



Mangrove Community Structure in the Bale Mangrove Ecotourism Area, East Lombok

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Abstract

Mangrove ecosystems play a crucial role in maintaining the stability of coastal environments; therefore, studies of mangrove community structure are essential to support the management of ecotourism areas. This study aims to analyze the structure of the mangrove community in the Bale Mangrove Ecotourism Area, East Lombok. The study employed a quantitative descriptive method through vegetation analysis using line transect and quadrat plot techniques, followed by analysis using the Importance Value Index (IVI), density, and the Shannon-Wiener diversity index (H'). The results indicate the presence of 5 mangrove species across 3 families, with the highest importance index values observed in the sapling stage, specifically *Rhizophora stylosa* (101.12%) and *Rhizophora mucronata* at the seedling stage (83.39%) and the tree stage (91.01%). The highest density was found at the seedling stage at 15,666.67 ind/ha, followed by saplings at 9,573.33 ind/ha and trees at 1,933.33 ind/ha, while the overall diversity index was classified as moderate with an H' value of 1.340. In conclusion, the mangrove community in the Bale Mangrove Ecotourism Area is relatively stable but dominated by certain species. The results of this study indicate the need for ecology-based management to enhance species diversity and ensure the sustainability of the mangrove ecosystem in the ecotourism area.

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Keywords: Bale Mangrove Ecotourism, East Lombok, mangrove community structure, importance value index (IVI), species diversity, vegetation density;



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INTRODUCTION

Mangrove ecosystems play a crucial role in maintaining the stability of coastal areas by protecting against ongoing coastal erosion and wave action (Malik et al., 2015; Mandagi, 2024). Mangrove vegetation communities provide essential habitats for aquatic organisms, including fish, crustaceans, and mollusks, that feed and breed in coastal waters (Manan et al., 2023). Additionally, mangroves' ability to absorb and store carbon in their biomass and sediments enables this ecosystem to contribute to climate change mitigation at both regional and global scales (Zulhalifah et al., 2021; Singh, 2020). The utilization of mangrove ecosystems in Indonesia is closely linked to the socioeconomic activities of coastal communities, particularly through support for the fisheries sector and the development of nature-based tourism (Nuraeni & Kusum, 2023). The development of mangrove areas as ecotourism destinations reflects efforts to integrate the interests of natural resource conservation with the improvement of local communities' well-being (Nurhayati et al., 2023; Hidayat et al., 2024). Tourism activities lacking

scientific data to support them can increase ecological pressure on mangrove vegetation that was previously in relatively stable condition (Blanton et al., 2024).

Mangrove community structure describes the arrangement of vegetation in terms of species composition, density, frequency of occurrence, and species dominance within a coastal area (Sinaga et al., 2023; Akbar et al., 2024). The presence of major genera such as *Rhizophora*, *Avicennia*, *Sonneratia*, and *Bruguiera* indicates that the vegetation can adapt to dynamic coastal environmental conditions (Bernales et al., 2025; Martha et al., 2025). Vegetation density reflects the natural regeneration capacity and the success rate of individual growth within a specific habitat (Mandagi, 2024). The Important Value Index (IVI) identifies species that play a dominant role in maintaining the stability of mangrove vegetation communities (Singh, 2020). Species diversity levels provide insight into ecosystem stability and the community's ability to respond to environmental changes (Malik et al., 2015). Variations in environmental

conditions, such as substrate, salinity, and tidal dynamics, influence the spatial distribution and dominance of vegetation in mangrove ecosystems (Mattone & Sheaves, 2024). Understanding community structure parameters provides the scientific basis for assessing the ecological condition of areas used for conservation and ecotourism activities (Manan et al., 2023).

Changes in coastal land use have led to a decline in mangrove ecosystem quality across regions with intense human activity (Bernales et al., 2025). In some locations, mangrove rehabilitation programs have relied on a single dominant species, ignoring the area's natural ecological conditions (Ghahramani et al., 2025). The dominance of a single species can reduce vegetation diversity and diminish the ecosystem's resilience to environmental disturbances over the long term (Martha et al., 2025). Ecotourism development in some mangrove areas remains focused on constructing physical facilities, without being balanced by scientific monitoring of vegetation conditions (Ekasari et al., 2024). The lack of quantitative data on mangrove community structure means that area management processes are not yet fully based on measurable biophysical conditions (Triyanti et al., 2025). Research on mangrove community structure is increasingly important for providing baseline data that support adaptive and sustainable area management (Sinaga et al., 2023).

The Bale Mangrove Ecotourism Area in East Lombok exemplifies the growth of ecotourism activities that directly harness the potential of coastal ecosystems (Hidayat et al., 2024). Scientific data on mangrove vegetation conditions are essential to ensure that the area's use maintains its ecological functions over the long term (Blanton et al., 2024). Information on species composition, density, frequency, and dominance provides a crucial foundation for assessing the overall health of the mangrove ecosystem (Akbar et al., 2024). This study aims to identify mangrove species composition and analyze community structure using density, frequency, dominance, and the Importance Value Index in the Bale Mangrove Ecotourism Area. The results of this study are expected to provide a scientific basis for sustainable ecotourism management and support mangrove conservation efforts in East Lombok.

