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Importance Value Index Of Mangrove Vegetation In Baluran National Park, Situbondo, East Java As A Succession Stabilizer

Shelais Ronne Octavia[1]*, Fitria Nur Hidayati[2], Abidah Laily Nisfia[3], Safira Parsa Qudsia[4], Firdatul Auliyah[5], Rania Elirica Aliyah[6], Lungga Karina Meisa Elora Sugiharto[7], Rakha Salma Fatimah Azzahra[8], Desire Triparawati Oktavia[9], Faiza Dwi Renita[10], Winarsih[11], Reyna Novita Sari[12]
[1]Universitas Negeri Surabaya, Surabaya, Indonesia
[2,3,4,5,6,7,8,9,10,11,12]Universitas Negeri Surabaya,, Surabaya, Indonesia
shelais.23042@mhs.unesa.ac.id

Abstract: Mangroves are habitats for living things that can create helpful interactions between the surrounding environment, mangroves are close to the high and low sea water which is overgrown with trees and bushes. From this observation, researchers hope to find various kinds of mangroves and examine the vegetation pattern in accordance with the importance index value in the mangrove area of Baluran National Park, Situbondo, East Java. The purposive sampling method was carried out with quadrant areas at several stations and then identified with the PLantNet application and measured vegetation parameters. After making observations, the results obtained were that the *Rhizophora mangle* species was the most common type of mangrove observed in the Baluran National Park area. The vegetation pattern of this place is along the coastal edge exposed to sea water.

Keywords: Dominance; Ecosystem; Frequency; Importance Index Value; Density

Abstrak: *Hutan mangrove merupakan habitat bagi makhluk hidup yang dapat menciptakan interaksi bermanfaat antara lingkungan sekitarnya. Hutan mangrove berada dekat dengan pasang surut air laut dan ditumbuhi pepohonan serta semak belukar. Dari pengamatan ini, para peneliti berharap dapat menemukan berbagai jenis mangrove dan meneliti pola vegetasi sesuai dengan nilai indeks kepentingan di kawasan mangrove Taman Nasional Baluran, Situbondo, Jawa Timur. Metode pengambilan sampel bertujuan dilakukan dengan area kuadran di beberapa stasiun dan kemudian diidentifikasi dengan aplikasi PlantNet serta diukur parameter vegetasinya. Setelah melakukan pengamatan, hasil yang diperoleh adalah spesies Rhizophora mangle merupakan jenis mangrove yang paling umum ditemukan di kawasan Taman Nasional Baluran. Pola vegetasi di tempat ini berada di sepanjang tepi pantai yang terpapar air laut.*

Kata kunci*: Dominasi; Ekosistem; Frekuensi; Nilai Indeks Kepentingan; Kepadatan*

Introduction

Mangroves are plants that live in muddy places, such as on tidal beaches and estuaries (Hanafi *et al*., 2021). Mangroves are an important aspect of the coastal environment because they help keep species and ecosystems alive and well (Rahman *et al*., 2025). Mangroves also help protect genetic variety in ecosystems (Kuncahyo *et al*., 2020). Nonetheless, different human activities pose a danger to the survival of mangroves (Santoso *et al*., 2019). One of the ways to protect the mangrove environment is to look at the significance value index to learn more about the types of plants that live there (Rumalean and Purwanti, 2019).

Conversely, biological succession processes impact mangrove ecosystems by interactions among species and environmental conditions. Wijaya *et al*. (2021) say that ecological succession is a slow shift in a group of species that goes on until it reaches a peak. You may utilize this approach to learn about succession by looking at relevant index value data. Manan *et al*. (2021)

elucidated that pioneer plant species typically exhibit elevated significance index values throughout the first phases of succession, while climax species prevail in the concluding stages. The ecological succession process may be used to protect the environment and as a guide for making conservation plans.

Many Indonesian researchers have researched mangrove vegetation. Parmadi *et al*. (2016) stated that Rhizophora apiculata is superior to Rhizophora mucronata, because Rhizophora apiculata is at the tree and seedling level, while Rhizophora mucronata is at the seedling level. Meanwhile, research in the Pati district showed Avicennia marina as the dominant species with the highest INP value, namely 246.1%-300%, which is included in the category of high dominance and low diversity (Rahman *et al*., 2025). In addition, there is also research on the Tabongo Coast that shows differences between locations, with Ceriops tagal dominant at station I (INP 73.02%) and Sonneratia alba at station II (INP 98.72%) (Djamadi *et al*., 2024).

