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Diversity and Species Composition of Mangroves in Rajpuri Creek of Raigad, Maharashtra, India.

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Abstract: *The Rajpuri Creek, located in Raigad, Maharashtra, represents a diverse and ecologically significant mangrove ecosystem. This study investigates the species composition, distribution, and diversity of mangroves in the creek through a comprehensive analysis of ten selected sites. Using quadrat analysis and diversity indices such as Margalef's index of richness, Shannon-Weaver diversity index, and Simpson's index of dominance, we assessed species richness and dominance. A total of 10 mangrove species belonging to seven families were identified, with the families Avicenniaceae, Sonneratiaceae, and Rhizophoraceae contributing significantly to the diversity. The uneven distribution of these species highlights the environmental heterogeneity across the creek. The study emphasizes the importance of these mangroves in maintaining ecological balance and provides insight into their conservation status in light of ongoing global environmental changes.*

Keywords: Mangrove diversity, Rajpuri Creek, species composition, quadrat analysis, Avicenniaceae, Sonneratiaceae, Rhizophoraceae, ecological balance, conservation

I. INTRODUCTION

Mangrove forests consist of various growth forms, including trees and shrubs, that thrive in the intertidal zones between land and sea in tropical and subtropical regions. These ecosystems are uniquely adapted to the dynamic conditions of coastal environments, providing vital ecological functions[1][2].Mangrove forests are known to support a total of 464 terrestrial vertebrate species, including 320 species of mammals, 118 species of reptiles, and 26 species of amphibians[3].Over the past twenty years, the global average temperature has risen by approximately 0.1°C each decade[4], In addition to various chlorofluorocarbons (CFCs), carbon dioxide (CO2) is one of the primary greenhouse gases contributing significantly to global warming[5], Mangroves have the ability to rapid carbon sequestration in comparison to terrestrial forests [6][7]. Mangroves globally span an estimated area of approximately 137,760 square kilometres, covering coastal regions around the world[8], out of which India constitutes 3.5% amounting the total 4921 Km^2. According to Jagtap et al.[9], Maharashtra's mangrove coverage estimated in the year 1987 was 210.17 sq. km, while according to the FSI report in 2019[10], Mangrove Forest Cover in Maharashtra is 320sq.km. The Raigad district encompasses around 222.21 square kilometres of land covered by mangroves.[11] identified 44 species classified as true mangroves and 86 species recognized as mangrove associates in India[12].Maharashtra's west coast is home to 20 distinct mangrove species spread across 15 genera and 11 families, with these mangroves found in seven coastal districts of the state.[2].Mangroves experienced an annual decline of 0.66% between 2000 and 2005 [13]. If this trend persists, the world could see the complete loss of mangrove forests within approximately 151.5 years, posing a significant threat to the ecological balance of global wetlands. The ongoing depletion of mangrove forests is driven by factors such as agricultural expansion, aquaculture, tourism, urbanization, and overexploitation[14][15], natural factors like cyclones, tsunami, disease, pest and parasites are also involved in the mangrove forests decline [16]. India is home to two notable species: *Sonnertia griffithii*, classified as critically endangered, and *Heritiera fomes*, listed as endangered[12].

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II. MATERIAL AND METHODS

A. Study area

The Rajpuri Creek, located along the Raigad coast of Maharashtra, stretches between latitudes 18°14' to 18°34' N and longitudes 72°97' to 73°11' E. It is one of the largest creek in the regionen compassing areas around Murud, Mhasala, Roha, and Srivardhan.