Population and sample

The study population comprised all mangrove vegetation within the Bale Mangrove Ecotourism Area in East Lombok. The study sample consisted of mangrove individuals collected from 15 10 × 10 m observation plots distributed across 3 transects. The sampling technique combined line transects and square plots selected via purposive sampling, following the standard method for mangrove vegetation analysis (Ellenberg et al., 1974). The independent variables in this study included observation location and growth category (seedlings, saplings, and trees). The dependent variables included species composition, density, importance value index (IVI), and diversity index. Data were collected through direct field measurements, recording species, number of individuals, and stem circumference or diameter at breast height (DBH). Vegetation classification criteria were based on diameter and height: seedlings (height <1.5 m), saplings (height ≥1.5 m and diameter <10 cm), and trees (diameter ≥10 cm) (Kusuma, 1997). The tools and materials used included a

measuring tape to measure stem circumference, an observation sheet (data sheet) for data recording, and a mangrove identification guidebook (Noor et al., 2012).

Research Procedures

The study began with a preparatory phase that included a literature review, an initial site survey, and the preparation of research tools and materials. The next phase involved purposively selecting transect locations to represent mangrove ecosystem conditions within the study area. Within each transect, 10 × 10 m observation plots were established, and mangrove species were identified, and the number of individuals in each growth category was recorded. Trunk diameter measurements were taken at chest height (±1.3 m above ground level) for the tree and sapling categories. All data were compiled for further analysis to determine the structure of the mangrove community. Data were also grouped by growth category (seedlings, saplings, and trees). All data were systematically recorded in observation sheets for subsequent analysis.

Data Analysis

Data analysis was conducted to calculate mangrove community structure parameters, including the importance value index (IVI), which is computed as the sum of relative frequency, relative density, and relative dominance. Subsequently, the Shannon-Wiener diversity index (H') was used to assess mangrove species diversity. Some of the equations used in this analysis include:

Density (D):

$$D = \frac{\text{number of individuals of the species in the sample}}{\text{area of observation}} \dots\dots\dots(1)$$

Relative density (RD):

$$RD = \frac{\text{species density of the sample}}{\text{total density of all species}} \times 100\% \dots\dots\dots(2)$$

Frequency (F):

$$F = \frac{\text{number of plots in which the species was found}}{\text{total observation plots}} \dots\dots\dots(3)$$

Relative frequency (RF):

$$RF = \frac{\text{frequency of the sample species}}{\text{total frequency of all species}} \times 100\% \dots\dots\dots(4)$$

Dominance (Do):

$$Do = \frac{\text{area of the base of the sample species}}{\text{total area of the observation plot}} \dots\dots\dots(5)$$

Relative dominance (RDo):

$$RDo = \frac{\text{species dominance example}}{\text{total dominance of all species}} \times 100\% \dots\dots\dots(6)$$

Importance Value Index (IVI):

$$IVI = RK + RF + RDo \dots\dots\dots(7)$$

Indeks keanekaragaman Shannon-Wiener (H'):

$$H' = -\sum (\text{pi ln pi}) \dots\dots\dots(8)$$

Pi is the ratio of the number of individuals of a species to the total number of individuals (Magurran, 2004). The criteria for the diversity index are:

- $H' < 1$ = low diversity
- $1 \leq H' \leq 3$ = moderate diversity
- $H' > 3$ = high diversity

RESULTS AND DISCUSSION

Species Composition at Bale Mangrove Ecotourism

The mangrove species composition in the Bale Mangrove Ecotourism Area, East Lombok, as presented in Table 1, comprises five species across three families: Acanthaceae, Lythraceae, and Rhizophoraceae. This

number reflects a relatively limited level of diversity compared to the potential mangrove diversity in tropical coastal regions. The presence of all species at every growth stage—from seedlings and saplings to mature trees—indicates that regeneration is ongoing. This distribution pattern suggests that environmental conditions continue to support the sustainability of the mangrove life cycle. The dominance of species from the Rhizophoraceae family is quite prominent in the community structure. This pattern is closely related to substrate characteristics, which tend to be muddy to sandy mud—an optimal habitat for the growth of Rhizophora species. The presence of mangrove vegetation in this area is also linked to rehabilitation efforts through prior replanting, so the community structure observed today reflects a combination of natural processes and human intervention in ecosystem restoration.

Table 1. Mangrove species composition by growth stage at Bale Mangrove Ecotourism

No.	Family/ Species	Local Name	IUCN Status	Stages of Growth		
				Seedling	Sapling	Tree
I. Acanthaceae						
1.	<i>Avicennia marina</i>	Api-api putih	Least Concern (LC)	+	+	+
II. Lythraceae						
2.	<i>Sonneratia alba</i>	Pedada	Least Concern (LC)	+	+	+
III. Rhizophoraceae						
3.	<i>Rhizophora apiculata</i>	Bakau minyak	Least Concern (LC)	+	+	+
4.	<i>Rhizophora mucronata</i>	Bakau kurap	Least Concern (LC)	+	+	+
5.	<i>Rhizophora stylosa</i>	Bakau pasir	Least Concern (LC)	+	+	+

Note: found (+); not found (-)

A comparison with studies in other regions reveals differences in mangrove species composition at the local level. A study in Sekotong reported eight mangrove species (Akbar et al., 2017), whereas five species were found in Eyat Mayang Village (Sari et al., 2020). These differences in species counts indicate that environmental factors and anthropogenic activities shape the structure of mangrove communities. Land-use changes in aquaculture areas can alter substrate conditions and salinity, leading to declines in species diversity (Tefarani et al., 2019). The dominance of the Rhizophoraceae family on muddy substrates aligns with mangrove ecological theory, which posits that this group has a high adaptive capacity to tidal conditions. The conservation status of all species, classified as Least Concern (LC), indicates they are not currently at global risk of extinction. Local conditions still require attention, as the dominance of certain species can affect community balance. The results of this study indicate that the mangrove ecosystem in the Bale Mangrove Ecotourism area is relatively stable; however, sustainable management is required to maintain species balance and diversity in the future.

