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Floristic Diversity of Mangroves along the Panvel Coast, Maharashtra

Aamod N. Thakkar
Veer Wajekar Arts., Science and Commerce College, Mahalan Vibhag, Phunde, Uran, Dist. Raigad

Abstract: *Mangrove ecosystems are among the most productive and ecologically significant coastal habitats in the world. These ecosystems occur in intertidal regions of creeks and estuaries where muddy soils, low oxygen levels, and saline conditions support specialized vegetation known as mangroves and mangrove associates. Mangroves play a vital role in maintaining coastal ecological balance by providing nursery grounds, breeding habitats, food resources, and shelter for numerous aquatic and terrestrial organisms. They also protect coastal regions from erosion, flooding, tidal surges, and other natural calamities.*

The present study was undertaken to assess the diversity of mangroves along Panvel Creek, Navi Mumbai, located on the west coast of India. Field investigations were carried out from March 2017 to February 2018 to document mangrove species, mangrove associates, and non-mangrove halophytes occurring in the study area. During the study period, eight true mangrove species belonging to five genera and three families were recorded. In addition, thirteen species of mangrove associates representing nine genera and five families were identified, along with one dominant species of non-mangrove halophyte occurring abundantly in the region.

The findings indicate that the productive habitat of Panvel Creek supports rich mangrove diversity and provides favorable ecological conditions for the growth and survival of mangrove vegetation. At present, the ecosystem does not appear to be severely affected by pollution stress. However, increasing anthropogenic activities such as rapid urbanization, industrialization, land reclamation, and the ongoing development of Navi Mumbai International Airport (NMIA) may exert considerable pressure on the ecological stability of the region in the future. Therefore, continuous ecological monitoring and effective conservation measures are essential for the sustainable management and protection of mangrove biodiversity along the Panvel coast.

Keywords: Mangrove diversity, Panvel Creek, coastal ecosystem, mangrove associates, Navi Mumbai, west coast of India.

I. INTRODUCTION

Mangrove ecosystems are among the most productive and biologically diverse ecosystems found in tropical and subtropical coastal regions of the world. These ecosystems develop in intertidal zones of estuaries, creeks, lagoons, and coastal mudflats where environmental conditions are characterized by saline water, tidal fluctuations, waterlogged soils, and low oxygen availability. The woody plants adapted to such extreme environmental conditions are known as mangroves, while associated plant species inhabiting nearby coastal regions are referred to as mangrove associates. Together with microorganisms, fungi, algae, invertebrates, fishes, birds, and other fauna, they form a complex and highly productive mangrove ecosystem.

Mangroves play a crucial ecological role in maintaining the stability and productivity of coastal environments. They act as natural barriers against coastal erosion, cyclones, tidal surges, and floods while also trapping sediments and

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improving water quality. Mangrove forests provide breeding, nursery, and feeding grounds for a wide variety of marine and estuarine organisms including fishes, crustaceans, molluscs, reptiles, birds, and mammals. These ecosystems also contribute significantly to nutrient cycling, carbon sequestration, and maintenance of coastal biodiversity. Because of their ecological and economic importance, mangroves are often regarded as one of the most valuable coastal ecosystems.

India possesses a considerable extent of mangrove vegetation distributed along both the eastern and western coasts. Approximately 0.14% of the total geographical area of the country is covered by mangroves, representing nearly 5% of the world's mangrove vegetation. Of the total mangrove cover in India, nearly 77% occurs along the east coast, while the remaining mangroves are distributed along the west coast. The coastal regions of Maharashtra, including Mumbai and Navi Mumbai, support important mangrove ecosystems associated with creeks, estuaries, and tidal mudflats.

