampling sites, separated approximately by 1 km were selected. These sites were selected on the basis of their strategic locations and different anthropogenic activities along the entire coastal area.

- **Field study/Sampling**

The present study was carried out from June 2018 to May 2019. The study sites were surveyed monthly during spring low tides and macrobenthos from intertidal regions and shallow coastal waters were photographed with Cannon EOS1100D digital camera.

- **Identification of macrobenthos:**

The macrobenthos were identified up to species level using standard taxonomic keys and Marine Species Identification Portal website (http://species-identification.org). Scientific names and classification of macrobenthos was adopted from World Register of Marine Species (WRoMS) website (http://www.marinespecies.org).
Taxonomic keys from the work of Tan and Martyn (2013), Garcia and Capote (2015) and Htwe and Naung (2019) is also used for identification of macrobenthos.

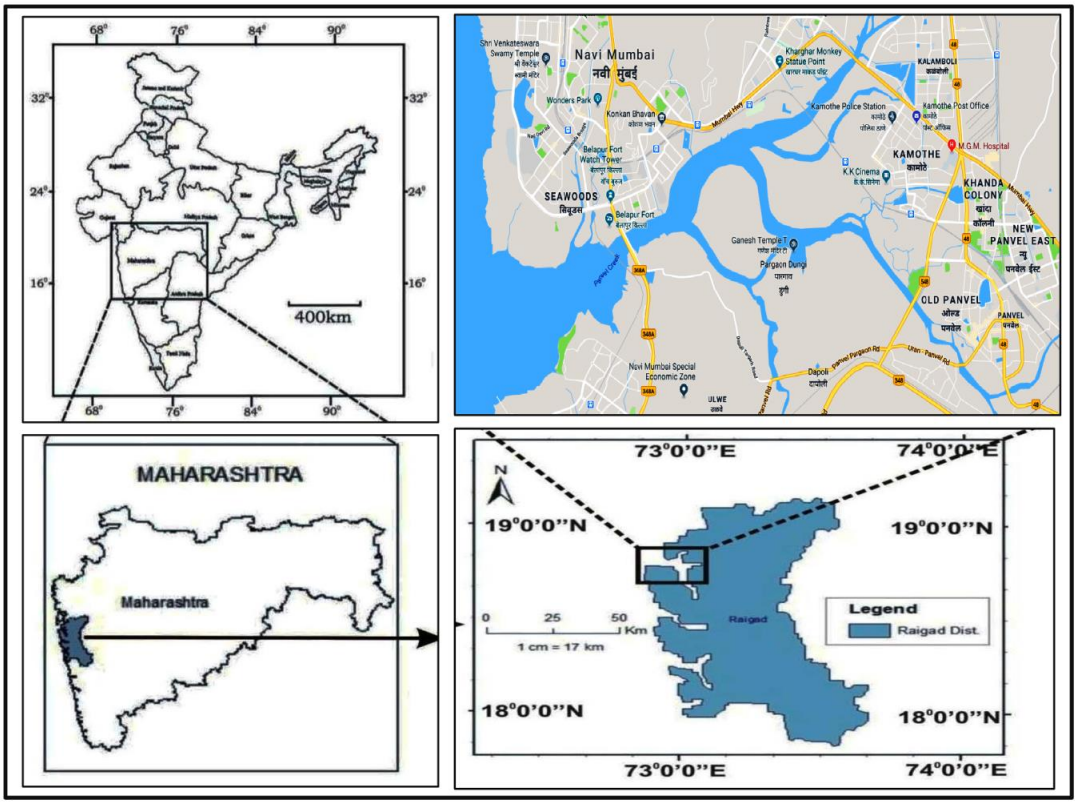

Fig. 1. Location map of study area representing Panvel creek.

Fig. 2. Tributaries of the Panvel creek (Source: Google maps)

Table 1: Checklist of benthic macrofauna recorded from Panvel creek during June 2018 to May 2019

Class	Order	Family	Scientific name
Polychaetes			
Polychaeta	Phyllodocida	Polynoidae	*Enipo gracilis* (Verrill, 1874)
	Acanthaceae	Nereididae	*Perinereis cultrifera* (Grube, 1840)
Crustaceans			
Hexanauplia	Sessilia	Balanidae	*Balanus balanus* (Linnaeus, 1758)
Malacostraca	Decapoda	Ocypodidae	*Uca annulipes* (H. Milne Edwards, 1837)
		Sesarmidae	*Armases angustipes* (Dana, 1852)
		Portunidae	*Charybdis natator* (Herbst, 1789)
		Varunidae	*Hemigrapsus sanguineus* (De Haan, 1835)
		Hymenoso-matidae	*Halicarcinus whitei* (Miers, 1876)
Gastropods			
Gastropoda	Caeno-gastropoda	Cerithiidae	*Clypeomorus bifasciata* (G. B. Sowerby II, 1855)
			Clypeomorus batillariaeformis (Habe & Kosuge, 1966)
		Potamididae	*Potamides cingulatus* (Gmelin, 1791)
			Telescopium telescopium (Linnaeus, 1758)
	Cycloneritida	Neritidae	*Nerita albicilla* (Linnaeus, 1758)
			Nerita chamaeleon (Linnaeus, 1758)
			Nerita crepidularia (Gmelin, 1791)
			Nerita oryzarum (Récluz, 1841)
			Neritina punctulata (Lamarck, 1816)
Pelecypods			
Bivalvia	Venerida	Trapezidae	*Neotrapezium sublaevigatum* (Lamarck, 1819)