The distribution of mangrove individuals along each transect showed clear differences among locations (Figure 1). Transect 1 was dominated by *Rhizophora stylosa* (130 individuals) and *Rhizophora mucronata* (72 individuals), with a limited presence of *Sonneratia alba* (32 individuals), while *Avicennia marina* and *Rhizophora apiculata* were not found. Transect 2 showed a more even distribution, dominated by *Rhizophora mucronata* (64

individuals), followed by *Sonneratia alba* (43 individuals), *Rhizophora stylosa* (38 individuals), and *Rhizophora apiculata* (32 individuals). Transect 3 showed an increase in the number of individuals across almost all species, with *Rhizophora stylosa* (125 individuals) and *Rhizophora mucronata* (108 individuals) remaining the dominant species, alongside the presence of *Avicennia marina* (16 individuals). This pattern confirms that the genus *Rhizophora* has the widest distribution and the highest number of individuals, making it a key component of the mangrove community structure at the study site.

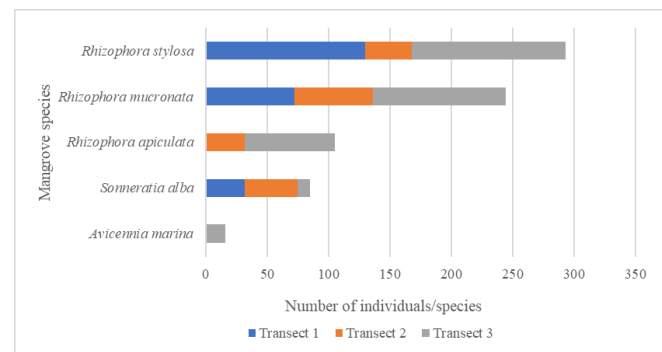


Figure 1. The number of individuals of each mangrove species in each observation transect at Bale Mangrove Ecotourism Area

Differences in mangrove species distributions among transects reflect variations in environmental conditions, including substrate characteristics, salinity levels, and tidal dynamics, in a coastal area (Purwanto et al., 2022). Mangrove zonation patterns are shaped by

waterlogging duration, tidal type, and soil properties such as mud, clay, and sand, which influence the density and species composition within each vegetation zone (Hilmi et al., 2021). The dominance of the genus *Rhizophora* across various mangrove sites indicates a high adaptive capacity to muddy substrates with relatively large fluctuations in salinity (Rahmani et al., 2023). Species such as *Rhizophora mucronata* and *Rhizophora apiculata* are often of significant importance and exhibit high densities due to their ability to compete and survive following environmental disturbances (Akbar et al., 2024). The relatively limited presence of *Avicennia marina* at certain locations indicates a more specific habitat preference and its ability to survive under high salinity conditions and on varied substrates (Barik et al., 2018). The dominance of one or two genera within a mangrove community can reduce the diversity index and highlight the need for ecology-based management to maintain the community's long-term stability (Raganas & Magcale-Macandog, 2020).

Importance index and density

The Importance Value Index (IVI) in Table 2 shows a consistent pattern of dominance among several key species in the Bale Mangrove Ecotourism Area, East Lombok. At the seedling level, *Rhizophora mucronata* had the highest IVI (83.39%), followed by *Rhizophora stylosa* (46.95%) and *Rhizophora apiculata* (36.44%). The same pattern persists at the sapling stage, with *Rhizophora stylosa* highest (101.12%), followed by *Rhizophora mucronata* (94.20%) and *Rhizophora apiculata* (58.67%). At the tree level, dominance again rests with *Rhizophora stylosa* (95.34%) and *Rhizophora mucronata* (91.01%), while other species have lower values. High IVI values for certain species indicate that they play a dominant role in occupying growing space and utilizing environmental resources more effectively than other species. The relatively consistent distribution of IVI values across all three growth stages also suggests that the dominance of these species has been established since the regeneration phase and continues into the mature phase, thereby forming a stable community structure that is, however, dominated by specific groups.

Table 2. Indeks nilai penting mangrove pada kategori pohon, pancang, dan semai di kawasan Ekowisata Bale Mangrove, Lombok Timur.

No	Spesies	Importance Value Index (%)		
		Seedling	Sapling	Tree
1.	<i>Avicennia marina</i>	11,81	7,88	16,67
2.	<i>Sonneratia alba</i>	21,41	38,13	33,59
3.	<i>Rhizophora apiculata</i>	36,44	58,67	63,39
4.	<i>Rhizophora mucronata</i>	83,39	94,20	91,01
5.	<i>Rhizophora stylosa</i>	46,95	101,12	95,34
Jumlah		200,00	300,00	300,00

The concept of IVI as an indicator of vegetation dominance holds that the higher a species' IVI, the greater its role in the community (Indriyanto, 2018). The dominance of *Rhizophora* across all growth stages aligns with its ecological characteristics, which enable it to adapt to muddy substrates and dynamic tidal conditions, and with its cryptoviviparous reproductive mechanism, which

enhances regeneration success (Noor et al., 2012; Bengen, 2018). These conditions are further supported by the substrate characteristics at the study site, which range from muddy to sandy mud, thereby providing ecological advantages for certain species (Setyawan & Winarno, 2016). The results of this study differ from those of Basyuni et al. (2017), which reported the dominance of the Avicenniaceae family in several coastal areas, suggesting that local environmental conditions strongly influence mangrove community structure.

The relatively low IVI values for *Avicennia marina* and *Sonneratia alba* suggest that the roles of these two species in the community are more limited. This indicates that the structure of the mangrove community at Bale Mangrove Ecotourism tends to be uneven and dominated by certain species. These findings imply that although the mangrove ecosystem remains stable, high dominance can reduce biodiversity in the long term; therefore, management that balances species composition is required to maintain the ecosystem's sustainability.