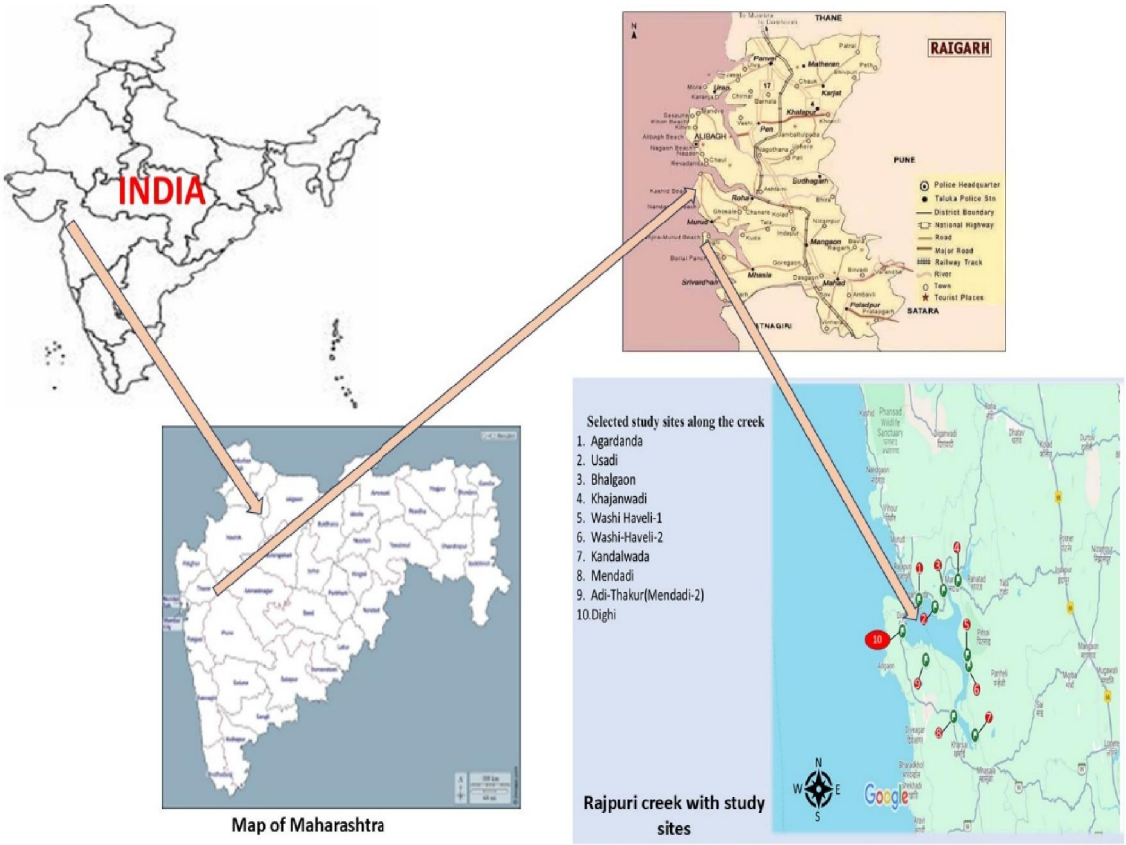

Fig.1. Map showing the location of the study site

B. Sampling of Study Sites

A comprehensive survey was conducted in Rajpuri Creek, Raigad District, Maharashtra, to assess the dynamics and diversity of the mangrove ecosystem. Ten sampling sites were meticulously selected based on several criteria, including the distribution and diversity of mangroves, sources of pollution, and variations in salinity levels. These sites were strategically chosen to encompass the spatial heterogeneity of the creek and provide a representative overview of its ecological conditions.

C. Population dynamics of Mangroves

The distribution pattern of mangroves in Rajpuri Creek, Raigad District, Maharashtra, was investigated using quadrate analysis, a widely recognized method for studying vegetation distribution. The primary objective of the population study was to elucidate the floristic composition, estimate species richness, and assess diversity within the study site.

To achieve this objective, the parameters percentage frequency, relative frequency, abundance, dominance, relative dominance and importance value index were calculated using

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Species richness, diversity and dominance indices

Species richness, diversity and dominance were analysed by using the methods of Margalef's index of richness, Shannon's diversity index and Simpson's index of dominance.

Margalef's index of richness (Margalef ,1968)

Margalef's index was estimated as,

Dmg= (S-1)/ LnN

Where,

S=Total number of species.

N=Total number of individuals.

Shannon-Weaver index of diversity (Shannon-Weaver,1963)

The Shannon diversity index was calculated as,

$H' = -\sum piLnpi$

Where,

H'= Shannon index of diversity

pi=the proportion of important value of the i^{th} species (pi=ni /N, ni is the important value index of i^{th} species and N is the important value index of all the species).

Simpson index of Dominance (Simpson,1949)

The Simpsons index of dominance was calculated using the formulae.

$D = \sum(pi)^2$

Where, D= Simpson index of dominance

pi=the proportion of important value of the i^{th} species (pi=ni /N, ni is the important value index of i^{th} species and N is the important value index of all the species).