In recent decades, mangrove ecosystems have been increasingly threatened by anthropogenic disturbances such as industrialization, urbanization, land reclamation, pollution, overexploitation of natural resources, and infrastructure development. Large-scale destruction of mangrove habitats has been reported from Mumbai and surrounding coastal regions due to increasing demand for housing, industrial expansion, sewage disposal, and dumping of solid waste. Studies have shown that Mumbai has lost a substantial portion of its mangrove cover over the past few decades as a result of unsustainable developmental activities. Pollution from domestic sewage, industrial effluents, oil spills, and chemical wastes further degrades the ecological health of coastal ecosystems.

The coastal environment of Panvel Creek in Navi Mumbai is currently under considerable ecological stress due to rapid developmental activities in the region. The ongoing construction of the Navi Mumbai International Airport (NMIA) over a large area near Panvel has resulted in destruction and reclamation of mangrove habitats. In addition, urbanization by the City and Industrial Development Corporation (CIDCO), sand dredging, encroachment, discharge of industrial effluents from Taloja MIDC, and other human activities are likely to affect the structure and diversity of mangrove ecosystems in the study area. Such disturbances may lead to habitat fragmentation, loss of biodiversity, and ecological imbalance in coastal regions.

Although extensive studies on mangrove ecology and biodiversity have been conducted in different parts of India, limited information is available regarding the species diversity of mangroves from Panvel Creek, Navi Mumbai. Therefore, the present study was undertaken to document the diversity of mangrove species, mangrove associates, and non-mangrove halophytes occurring along Panvel Creek on the west coast of India. The study also aims to provide baseline information for future ecological monitoring, conservation planning, and sustainable management of mangrove ecosystems in the region.

II. MATERIALS AND METHODS

Study Area

Panvel is situated in the Raigad district of Maharashtra on the west coast of India and serves as an important junction connecting Navi Mumbai, Thane, Pune, and Ratnagiri districts. Geographically, the region is located along the banks of Panvel Creek, an ecologically important estuarine system supporting extensive mudflats and mangrove vegetation. The Panvel Creek extends between Lat. 18°58′26.895″ N to 18°59′58.432″ N and Long. 73°01′43.74″ E to 73°06′48.269″ E. The creek receives freshwater input from four major rivers namely Gadhi, Kalundre, Taloje, and Ulve rivers, which ultimately merge into the estuarine ecosystem.

Panvel Creek is approximately 7 km long and forms a tributary connected with Sheva Creek and Belapur Creek. The creek is predominantly characterized by extensive mudflats, marshy regions, tidal flats, and sparse mangrove

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vegetation, while rocky substrata are comparatively less common. The mudflat and mangrove habitats associated with the creek support rich biodiversity and provide important ecological services such as nutrient cycling, shoreline stabilization, sediment trapping, and nursery grounds for aquatic organisms.

The mangrove vegetation surrounding Panvel Creek plays a significant role in maintaining ecological balance and supporting coastal biodiversity. Biodiversity and community structure are considered important determinants of ecosystem functioning, productivity, and stability. Compared to terrestrial ecosystems, marine and estuarine ecosystems have received comparatively less ecological attention despite their ecological and economic importance. Therefore, documentation and assessment of mangrove diversity are essential for understanding the ecological status of coastal habitats and developing conservation strategies.

III. METHODOLOGY

The present study was conducted for a period of one year from March 2017 to February 2018 to assess the diversity of mangroves and associated vegetation along Panvel Creek, Navi Mumbai. Regular field surveys were carried out throughout the study period covering different tidal zones, mudflats, marshy regions, and mangrove patches of the creek ecosystem.

Mangrove species, mangrove associates, and non-mangrove halophytic vegetation occurring in the study area were observed, recorded, and identified based on their morphological characteristics and habitat distribution. Identification of mangrove species was carried out using standard taxonomic literature and reference manuals provided by Kathiresan (2000) and Naskar and Mandal (1999).

The collected information was systematically analyzed to document the diversity and distribution of mangrove vegetation occurring along the Panvel coastal ecosystem. The study aimed to generate baseline ecological data useful for future biodiversity monitoring, environmental assessment, and conservation planning of mangrove habitats in the region.