Mangrove density at the growth stage

Mangrove density varies markedly across growth stages. The seedling stage has the highest density at 15,666.67 individuals per hectare, followed by the sapling stage at 9,573.33 individuals per hectare. In comparison, the tree stage shows the lowest value at 1,933.33 individuals per hectare (Figure 2). This pattern indicates that the number of individuals decreases as the growth phase progresses. This suggests that the regeneration process is proceeding quite well, as evidenced by the high number of seedlings. The decline in the number of individuals at the sapling and tree stages indicates the presence of natural selection during growth, whether due to competition, limited growing space, or other environmental factors. The relatively low tree density may also be attributed to larger individual sizes, which require more growing space, resulting in fewer trees than in the early growth stages.

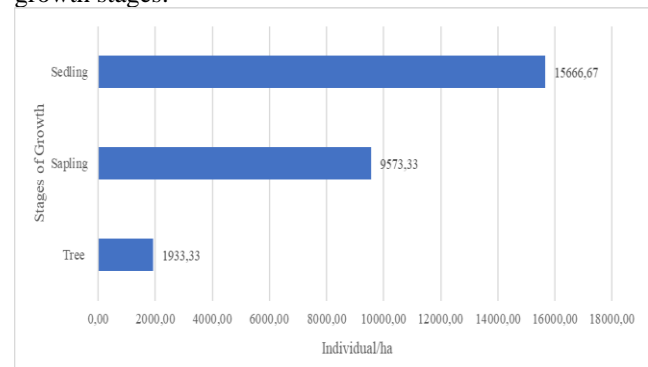


Figure 2. Mangrove density at the growth stage in the Bale Mangrove Ecotourism Area, East Lombok

A vegetation density pattern with more seedlings than trees indicates active natural regeneration within a mangrove community (Maylani et al., 2022). High seedling and sapling densities are generally interpreted as indicators of successful regeneration, particularly when accompanied by a sufficient number of individuals at the sapling and tree stages (Fatonah et al., 2021). The success of mangrove regeneration is heavily influenced by environmental factors such as substrate characteristics, salinity levels, and tidal dynamics, which determine propagules' ability to attach and progress to the next growth phase (Valentino et al., 2023).

Differences in density across growth stages are also related to the small size of individuals in the seedling and sapling phases, meaning that competition for light, nutrients, and growing space has not yet intensified to the same extent as in the tree phase (George et al., 2019). A stand structure dominated by young-stage individuals, with a relatively low number of trees, indicates a stand that is still developing and is generally classified as being in good ecological condition (Tharieg et al., 2023). These conditions indicate that the sustainability of the mangrove ecosystem can be maintained if individuals at the seedling and sapling stages reach maturity through sustainable habitat management and control of environmental disturbances (Azman et al., 2021).

Distribution of mangrove diameters

The distribution of mangrove diameters in the Bale Mangrove Ecotourism Area is dominated by small- to medium-diameter classes (Figure 3). The largest number of individuals was in the 5.6–10.5 cm diameter class (323), followed by the 10.6–15.5 cm class (230), while the smallest diameter class (1–5.5 cm) contained 118 individuals. The number of individuals then drops sharply in the larger diameter classes, with 30 individuals in the 15.6–20.5 cm class, 24 in the 20.6–25.5 cm class, 12 in the 25.6–30.5 cm class, and only 6 in the 30.6–40.5 cm class. This pattern indicates that most individuals are in the early- to middle-growth phase, while large-diameter individuals are relatively few. Such a distribution suggests that the mangrove stand structure at the study site is still dominated by young individuals developing toward the adult phase.

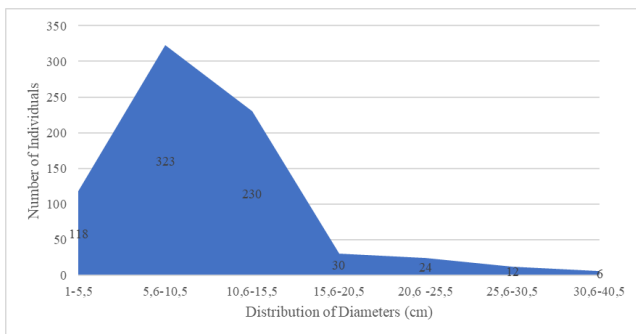


Figure 3. Distribution of mangrove tree diameters in the Bale Mangrove ecotourism area, East Lombok

The distribution of mangrove stem diameters at the Bale Mangrove Ecotourism site, which forms an inverted J-curve, indicates a dominance of small-diameter individuals, a feature generally associated with communities undergoing active regeneration and sustained recruitment (Alongi, 2020; Matatula et al., 2021). The dominance of individuals in the small- to medium-diameter classes indicates that natural regeneration processes are still ongoing under environmental conditions that are relatively supportive of mangrove vegetation growth (Rahman et al., 2023; Azman et al., 2021). An inverted J-shaped or L-curve diameter distribution in mangrove ecosystems generally indicates a relatively stable stand structure with good recovery capacity, provided environmental pressures are controlled (Zanvo et al., 2021). The number of individuals in the smallest diameter class is not significantly higher than that in the medium-diameter class, which may indicate the influence of intraspecific competition and spatial and resource constraints during the early growth phase (Kamara & Kamruzzaman, 2020; Diniyatushoalihan et al., 2023). Diameter structures that have not yet fully formed the ideal inverted J-curve are also frequently observed in areas undergoing revegetation or restoration that are still in the active succession phase (Djamaluddin et al., 2023). Such a diameter distribution pattern implies the potential for future increases in biomass and carbon stocks as individuals grow into larger diameter classes (Ahmed et al., 2022a).