Although various studies have been conducted in coastal areas of Indonesia, studies that specifically identify mangrove vegetation structures using importance index values in Baluran National Park are still minimal. This national park is located in Situbondo Regency, East Java, which has a mangrove forest area of 95.81 ha or 35.16% of its total mangrove forest area. The number of true mangrove vegetation species on Bama Beach is 16, including 7 families (Istomo and Ghifary, 2021). Limited data on the structure of mangrove vegetation in this area means that management strategies do not fully reflect the actual condition of the ecosystem.

Baluran National Park was chosen as a mangrove research site because it has natural mangrove areas that grow without human intervention, thus reflecting the condition of mangrove ecosystems that are still intact, healthy, and rich in mangrove tree species diversity. This naturalness and diversity are very important for obtaining comprehensive vegetation structure data. This includes species composition, density, distribution, height, and diameter, which are key indicators in assessing mangroves' condition and ecological function. Vegetation structure data is essential for the sustainable management of mangrove ecosystems, assisting with change monitoring, conservation planning, and maintaining ecosystem function. Understanding vegetation structure can help manage and sustain Baluran's coastal ecosystems effectively, with long-term benefits for the environment and society (Ardiansyah *et al*., 2023).

Scientific information on the importance index value of mangrove vegetation as a succession stabilizer needs to be studied systematically in this area. Therefore, this research focuses on identifying mangrove species and in addition to studying the importance index value related to mangrove vegetation as a succession stabilizer in the mangrove area of Baluran National Park, Situbondo, East Java. The study investigated important values such as the number of populations of each species (density), the area occupied by the species (dominance), and the degree of presence or occurrence of the species in the study site. The research is intended to make

meaningful contributions relevant data for conservation efforts and mangrove ecosystem management in an integrated and sustainable manner.

This section is supported by a literature review that serves as a basis for the research concept. Authors are required to present a review of both primary (references from journal articles and conference proceedings) and recent (references published within the last 10 years). The literature review is not limited to theory alone but also includes empirical evidence. Enrich this introduction with previous efforts. This article is the result of research that is a downstream process of research findings, which can be the results of one's own research or that of other researchers.

Methods

The materials used in this study were: tape measure, carpenter ruler, raffia rope, flora identification book and the PlantNet application. These materials were applied to aid in the identification and measurement of mangrove species in the field. The materials observed were the mangrove plant species that have been reported based on identification using the PlantNet application.

On May 3rd 2025, vegetation sampling on purposive sampling was applied to cover quadrant plot in the Mangrove Ecosystem Area of Baluran National Park, Situbondo Regency, East Java Province. Four points were marked in 10x10 m2 quadrant plots at 10 stations and a tree to be the central point of each one. From the central point of the field, four lines stretch out energetically at the four compass points in raffia rope of the tree lying a new one, this is to be the subpoint. After that, using a carpenter ruler to measure the distance from the middle point to the closest tree. The mangrove trunk is measured at chest height and girth is quantified. The species of the mangrove tree was documented and determined by the PlantNet application at every sub-point. This approach is intended to derive an important factor in the community of mangrove species (Hapsari *et al.,* 2022)

Ecological conditions that influence the presence of mangrove tree species in the study area were observed based on soil and air environmental conditions. Soil conditions included pH, temperature, and humidity. Soil pH and moisture were measured using a soil meter, while soil temperature was measured using a soil thermometer. Air environmental conditions included air temperature, air humidity, CO_2 concentration, and light intensity. Air temperature, humidity, and CO_2 concentration were measured using an air quality detector, while light intensity was measured using a luxmeter.

In analyzing mangrove vegetation, the Importance Value Index (IVI) of each species was determined to assess the role and relative importance of each species within the mangrove community (Rawana et al., 2022). The IVI provides an indication of the contribution of each species to the vegetation structure and ranges from 0% to 300%. The IVI was determined by combining

the relative density, relative frequency, and relative dominance of each species (Malahayati et al., 2023; Laksananny et al., 2023). In addition, vegetation analysis involved determining species density, frequency, and dominance, as well as their respective relative values.

Supporting measurements were also conducted to obtain the parameters required for mangrove vegetation analysis (Agustin et al., 2023). These measurements included the distance between sampling points, the area of the observation plots, tree radius, and the number of individual trees or habitus recorded within each observation area. The collected measurements were subsequently used to characterize the structure and composition of mangrove vegetation in the study area.

Results

The results presented below are derived from a study on mangrove vegetation conducted in Baluran National Park, Situbondo.