III. RESULTS AND DISCUSSION

Species Composition

The survey of mangrove species across different sites in Rajpuri Creek reveals distinct patterns of presence and absence, highlighting the composition of mangroves in this region. Out of 20 species present in Maharashtra, total of 10 mangrove species were observed belonging to 7 families (**Fig.1**).Among the seven families, three-Avicenniaceae, Sonneratiaceae, and Rhizophoraceae -each contain two mangrove species. These families contribute significantly to the mangrove diversity in the Rajpuri Creek ecosystem, with Avicenniaceae represented by *Avicennia marina* and *Avicennia officinalis*, Sonneratiaceae by *Sonnertia alba* and *Sonnertia apetala*, and Rhizophoraceae by *Rhizophora mucronata* and *Ceriops tagal. The* distribution of mangrove species along the creek is uneven. The list of observed mangroves at 10 different localities with families is shown in **Table. I.**

Table. I. Distribution of Mangroves on different sites in Rajpuri Creek With family

Sr. No	Name of Species	Family	1	2	3	4	5	6	7	8	9	10
1	*Avicennia marina* (Forsk) Virrh.	Avicenniaceae	+	+	+	+	+	+		+	+	+
2	*Avicennia officinalis* L.	Avicenniaceae		+	+	+		+				
3	*Sonnertia apetala* Buch. -Ham.	Sonneratiaceae		+	+		+					
4	*Sonnertia alba* J. Smith	Sonneratiaceae	+	+	+	+		+			+	+
5	*Rhizophora mucronata* Poir.	Acanthaceae	+	+	+	+	+	+	+	+		+
6	*Acanthus illicifolious* Linn.	Euphorbiaceae	+	+	+		+		+	+		+
7	*Excoecaria agallocha* Linn.	Myrsinaceae				+			+			
8	*Aegiceras corniculatum* (L.) Blanco.	Combretaceae	+	+	+	+	+		+	+		+
9	*Lumnitzera racemosa* Willd.	Rhizophoraceae					+		+			
10	*Ceriops tagal* (Perr.) C.B. Rob	Rhizophoraceae		+	+							

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1.Agardanda,2. Usadi ,3. Bhalgaon 4. Khajanwadi,5. Washi-haweli1,6. Washi-haweli2,7.Kandalwada, 8. Mendadi,9. Adi thakur,10. Dighi. + indicate presence of species

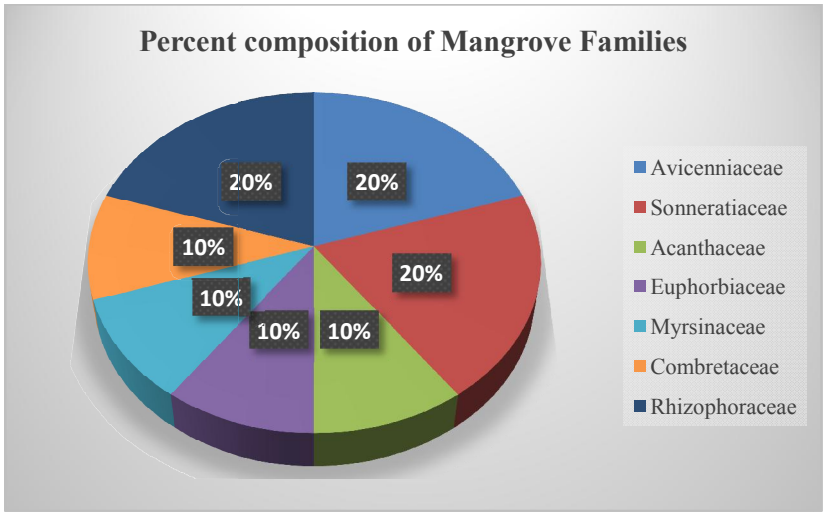

Fig.2. Percent composition of Mangrove Families

Mangrove diversity indices

The research site recorded a species richness of 10, indicating the presence of 10 distinct species within the study area. The Shannon-Wiener diversity index for the site was calculated at 1.94, which, according to Fernando's (1998) classification, places the area within the low diversity category (**Fig.3**). Additional diversity indices were also measured, including the Simpson Index at 0.83, the Berger-Parker Index at 0.25, Margalef's Index of Species Richness at 1.41, and Pileous Evenness Index at 0.84. These values collectively suggest a moderate level of species evenness and richness, with relatively low dominance by any single species.