Mangrove Species Diversity Index

The mangrove species diversity index in the Bale Mangrove Ecotourism Area, East Lombok, varies across growth stages (Table 3). The diversity index values at the tree and sapling levels were 1 and 1.003, respectively, falling within the moderate category ($1 < H' < 3$). In contrast, at the seedling level, the value was 0.676 ($H' < 1$), classifying it as low. This difference indicates that the community structure in the mature and intermediate growth phases is relatively more balanced than in the early phase. The lower value at the seedling level indicates that the distribution of individuals in this phase is uneven, with certain species dominating. This condition reflects that the regeneration process has not yet fully produced a diverse species composition, so community stability in the early phase remains limited. The dominance of certain species at the seedling stage is the primary factor driving low diversity in that phase (Rahman et al., 2019; Andrianto et al., 2018).

Table 3. Mangrove species diversity index in the Bale Mangrove Ecotourism Area, East Lombok.

Species	Number of individuals	Pi	lnPi	Pi.lnPi
<i>Avicennia marina</i>	16	0,022	-3,838	-0,083
<i>Rhizophora apiculata</i>	85	0,114	-2,168	-0,248
<i>Rhizophora mucronata</i>	105	0,141	-1,957	-0,277
<i>Rhizophora stylosa</i>	244	0,328	-1,114	-0,366
<i>Sonneratia alba</i>	293	0,394	-0,931	-0,367
Total	743			-1,340
H'				1,340

Species diversity within a vegetation community is determined by the number of species and the distribution of individuals among species, quantified by the Shannon-Weiner diversity index, an indicator of community stability (Sari et al., 2023). Diversity index values in the moderate category at the sapling and tree levels generally indicate

relatively stable community conditions, in which species interactions can still maintain ecosystem functions (Hilmi et al., 2015). Conversely, low diversity index values are often associated with the dominance of one or a few species, leading to an uneven distribution of individuals within a community (Pratiwi et al., 2022). Low levels of

biodiversity may also be influenced by environmental disturbances, both natural and anthropogenic, including changes in the physical and chemical conditions of the water and the pressure of human activities in coastal areas (Ulyah et al., 2021). In mangrove ecosystems, the limited number of species capable of adapting to high salinity and tidal flooding results in naturally lower diversity than in other terrestrial ecosystems (Malahayati et al., 2023). A diversity pattern showing a moderate category at the tree level but a low one at the seedling level indicates that the community is relatively stable in its mature phase. However, the regeneration process still requires ecologically based management to ensure the long-term sustainability of the ecosystem (Rachmansyah et al., 2023).

Environmental parameters

The average values of environmental parameters in the Bale Mangrove Ecotourism area indicate conditions that are generally conducive to mangrove growth (Table 4). A water pH of 6.6 indicates neutral to slightly acidic conditions, which fall within the tolerance range of most mangrove species. An average salinity of 27.4‰ indicates a brackish environment with a fairly strong tidal influence, making it suitable for the growth of mangrove species such as *Rhizophora* and *Avicennia*. A water temperature of 27.2°C indicates optimal thermal conditions for mangrove physiological processes, including photosynthesis and respiration. The average substrate depth of 8.8 cm indicates a relatively shallow substrate, which may affect root stability and nutrient availability. This combination of parameters suggests that environmental conditions at the study site remain within a range that supports the growth and development of mangrove vegetation.

Table. 4. Environmental Parameters

Environmental Parameters	Average Score
pH air	6,6
Salinity (%)	27,4
Temperature (°C)	27,2
Substrate depth (cm)	8,8

Environmental parameters in the Bale Mangrove Ecotourism Area generally remain within the ecological tolerance range of tropical mangroves, particularly for temperature, pH, and salinity, thereby supporting optimal growth of coastal vegetation (Krauss et al., 2008). Salinity variation within mangrove habitats reflects species' physiological adaptability to osmotic stress, which in turn influences growth and ecosystem function (Ahmed et al., 2022b). The genus *Rhizophora* is known for its tolerance of moderate to high salinity, although extreme increases can inhibit vegetation growth and productivity (Raganas & Magcale-Macandog, 2020). Substrate characteristics dominated by sandy mud play a crucial role in root development and the stability of mangrove stands (Dewiyanti et al., 2021). A combination of environmental factors, including temperature, salinity, pH, and nutrient availability, collectively influences the success of natural regeneration and species dominance within mangrove communities (Das et al., 2019). These relatively suitable

environmental conditions indicate that the Bale Mangrove Ecotourism ecosystem has strong potential for sustainability. However, it still requires management based on environmental parameters to maintain the stability of community structure and long-term ecological functions (Akpovwovwo & Ekanade, 2025).

CONCLUSION

The mangrove community structure in the Bale Mangrove Ecotourism Area, East Lombok, comprises five species from three families, with *Rhizophora stylosa* (IVI for saplings: 101.12%) and *Rhizophora mucronata* (IVI for trees: 91.01%) showing the highest dominance, indicating their primary ecological roles within the community. Vegetation density values indicate an active regeneration pattern, with the highest density at the seedling stage (15,666.67 ind/ha), followed by saplings (9,573.33 ind/ha), and trees (1,933.33 ind/ha). The mangrove species diversity index is classified as moderate ($H' = 1.340$), indicating that the community is in a relatively stable condition. However, it still shows a tendency toward the dominance of certain species. The results of this study confirm that the structure of the mangrove community in the Bale Mangrove Ecotourism Area has demonstrated a well-functioning regeneration process; however, the distribution of species composition is not yet fully even. The implications of this study emphasize the need for sustainable management strategies that enhance species diversity to maintain community stability and support the sustainability of ecological functions and the development of conservation-based mangrove ecotourism.