Table 2: List of families with number of genera & species of macrobenthos from Panvel creek, Navi Mumbai

Sr. No.	Family	Genera	Species
1	Polynoidae	01	01
2	Nereididae	01	01
3	Balanidae	01	01
4	Ocypodidae	01	01
5	Sesarmidae	01	01
6	Portunidae	01	01
7	Varunidae	01	01
8	Hymenosomatidae	01	01
9	Cerithiidae	01	02
10	Potamididae	02	02
11	Neritidae	02	05
12	Trapezidae	01	01
Total	**12**	**14**	**18**

Results and Discussion

A total of 18 species of macrobenthic fauna consisting of 14 genera, 12 families, 06 orders and 05 classes were recorded. Table 1 and 2 displays the list of macrobenthos identified in the present study. The most abundant taxa were polychaetes, crustaceans, gastropods and pelecypods.

Among the species identified in present study, species belonging to Polynoidae, Cerithiidae, Potamididae, Neritidae and Trapezidae shows highest distribution and abundance. Panvel creek is dominated by *Perinereis cultrifera*, *Clypeomorus bifasciata*, *Potamides cingulatus*, *Nerita oryzarum* and *Neotrapezium sublaevigatum*.

During present investigation, exceptionally high abundance was recorded for *Neotrapezium sublaevigatum* of the family Trapezidae from the class bivalvia. *Neotrapezium sublaevigatum* is present in the form of a mat with more than thousand individuals (Fig. 4). This could be attributed to the family Trapezidae which belong to the class of opportunistic taxa (Pawhestri et al., 2015). Putro et al. (2017) have documented that opportunistic taxa exploits disturbed condition due to environmental stress by increasing their reproduction so that the population is increasing compared to other organisms which cannot survive.

It is also noted that many non-point sources of pollution are discharging untreated sewage, municipal waste and effluents in the creek. This is observed on the muddy substratum of the creek where up to two to three feet deep the wastes are percolated attributing dark oily black colour to the clay with repellent smell which indicates that the creek is moderately polluted. (Fig. 4 & 5).

Zingde (1999) reported that disposal of domestic wastes and untreated or partially treated industrial effluents in coastal region of Mumbai and around, has depleted coastal resources, public health

risk, and loss of coastal and marine biodiversity. Kale (2017) recorded that in Panvel creek, anthropogenic activities have decreased the diversity and density of macrobenthos from 2008 to 2015. Slaughtering of mangroves from Navi Mumbai region due to over exploration, unsustainable demand and reclamation have resulted in destruction of marine life (Pawar, 2013). According to Kantharajan et al., (2018), plastics is a menace to the mangrove ecosystems of megacity Mumbai and management of plastics and other trash is necessary for maintaining the intactness of mangrove ecosystem in Mumbai.

Conclusion :

This study showed that at present though the creek is resourceful and supports the coastal marine life, is under considerable stress of anthropogenic inputs. Coastal environment of Panvel creek is deteriorating due to habitat destruction, coastal degradation, construction of Navi Mumbai International Airport, pollution, unplanned development activities, encroachment and aquaculture. Present information could be helpful as a baseline data for further study of anthropogenic inputs on coastal ecosystem of Panvel creek. It is recommended that awareness among coastal community for sustainable development should be made as well as management plans must be done to keep the creek free from pollution.

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Enipo gracilis

Perinereis cultrifera

`Armases angustipes

Balanus balanus


Charybdis natator


Hemigrapsus sanguineus


Halicarcinus whitei


Species of *Nerita* & *Neritina*


Telescopium telescopium


Neotrapezium sublaevigatum

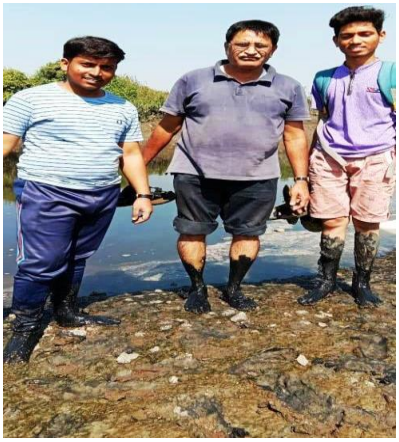
Fig. 3. Benthic macrofauna recorded from Panvel creek, Navi Mumbai.


Neotrapezium sublaevigatum - Opportinistic taxa


Gastropods coated with oil and chemical wastes


Chemicals, oils and other wastes in the creek

Discharge of chemical wastes in creek



Black and oily clay of the creek

Fig. 4. Current status of pollution in the Panvel creek.

Aquaculture

Unplanned developmental activities


Construction of Navi Mumbai International Airport


Construction of roads along the creek

Habitat destruction


Coastal degradation Coastal pollution

Fig. 5. Anthropogenic threats to mangrove ecosystem of the Panvel creek.