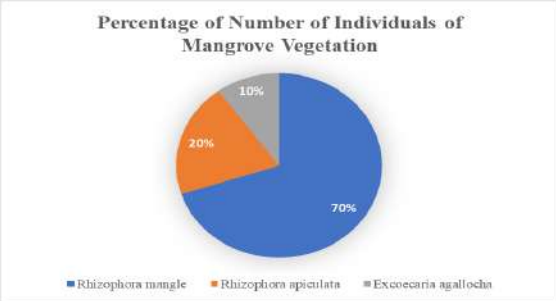

Diagram 1. Percentage of the Number of Individuals of Mangrove Vegetation in Bama Beach

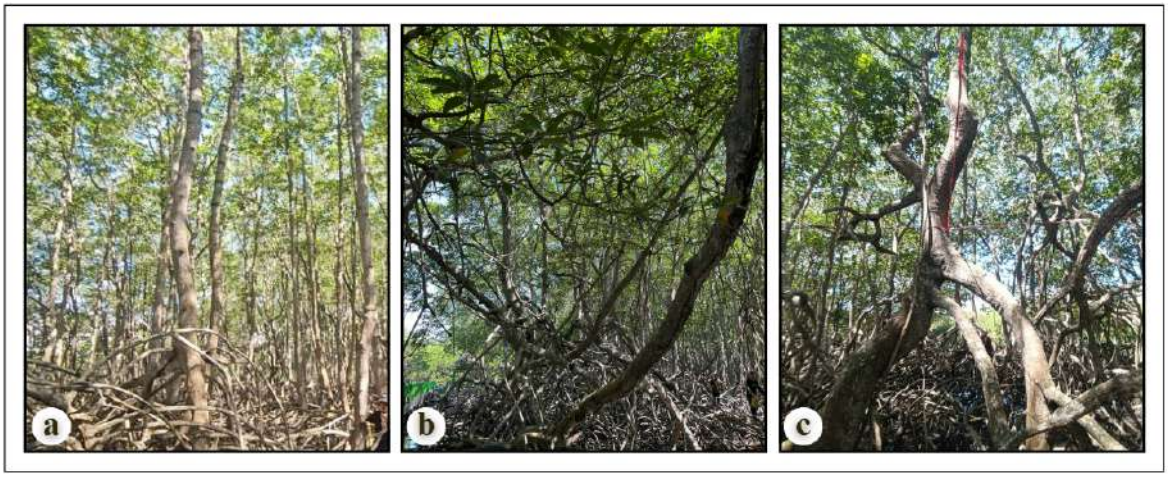

Figure 3. (a) *Rhizophora mangle* (b) *Rhizophora apiculata* (c) *Excoecaria agallocha*

Table 1. Analysis Results of Mangrove Vegetation in Baluran National Park, Situbondo

Station	Species	Total Individuals	AD	RD (%)	ADM	RDM (%)	AF	RF (%)	IVI (%)
1	*Rhizophora apiculata*	16	0,10	10,00	0,00079	0,40	0,40	10,00	20,40
2	*Rhizophora mangle*	16	0,01	10,00	0,00073	0,38	0,40	10,00	20,38
3	*Excoecaria agallocha*	16	0,37	10,00	0,00118	0,61	0,40	10,00	20,61
4	*Rhizophora mangle*	16	0,03	10,00	0,00088	0,45	0,40	10,00	20,45
5	*Rhizophora apiculata*	16	0,12	10,00	0,00010	0,05	0,40	10,00	20,05
6	*Rhizophora mangle*	16	2,08	10,00	0,01	2,86	0,40	10,00	22,86
7	*Rhizophora mangle*	16	0,19	10,00	0,01396	7,15	0,40	10,00	27,15
8	*Rhizophora mangle*	16	0,01	10,00	0,0001	0,08	0,40	10,00	20,08
9	*Rhizophora mangle*	16	0,42	10,00	0,16739	85,74	0,40	10,00	105,74
10	*Rhizophora mangle*	16	1,63	10,00	0,00447	2,29	0,40	10,00	22,29
	Total	**160**	**4,95**	**100,00**	**0,19523**	**100,00**	**4,00**	**100,00**	**300,00**

Description: Absolute Density (AD); Relative Density (RD); Absolute Dominance (ADM); Relative Dominance (RDM); Absolute Frequency (AF); Relative Frequency (RF); Importance Value Index (IVI).

In Situbondo's Baluran National Park, an examination of the mangrove vegetation revealed 160 mangrove individuals spread across 10 observation stations. *Rhizophora mangle*, *Rhizophora apiculata*, and *Excoecaria agallocha* were the three different species represented by the 16 individuals in each station. The most prevalent and exhibiting extraordinarily high dominance values among them was *Rhizophora mangle*, particularly at Station 9, where its relative dominance reached 85.74% and its Importance Value Index (IVI) was found to be 105.74%. An equitable

distribution across the locations was suggested by the equal relative frequency values of 10% displayed by all three species. Relative density readings also were consistent at 10% for each species, suggesting a consistent number of individuals. Nevertheless, in certain sites, *Rhizophora mangle* showed greater dominance than in others, suggesting broader canopy coverage. With *Rhizophora mangle* being the predominant element of the mangrove vegetation structure in this coastal ecosystem, our results validate the presence of *Rhizophora mangle*, *Rhizophora apiculata*, and *Excoecaria agallocha* in the region.