IV. RESULTS AND DISCUSSION:

Table 1: Species diversity of mangrove ecosystem from Panvel, Navi Mumbai, Maharashtra.

Table 1. Mangrove Species Recorded from Panvel Creek, Navi Mumbai, West Coast of India

Sr. No.	Category	Order	Family	Scientific Name
1	True Mangrove	Scrophulariales	Acanthaceae	*Acanthus ilicifolius*
2	True Mangrove	Lamiales	Avicenniaceae	*Avicennia officinalis*
3	True Mangrove	Lamiales	Avicenniaceae	*Avicennia alba*
4	True Mangrove	Lamiales	Avicenniaceae	*Avicennia marina*
5	True Mangrove	Malpighiales	Rhizophoraceae	*Rhizophora apiculata*
6	True Mangrove	Malpighiales	Rhizophoraceae	*Rhizophora mucronata*
7	True Mangrove	Malpighiales	Rhizophoraceae	*Ceriops tagal*
8	True Mangrove	Malpighiales	Rhizophoraceae	*Bruguiera sexangula*
9	Mangrove Associate	Solanales	Convolvulaceae	*Ipomoea carnea*
10	Mangrove Associate	Solanales	Convolvulaceae	*Ipomoea stolonifera*
11	Mangrove Associate	Solanales	Convolvulaceae	*Ipomoea pes-caprae*
12	Mangrove Associate	Fabales	Fabaceae	*Derris trifoliata*
13	Mangrove Associate	Fabales	Fabaceae	*Caesalpinia bonduc*
14	Mangrove Associate	Fabales	Fabaceae	*Derris scandens*
15	Mangrove Associate	Rhamnales	Rhamnaceae	*Ziziphus ziziphus*
16	Mangrove Associate	Rhamnales	Rhamnaceae	*Ziziphus mauritiana*
17	Mangrove Associate	Lamiales	Verbenaceae	*Lantana camara*
18	Mangrove Associate	Lamiales	Verbenaceae	*Premna corymbosa*

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19	Mangrove Associate	Lamiales	Verbenaceae	*Clerodendrum inerme*
20	Mangrove Associate	Cyperales	Cyperaceae	*Scirpus littoralis*
21	Mangrove Associate	Cyperales	Cyperaceae	*Fimbristylis ferruginea*
22	Non-Mangrove Halophyte	Caryophyllales	Aizoaceae	*Sesuvium portulacastrum*

Summary of Recorded Vegetation

Vegetation Type	Number of Species	Number of Genera	Number of Families
True Mangroves	8	5	3
Mangrove Associates	13	9	5
Non-Mangrove Halophytes	1	1	1
Total	**22**	**15**	**9**

Discussion:

True Mangroves: During present study eight species of mangroves belonging to five genera and three families were recorded (Table 1). A moderate cover of patchy mangroves was observed in upper littoral zone of the creek. The supra littoral zone of the entire coastal stretch of Panvel has moderate cover of mangroves with the species of *Avicennia marina* dominating.

Mangrove associates: were represented by thirteen species belonging to nine genera and five families in the study area. Non-mangrove halophytes: *Sesuvium portulacastrum,* single species of non-mangrove halophytes of family Aizoaceae was recorded in abundant.

Though the variety of mangrove species found at Panvel is less, it has sparse cover along the coastal belt of Panvel providing ground to support rich mangrove community.

Ongoing construction of Navi-Mumbai International Airport (NMIA), urbanization by the City and Industrial Development Corporation (CIDCO), release of industrial effluents, and untreated sewage, dumping of solid waste and debris, dredging of sand and unchecked encroachment along the coastal line have resulted in deterioration of water quality. Incidences of industrial pollution are common in creeks of Mumbai and Navi Mumbai (Pawar, 2012). Fourteen mangrove species in and around Mumbai coast are reported (Navalkar, 1951). In order to ensure sustainable development, one of the key prepositions is prioritize Conservation of wetlands and their scientific restoration by systematically understanding the mechanism involved in the evolution and degradation of wetland ecology (Sharma, 2013).