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AUTHOR'S CONTRIBUTION

Table. 5. Details of Authors' Contributions

Contribution Indicator	Author			
	1	2	3	4
Conceptualization	✓			
Literature Review		✓		
Research Design / Methodology		✓		
Instrument Development	✓			
Data Collection		✓		✓
Data Curation			✓	
Formal Analysis	✓		✓	
Data Interpretation		✓		✓
Writing – Original Draft			✓	
Writing – Review & Editing	✓	✓		✓

Visualization / Tables	✓
Supervision	✓

REFERENCES

- Ahmed, S., Kamruzzaman, M., Rahman, M., Sakib, N., Azad, M., & Dey, T. (2022a). Stand structure and carbon storage of a young mangrove plantation forest in the coastal area of Bangladesh: The promise of a natural solution. *Nature-Based Solutions*.
<https://doi.org/10.1016/j.nbsj.2022.100025>
- Ahmed, S., Sarker, S., Friess, D., Jacobs, M., Islam, M., Alam, M., Suvo, M., Hossain, M., Dey, T., Sullibie, C., Naabeh, S., & Pretzsch, H. (2022b). Salinity reduces site quality and mangrove forest functions: From monitoring to understanding. *Science of the Total Environment*.
<https://doi.org/10.1016/j.scitotenv.2022.158662>
- Akbar, L., Idrus, A., Mahrus, M., & Santoso, D. (2024). Mangrove structure and composition analysis in Teluk Jor, East Lombok Regency. *Jurnal Biologi Tropis*. <https://doi.org/10.29303/jbt.v24i2b.8253>
- Akbar, N., Haya, N., & Baksir, A. (2017). Struktur komunitas dan pemetaan ekosistem mangrove di pesisir Pulau Maitara, Provinsi Maluku Utara. *Depik*, 6(2), 167–181.
<https://doi.org/10.13170/depik.6.2.6402>
- Akpovwovwo, U., & Ekanade, T. (2025). Status of natural regeneration of mangroves in southern Nigeria. *Jurnal Pengelolaan Sumberdaya Alam dan Lingkungan*.
<https://doi.org/10.29244/jpsl.15.3.425>
- Alongi, D. M. (2015). The impact of climate change on mangrove forests. *Jurnal Ilmu Kelautan Indonesia*, 20(1), 1–10.
<https://doi.org/10.14710/ik.ijms.20.1.1-10>
- Azman, M., Sharma, S., Shaharudin, M., Hamzah, M., Adibah, S., Zakaria, R., & Mackenzie, R. (2021). Stand structure, biomass, and dynamics of naturally regenerated and restored mangroves in Malaysia. *Forest Ecology and Management*, 482, 118852.
<https://doi.org/10.1016/j.foreco.2020.118852>
- Barik, J., Mukhopadhyay, A., Ghosh, T., Mukhopadhyay, S., Chowdhury, S., & Hazra, S. (2018). Mangrove species distribution and water salinity: An indicator species approach to Sundarban. *Journal of Coastal Conservation*, 22, 361–368.
<https://doi.org/10.1007/s11852-017-0584-7>
- Basyuni, M., Sulistiyono, N., & Slamet, B. (2017). Struktur komunitas mangrove di pesisir Sumatera Utara. *Jurnal Ilmu dan Teknologi Kelautan Tropis*, 9(1), 123–134.
<https://doi.org/10.29244/jitkt.v9i1.17923>
- Bernales, W., Guiritan, F., Pecato, C., Mercado, J., Tangonan, J., Calagui, L., & Corbita, V. (2025). Community structure of mangrove species in Bagakay Trail Lagoon, Claver, Surigao del Norte, Philippines. *Jurnal Sylva Lestari*.
<https://doi.org/10.23960/jsl.v13i3.1193>
- Blanton, A., Ewane, E., McTavish, F., Watt, M., Rogers, K., Daneil, R., Vizcaino, I., Gomez, A., Arachchige, P., King, S., Galgamuwa, G., Peñaranda, M., Al-Musawi, L., Montenegro, J., Broadbent, E., Zambrano, A., Hudak, A., Swangiang, K., Valasquez-Camacho, L., Vorenberg, J., Srinivasan, S., Abdullah, M., Charabi, Y., Jaafar, W., Musa, F., Sidik, F., Al-Awadhi, T., Ali, T., Doaemo, W., & Mohan, M. (2024). Ecotourism and mangrove conservation in Southeast Asia: Current trends and perspectives. *Journal of Environmental Management*, 365, 121529.
<https://doi.org/10.1016/j.jenvman.2024.121529>
- Das, L., Patel, R., Salvi, H., & Kamboj, R. (2019). Assessment of natural regeneration of mangrove with reference to edaphic factors and water in Southern Gulf of Kachchh, Gujarat, India. *Heliyon*, 5.
<https://doi.org/10.1016/j.heliyon.2019.e02250>
- Dewiyanti, I., Darmawi, D., Muchlisin, Z., Helmi, T., Imelda, I., & Defira, C. (2021). Physical and chemical characteristics of soil in mangrove ecosystem based on differences habitat in Banda Aceh and Aceh Besar. *IOP Conference Series: Earth and Environmental Science*, 674.
<https://doi.org/10.1088/1755-1315/674/1/012092>
- Diniyatushoaliha, A., Al Idrus, A., & Santoso, D. (2023). Carbon Content Potential of Mangrove Species in Gili Sulat, East Lombok. *Jurnal Biologi Tropis*, 23(3), 392–400.
<https://doi.org/10.29303/jbt.v23i3.5275>
- Djamaluddin, R., Fusi, M., Djabar, B., Evans, D., Holmes, R., Huxham, M., O'Connell, D., Salzmann, U., Singleton, I., Tjoa, A., Trianto, A., & Diele, K. (2023). Point of (no) return? Vegetation structure and diversity of restored mangroves in Sulawesi, Indonesia, 14–16 years on. *Restoration Ecology*, 31. <https://doi.org/10.1111/rec.13963>
- Ekasari, A., Partama, I., & Martiningsih, N. (2024). Collaborative mangrove ecosystem management strategy to support coastal ecotourism in Pemogan Village, Denpasar City. In *Transport, Ecology, Sustainable Development: EKO VARNA 2023*.
<https://doi.org/10.1063/5.0197198>
- Ellenberg, D., & Mueller-Dombois, D. (1974). *Aims and methods of vegetation ecology* (Vol. 547). New York: Wiley.
- Ghahramani, P., Hajjalizadeh, P., Maghsoodi, P., Azizi, S., Ghodrati-Shojaei, M., & Naderloo, R. (2025). Macrobenthos of natural vs. planted mangroves: Species compositions and functional perspective. *Marine Environmental Research*, 212, 107525.
<https://doi.org/10.1016/j.marenvres.2025.107525>
- Hidayat, A., Budiastuti, M., Trihatmoko, E., Danardono, D., & Ainurrohman, D. (2024). The potential of community-based ecotourism development with an ecosystem service approach: A case study of