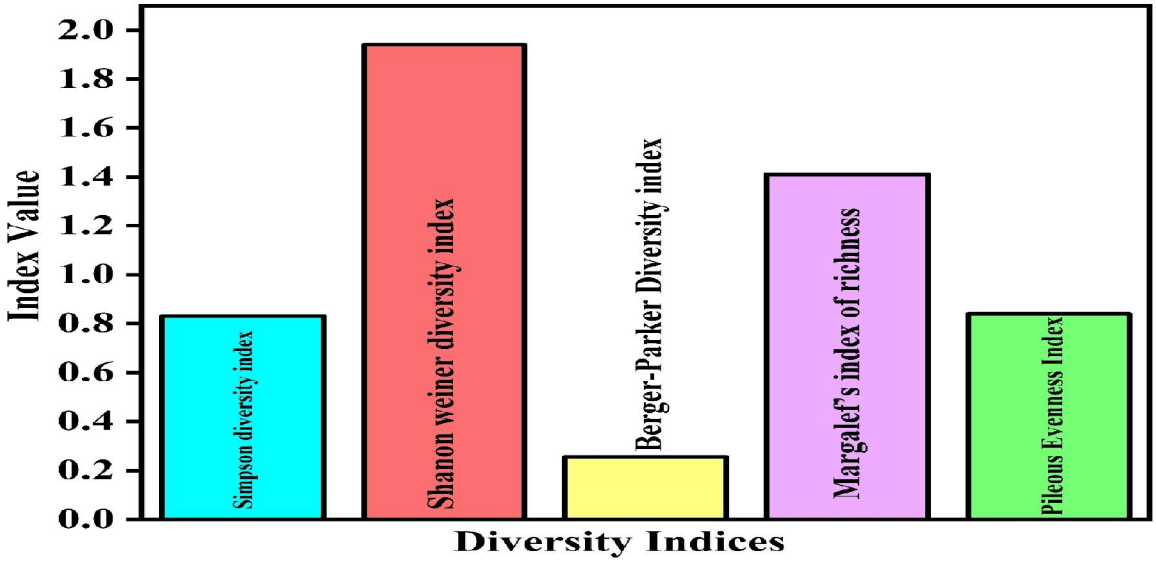

Fig.3. Diversity indices of Mangroves in Rajpuri creek of Raigad (MH-INDIA)

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Relative abundance

Fig.4 shows relative abundance present in the study area.The dominant species, *Avicennia marina*, showed the highest relative abundance, comprising 25.59% of the total population. *Acanthus ilicifolius* followed with 19.70%, while *Aegiceras corniculatum* accounted for 17.17% of the total species. *Sonneratia alba* and *Rhizophora mucronata* were also significant, contributing 13.64% and 11.45%, respectively. Other species such as *Lumnitzera racemosa* (3.20%), *Sonneratia apetala* (2.86%), and *Avicennia officinalis* (2.86%) were present in moderate proportions. *Excoecaria agallocha* accounted for 2.36%, and *Ceriops tagal* was the least abundant species, comprising 1.18% of the total population. This distribution highlights the dominance of certain species while reflecting the diversity present in the creek ecosystem.

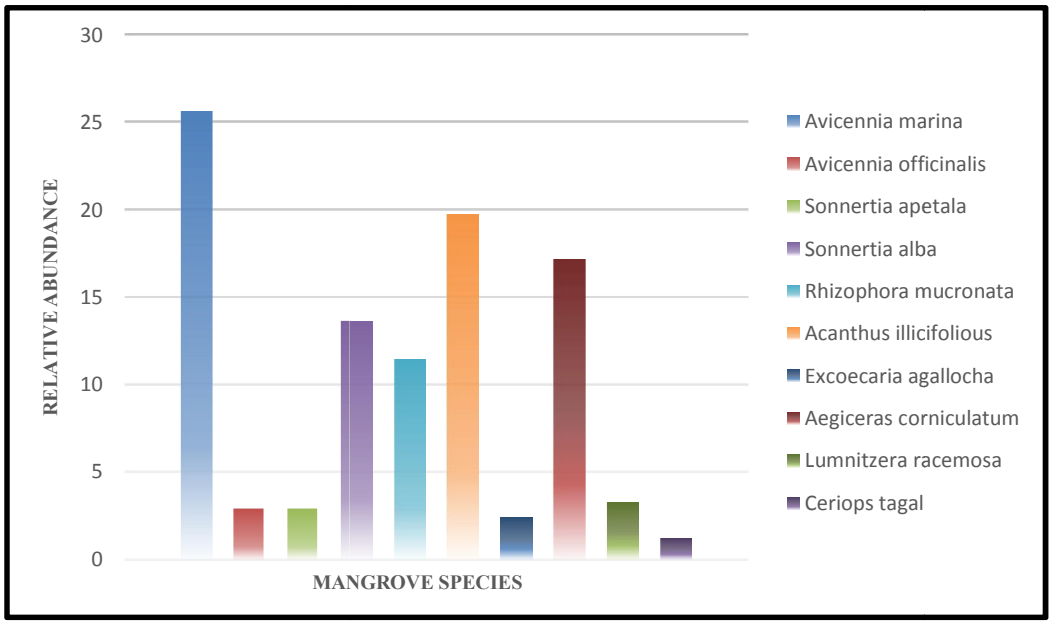

Fig.4. The percent relative abundance recorded in Rajpuri creek of Raigad (MH-INDIA)