Conclusion:

The upcoming project of Navi Mumbai International Airport and Navi Mumbai Metro, development of residential colonies by CIDCO, sewage water discharge, illegal dumping of waste, release of industrial effluents, reclamation, encroachment and dredging of sand would be further enhancing opportunities for development in the area leading to destruction of mangrove ecosystem. Though these developments are essential they should be sustainable and loss of habitats should be restored. What is needed is the collective effort and a strong will from all stakeholders to save the mangroves and wetlands. Strict legislative protection, active participation of locals and continuous long term biodiversity monitoring program are needed in order to conserve such ecosystems. It is felt utmost important to sensitized, in conserving this natural wealth from the various destructions that may occur in future.

Discussion

The present investigation revealed the occurrence of moderate mangrove diversity along the Panvel Creek ecosystem of Navi Mumbai on the west coast of India. During the study period, eight true mangrove species belonging to five genera and three families were recorded from the study area. The mangrove vegetation was mainly distributed in patchy

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formations along the upper littoral zones of the creek. Among the recorded species, *Avicennia marina* was found to be the dominant mangrove species throughout the coastal stretch of Panvel Creek. The dominance of *Avicennia marina* may be attributed to its high tolerance to salinity fluctuations, waterlogged conditions, and anthropogenic disturbances commonly observed in estuarine ecosystems.

Mangrove associates recorded during the study were represented by thirteen species belonging to nine genera and five families. These associated plant species were commonly observed in the adjoining marshy regions, mudflats, and elevated coastal areas surrounding the mangrove habitats. In addition, one species of non-mangrove halophyte, *Sesuvium portulacastrum* belonging to the family Aizoaceae, was recorded abundantly in the study area. The occurrence of mangrove associates and halophytic vegetation indicates the ecological adaptability and environmental heterogeneity of the Panvel Creek ecosystem.

Although the overall diversity of true mangrove species recorded from Panvel Creek was comparatively lower than that reported from some other coastal regions, the mangrove vegetation still forms an important ecological component of the coastal belt. The patchy mangrove cover supports a rich ecological community by providing shelter, breeding grounds, nutrient cycling, and habitat for various aquatic and terrestrial organisms. Mangrove ecosystems also play an essential role in shoreline stabilization, sediment trapping, carbon sequestration, and protection against coastal erosion and tidal impacts.

The Panvel coastal ecosystem is presently subjected to increasing anthropogenic pressure due to rapid urbanization and infrastructural development. The ongoing construction activities associated with the Navi Mumbai International Airport (NMIA), expansion of residential areas by the City and Industrial Development Corporation (CIDCO), discharge of industrial effluents, untreated domestic sewage, dumping of solid waste and construction debris, sand dredging, and illegal encroachment along the coastal belt have adversely affected the ecological health of the region. Similar incidences of industrial pollution and habitat degradation have been frequently reported from creeks of Mumbai and Navi Mumbai.

Previous studies have documented approximately fourteen mangrove species along the Mumbai coastal region, indicating that mangrove diversity in urban coastal ecosystems is under considerable ecological stress. Wetlands and mangrove ecosystems require scientific conservation and restoration strategies to ensure sustainable coastal development. Understanding the processes responsible for ecological degradation is therefore essential for effective management and restoration of wetland ecosystems.

The present findings highlight the ecological significance of Panvel Creek mangroves despite increasing developmental pressures. Continuous monitoring and ecological assessment of the region are necessary to evaluate changes in mangrove diversity and ecosystem health over time.

Conclusion

The present study demonstrated that the Panvel Creek ecosystem supports moderate diversity of mangroves, mangrove associates, and halophytic vegetation, which collectively contribute to the ecological stability and productivity of the coastal environment. Although the mangrove cover in the region is sparse and patchily distributed, it provides important ecological services such as shoreline protection, habitat support, nutrient cycling, and maintenance of biodiversity.