- Kaliwlingi Village, Brebes, Indonesia. *Environment, Development and Sustainability*, 26, 31099–31119. <https://doi.org/10.1007/s10668-023-04380-w>
- Hilmi, E., Amron, A., Sari, L., Cahyo, T., & Siregar, A. (2021). The mangrove landscape and zonation following soil properties and water inundation distribution in Segara Anakan Cilacap. *Jurnal Manajemen Hutan Tropika*. <https://doi.org/10.7226/jtfm.27.3.152>
- Hilmi, E., Siregar, A., & Febryanni, L. (2015). Struktur komunitas, zonasi dan keanekaragaman hayati vegetasi mangrove di Segara Anakan Cilacap. *Oseanologi dan Limnologi di Indonesia*. <https://doi.org/10.20884/1.oa.2015.11.2.36>
- Indriyanto. (2018). Analisis vegetasi dan struktur komunitas tumbuhan. *Jurnal Sylva Lestari*, 6(2), 1–10. <https://doi.org/10.23960/jsl261-10>
- Kamara, M., & Kamruzzaman, M. (2020). Self-thinning process, dynamics of aboveground biomass, and stand structure in overcrowded mangrove *Kandelia obovata* stand. *Regional Studies in Marine Science*, 38, 101375. <https://doi.org/10.1016/j.rsma.2020.101375>
- Krauss, K. W., Lovelock, C. E., McKee, K. L., López-Hoffman, L., Ewe, S. M. L., & Sousa, W. P. (2008). Environmental drivers in mangrove establishment and early development: A review. *Aquatic Botany*, 89, 105–127. <https://doi.org/10.1016/j.aquabot.2007.12.014>
- Kusmana, C. (1997). *Metode survei vegetasi hutan mangrove*. Bogor: Institut Pertanian Bogor.
- Magurran, A. E. (2004). *Measuring biological diversity*. Blackwell Publishing.
- Malahayati, M., Arlita, T., & Dewiyanti, I. (2023). Indeks nilai penting dan keanekaragaman jenis vegetasi mangrove di pesisir utara Aceh Besar. *Jurnal Ilmiah Mahasiswa Pertanian*. <https://doi.org/10.17969/jimfp.v8i1.23218>
- Malik, A., Fensholt, R., & Mertz, O. (2015). Mangrove exploitation effects on biodiversity and ecosystem services. *Biodiversity and Conservation*, 24, 3543–3557. <https://doi.org/10.1007/s10531-015-1015-4>
- Manan, J., Manumpil, A., Asaribab, P., & Saleky, D. (2023). Biodiversity and ecological structure of mangrove in coastal waters of Dafi Village, Biak Numfor Regency. *Jurnal Ilmiah PLATAX*. <https://doi.org/10.35800/jip.v11i1.46431>
- Mandagi, S. (2024). Species composition and density of mangrove forests in North Minahasa, Indonesia. *Aquatic Science & Management*. <https://doi.org/10.35800/jasm.v12i1.63540>
- Martha, E., Candri, D., Ahyadi, H., Ghazali, M., & Munawaroh, A. (2025). Mangrove species composition in the mangrove forest of Cendi Manik Village, Sekotong, West Lombok Regency. *Jurnal Biologi Tropis*. <https://doi.org/10.29303/jbt.v25i2.9189>
- Matatula, J., Afandi, A., & Wirabuana, P. (2021). A comparison of stand structure, species diversity and aboveground biomass between natural and planted mangroves in Sikka, East Nusa Tenggara, Indonesia. *Biodiversitas*, 22. <https://doi.org/10.13057/biodiv/d220303>
- Mattone, C., & Sheaves, M. (2024). Mangrove forest ecological function is influenced by environmental settings and benthic fauna composition. *Estuarine, Coastal and Shelf Science*. <https://doi.org/10.1016/j.ecss.2024.108959>
- Noor, Y. R., Khazali, M., & Suryadiputra, I. N. N. (2012). Panduan pengenalan mangrove di Indonesia. *Wetlands International Indonesia Programme*, 1(1), 1–220. <https://doi.org/10.13140/RG.2.1.2604.2966>
- Nuraeni, E., & Kusum, Y. (2023). The role of community-based tourism for mangrove conservation in Banten, Indonesia. *Jurnal Pengelolaan Sumberdaya Alam dan Lingkungan*, 13(4), 606–612. <https://doi.org/10.29244/jpsl.13.4.606-612>
- Nurhayati, A., Akbarsyah, N., Pamungkas, W., Herawati, T., & Yustiati, A. (2023). Strengthening local community in mangrove ecotourism at Pangandaran, West Java Province, Indonesia. *Asian Journal of Fisheries and Aquatic Research*. <https://doi.org/10.9734/ajfar/2023/v21i3543>
- Pratiwi, N., Amalia, F., Rahmawati, I., & Setyoko, S. (2022). Keanekaragaman flora mangrove pada tingkat pohon di Cagar Alam Pulau Dua Banten. *Bionature*. <https://doi.org/10.35580/bionature.v23i1.35697>
- Purwanto, R., Mulyana, B., Satria, R., Yasin, E., Putra, I., & Putra, A. (2022). Spatial distribution of mangrove vegetation species, salinity, and mud thickness in mangrove forest in Pangarengan, Cirebon, Indonesia. *Biodiversitas*. <https://doi.org/10.13057/biodiv/d230324>
- Rachmansyah, M., Pribadi, R., & Suyadi, S. (2023). Faktor spasial, ekologi, dan sosial ekonomi untuk penilaian kondisi ekosistem mangrove studi kasus Segara Anakan. *Buletin Oseanografi Marina*. <https://doi.org/10.14710/buloma.v12i2.47793>
- Raganas, A., & Magcale-Macandog, D. (2020). Physicochemical factors influencing zonation patterns, niche width and tolerances of dominant mangroves in southern Oriental Mindoro, Philippines. *Indo Pacific Journal of Ocean Life*. <https://doi.org/10.13057/oceanlife/o040201>
- Raganas, A., & Magcale-Macandog, D. (2020). Physicochemical factors influencing zonation patterns, niche width and tolerances of dominant mangroves in southern Oriental Mindoro, Philippines. *Indo Pacific Journal of Ocean Life*. <https://doi.org/10.13057/oceanlife/o040201>
- Rahmani, A., Idrus, A., & Mertha, I. (2023). The structure of mangrove community in regional marine conservation area Gili Sulat West Nusa Tenggara.