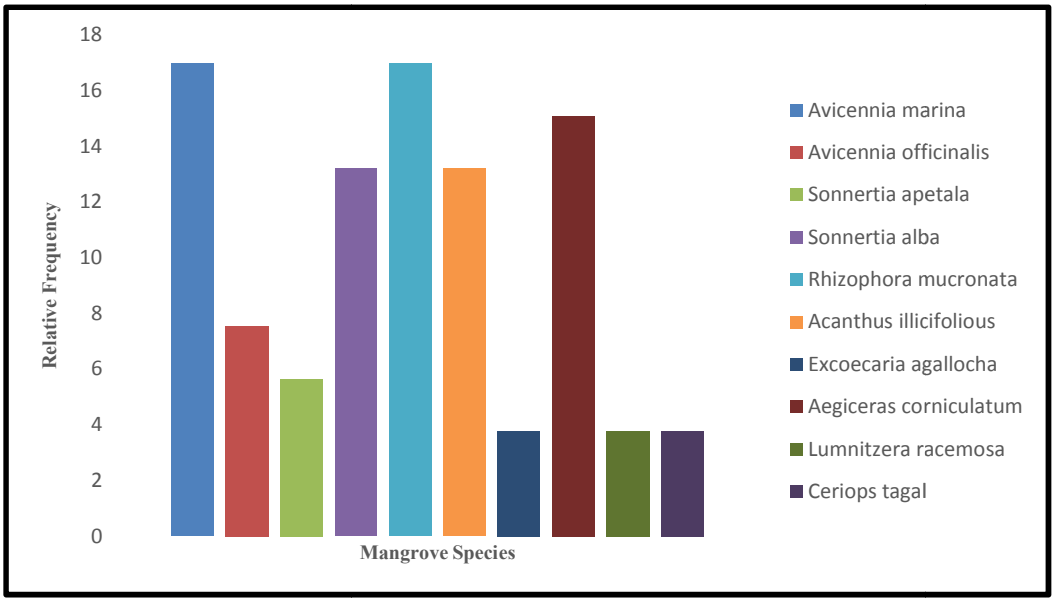

Fig.5. The percent relative Frequency recorded in Rajpuri creek of Raigad (MH-INDIA)

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Relative frequency

The relative frequency of various mangrove species in Rajpuri Creek, Raigad district, was calculated and showed clear patterns of species distribution across the study area (**Fig.5**). *Avicennia marina* and *Rhizophora mucronata* exhibited the highest relative frequencies, each accounting for 16.98% of the total observations. These two species demonstrated widespread distribution within the creek. Aegiceras corniculatum followed closely with a relative frequency of 15.09%, reflecting its significant presence in the mangrove ecosystem.*Sonnertia alba* and *Acanthus illicifolious* displayed similar relative frequencies of 13.21%, indicating moderately extensive occurrences across the quadrats sampled. Avicennia officinalis was present with a relative frequency of 7.55%, while Sonnertia apetala had a lower relative frequency of 5.66%, suggesting more limited occurrences. In contrast, Excoecaria agallocha, Lumnitzera racemosa, and Ceriops tagal exhibited the lowest relative frequencies, each accounting for 3.77% of the total. These species were sparsely distributed, indicating their comparatively rare presence in the mangrove habitat of Rajpuri Creek.

IV. CONCLUSION

The study of mangroves in Rajpuri Creek, Raigad, Maharashtra, reveals a moderately diverse ecosystem comprising 10 distinct mangrove species spread across 7 families. The species composition showed that *Avicennia marina* and *Rhizophora mucronata* dominate the mangrove vegetation, contributing significantly to the ecological stability of the creek. The diversity indices, including the Shannon-Weiner and Simpson indices, indicate moderate diversity, species richness, and evenness, with low dominance by any one species. However, the uneven distribution of species suggests potential environmental stressors or spatial heterogeneity influencing the mangrove population dynamics. *Avicennia marina* displayed the highest relative abundance and frequency, signifying its ecological importance in the creek. The findings underscore the need for continued conservation efforts to preserve the mangrove diversity in Rajpuri Creek, which plays a crucial role in maintaining coastal ecosystem health and resilience against anthropogenic and natural stressors.

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