Discussion

The mangroves at Bama Beach consisted of *Rhizophora mangle*, *Rhizophora apiculata* and *Excoecaria agallocha* as revealed by the survey. *Rhizophora mangle* was the most frequent species (n = 112). *Rhizophora mangle*, (commonly known as the red mangrove) is a tropical and subtropical mangrove tree, the most widespread of all mangrove species and the most specialized to its tidal habitat. The intertidal zone situated on the shoreline which is inundated by tides and seawater exposure (Burhanuddin, 2024). These mangroves play an important ecological and economic role in tropical coastal areas. *Rhizophora mangle* is a mangrove species with an alluvial layer of fine mud or fine clay. Taxonomically, mangroves (*Rhizophora mangle*) belong to the family Rhizophoraceae (Deyoe *et al*., 2020). Rhizophoraceae is one of the most dominant families in most mangroves in Indonesia (Indriaty *et al*., 2024). The large number of red mangrove species in coastal areas can provide benefits to the ecosystem because they have unique adaptations to seawater conditions, especially salinity and flooding (Aguilera *et al.,* 2025).

Rhizophora apiculata is also one of the mangrove species that grow along the coast of Indonesia. Based on the results of the study, the number of individuals in this mangrove was 36. This shows that the distribution of *Rhizophora apiculata* is also not less extensive in the coastal area of Bama Beach. *Rhizophora* is a mangrove with the main component of mangroves so it can grow in slightly hard and shallow muddy areas. This species will be able to grow up to 30 meters (Hadi *et al.,* 2016). *Rhizophora apiculata* is often referred to as oil mangrove as an herbal plant. This mangrove has potential in biological, ecological, and medical fields. In the utilization of the medical field, oil mangrove plants are used as traditional medicine such as slimming drugs, and antidiarrheal, and some studies also mention that they can be used as natural antiseptics, antibacterials, and wound healing (Wardina *et al.,* 2023). *Rhizophora* is a genus of mangrove plants that also belongs to the Rhizophoraceae family and is commonly found in intertidal areas. *Rhizophora* is the dominant mangrove plant species in mangrove areas (Datt *et al*., 2021).

The third mangrove species is *Excoecaria agallocha* with 16 individuals. This mangrove tree can grow up to 15 meters. This mangrove tree is included in coastal plants or mangroves that live in the back area of natural mangrove trees (Sumanto, 2020). *Excoecaria agallocha* has gray to

brownish bark, but the inside is yellowish green and has nodules. This tree has roots that spread over the surface of the soil and has sap on the trunk, branches, and leaves. *Excoecaria agallocha* is known to have potential, especially in its leaves, as antibacterial, antioxidant, anticancer, and others (Puspitasari, 2018). *Excoecaria agallocha* is a semi-woody plant belonging to the genus *Excoecaria* and the Euphorbiaceae family that is used in traditional medicine, especially in Asian countries. One of the substances produced by this mangrove is diterpenoids.

According to observations of the mangrove vegetation's structure in Baluran National Park, the discovered species absolute densities varied between 0.01 and 2.08 individuals per unit area. In spite of this variance, the relative density for all species was consistently found to be 10%, suggesting that the three species *Rhizophora apiculata*, *Rhizophora mangle*, and *Excoecaria agallocha* had an equitable distribution of individuals. According to Supriharyono (2017), this balance implies that every species has an equal role in the local vegetation community, indicating a stable ecosystem free from species dominance, which is a crucial sign of ecological health. Variations in absolute density are probably caused by species-specific responses to environmental conditions such tidal exposure, substrate composition, and salinity (Rahman, 2025). *Rhizophora* species are generally suited to soft, wet, and dynamic environments, while *Excoecaria agallocha* prefers drier regions or zones that are further from the peak tidal reach. Effective ecosystem management and conservation depend on an understanding of the density of mangrove vegetation, especially when determining which species should get priority protection or rehabilitation efforts (Hidayat *et al.,* 2020).