- Jurnal Biologi Tropis.
<https://doi.org/10.29303/jbt.v23i1.4597>
- Sari, D., Idris, M., Anwar, H., Aji, I., & B, K. (2023). Analisis vegetasi mangrove di Desa Eyat Mayang, Kecamatan Lembar, Kabupaten Lombok Barat. *Empiricism Journal*.
<https://doi.org/10.36312/ej.v4i1.1205>
- Sari, N. P., Lestari, S., & Putra, I. G. A. (2023). Komposisi jenis mangrove di Desa Eyat Mayang Kecamatan Lembar Kabupaten Lombok Barat. *Jurnal Biologi Tropis*, 23(1), 39–46.
<https://doi.org/10.29303/jbt.v23i1.5799>
- Setyawan, A. D., & Winarno, K. (2016). Pemanfaatan langsung ekosistem mangrove di Jawa Tengah dan penggunaan lahan di sekitarnya; kerusakan dan upaya restorasi. *Biodiversitas*, 7(3), 282–291.
<https://doi.org/10.13057/biodiv/d070318>
- Sinaga, R., Andrito, W., Roni, S., Laia, D., & Hidayati, J. (2023). Community structure and health status of mangrove ecosystem in Anambas Islands Marine Tourism Park, Indonesia. *BIO Web of Conferences*.
<https://doi.org/10.1051/bioconf/20237003006>
- Singh, J. (2020). Structural characteristics of mangrove forest in different coastal habitats of Gulf of Khambhat arid region of Gujarat, west coast of India. *Heliyon*, 6, e04685.
<https://doi.org/10.1016/j.heliyon.2020.e04685>
- Tefarani, R., Tri Martuti, N. K., & Ngabekti, S. (2019). Keanekaragaman spesies mangrove dan zonasi di wilayah pesisir Semarang. *Life Science*, 8(1), 41–53. <https://doi.org/10.15294/lifesci.v8i1.29989>.
- Triyanti, R., Wijaya, R., Priyatmoko, R., Rahmawati, E., Asih, T., Nugraha, R., & Zamroni, A. (2025). The transformation of community-based mangrove conservation to coastal tourism on the northern coast of Java, Indonesia. *International Journal of Conservation Science*.
<https://doi.org/10.36868/ijcs.2025.01.14>
- Ulyah, F., Hastuti, E., & Prihastanti, E. (2021). Struktur komunitas vegetasi mangrove di pesisir pantai Kepulauan Karimunjawa. *Jurnal Ilmu Lingkungan*.
<https://doi.org/10.14710/jil.20.1.176-186>
- Zanvo, M., Salako, K., Gnanglè, C., Mensah, S., Assogbadjo, A., & Kakai, R. (2021). Impacts of harvesting intensity on tree taxonomic diversity, structural diversity, population structure, and stability in a West African mangrove forest. *Wetlands Ecology and Management*, 29, 433–450.
<https://doi.org/10.1007/s11273-021-09793-w>
- Zulhalifah, Z., Syukur, A., Santoso, D., & Karnan, K. (2021). Species diversity and composition, and above-ground carbon of mangrove vegetation in Jor Bay, East Lombok, Indonesia. *Biodiversitas*.
<https://doi.org/10.13057/biodiv/d220455>