Rapid urbanization and infrastructural projects including the Navi Mumbai International Airport, Navi Mumbai Metro, expansion of residential colonies by CIDCO, industrial growth, sewage discharge, illegal dumping of waste, land reclamation, sand dredging, and encroachment are likely to exert increasing pressure on the mangrove ecosystem in the

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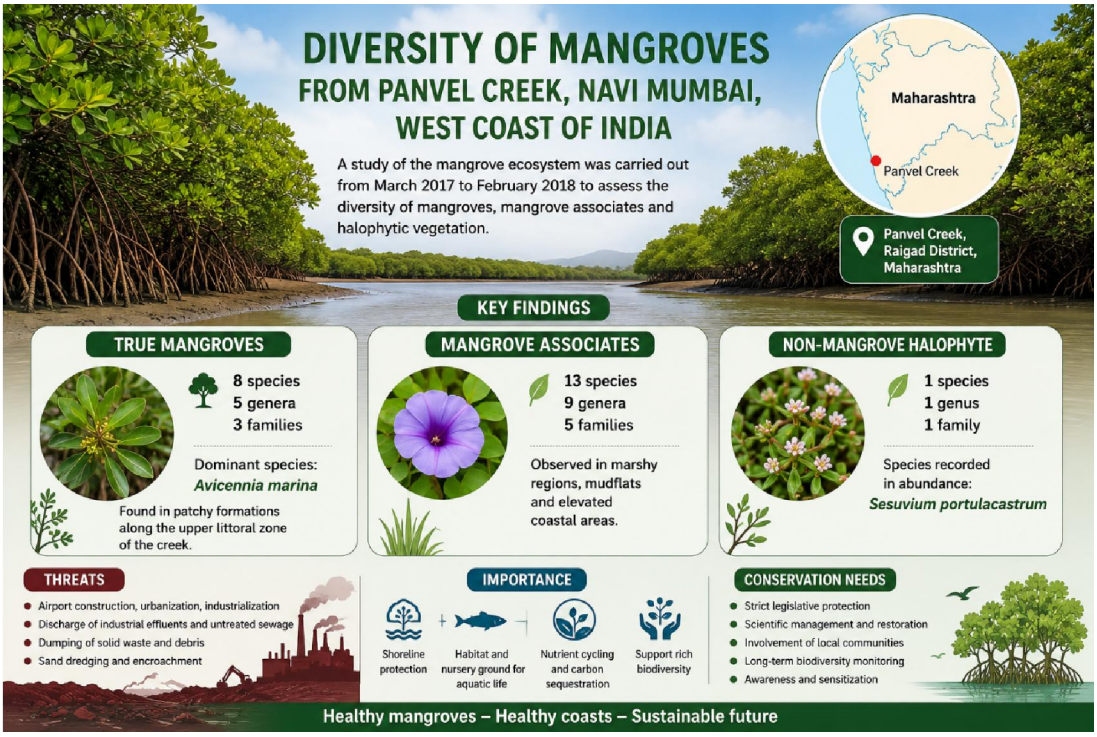
near future. Such developmental activities may lead to large-scale habitat destruction, fragmentation, and decline in mangrove biodiversity if not managed sustainably.

While developmental projects are essential for economic growth and urban expansion, they should be implemented in an environmentally sustainable manner with minimum ecological damage. Restoration of degraded mangrove habitats and conservation of remaining wetlands should be prioritized to maintain ecological balance in the region.
The study emphasizes the urgent need for strict legislative protection, scientific management, long-term biodiversity monitoring, and active participation of local communities in mangrove conservation programs. Public awareness regarding the ecological and economic importance of mangroves should also be promoted to ensure protection of these valuable coastal ecosystems for future generations.



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