Dominance is the area of land that is significantly dominated by a certain plant. The level of dominance of a plant is calculated through the percentage of area it occupies (Oktaviani *et al*., 2017). Based on observations in Baluran National Park, all stations show a fairly striking level of dominance variation, ranging from 0.0001 to 0.16739. The highest dominance value was recorded for *Rhizophora mangle* species at station 9, while the lowest value was also from the same species but found at other stations. This indicates that, while the distribution of the species is wide, its potential to be dominant is largely reliant on local conditions. At station 9, it was 85.74% much higher than at the other stations, where it ran below 10%. Such a high value for dominance means, in general, this species has a large stem volume and a wide canopy. The parameters that determine dominance are density and basal area; it increases the former parameter then obviously will increase its dominance (Sulastri *et al*., 2024). This is also reinforced by dominant species that have great productivity, and in determining a dominant vegetation type what needs to be known is the diameter of the stem. The supremacy of particular kinds seen at the study site mirrors a place that is well-fit to their ecological needs and encourages their growth (Melaponty *et al*., 2019).

Frequency is a measure that indicates how often a species appears within observation plots. Absolute frequency refers to the number of plots in which a species is found, while relative

frequency expresses the percentage of species occurrence compared to the total frequency of all species within an area (Luturyali *et al.,* 2019). Based on data from all stations, the three dominant species *Rhizophora apiculata*, *Rhizophora mangle*, and *Excoecaria agallocha*, each had absolute frequency of 0,40 meaning they were each present in 4 out of the total observation plots. This indicates that these species have an equal frequency of occurrence in Baluran National Park, Situbondo. Similarly, their relative frequencies were the same, each species at 10.00%. Relative frequency is calculated by comparing the absolute frequency of a species with the total frequency of all species observed (Laksamanny *et al.,* 2023). The equal values in relative frequency suggest that no species appeared more frequently than the others at the study area. This equal level of presence indicate that all three species have relatively similar capabilities for growth and survival in the mangrove habitat and ecosystem of Baluran National Park, Situbondo

The result of the observation revealed variation in the Importance Value Index (INP) at each sampling site. Species such as *Rhizophora apiculata*, *Rhizophora mangle*, and *Excoecaria agallocha* generally recorded INP values between 20% and 27%, which are considered within the low to medium range. This value indicates that the distribution and influence of each species on the surrounding environment is relatively balanced, and there is no significant dominance in most locations (Baderan *et al.,* 2021). However, at Station 9, *Rhizophora mangle* showed a very high INP value of 105.74%. This value indicates that the species dominates structurally in the mangrove ecosystem at that location, both in terms of density, dominance, and frequency of occurrence (Istomo and Ghifary, 2021). Based on the general characteristics of the Baluran National Park area, it is known that this area has high temperatures (around 30-34°C), pH of the water was neutral to slightly acidic (6.5-7.5), and salinity that tends to be moderate to high (Budiawan and Ardiyansyah, 2020). These conditions are in accordance with the ecological tolerance range of *Rhizophora mangle* which is able to grow in brackish waters with fluctuating salinity and muddy substrates. A relative dominance (DR) score of 85.74% further confirms the species ability to adapt and compete effectively within the observed environmental conditions.

In the mangrove area of Bama Beach, Baluran National Park, researchers identified only three species as *Rhizophora mangle, Rhizophora apiculata*, and *Excoecaria agallocha*. Even with limited number, the species shared fairly balanced roles in terms of population density, ecological dominance, and frequency of presence. According to Astuti *et al.* (2021), this suggests that the mangrove community at the location is steady and getting closer to the climax. According to Baderan *et al.* (2021), the climax is the last stage of ecosystem evolution and is distinguished by stable environmental conditions, a balanced vegetation structure, and dominating species types that have adapted to their surroundings.

The stability of the ecosystem's structure and function, rather than the quantity of species, is what determines if a climax community exists in mangrove ecosystems (Setyawan *et al*., 2016).

The three mangrove species that can coexist and preserve ecological balance in Baluran National Park suggest that the mangrove ecosystem at Bama Beach is stable and working well. This climax community's presence also indicates that mangrove vegetation's natural and sustainable growth is still supported by the coastal environment (Susilo and Rismayani, 2019).

Conclusion

After observation, the results obtained were that there were 3 kinds of mangrove trees found in Bama Beach, namely *Rhizophora mangle*, *Rhizophora apiculata*, and *Excoecaria agallocha*. Of the 3 types of mangrove trees, *Rhizophora mangle* was observed the most. From several observation stations there is an Important Index Value (INP) which shows that the environment is very strong with high salinity levels and muddy substrate conditions. In addition, the results of dominance, frequency and density values show relatively good results. It is evident that the mangrove community in the Bama Beach area is already in a balanced condition and supports the natural and sustainable growth of mangrove vegetation.

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