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Mangrove vegetation analysis in Bama beach Baluran National Park

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Abstract: Research was conducted on the analysis of mangrove vegetation on the coast of Bama, the Baluran National Park Situbondo Regency, in February 2021. The purpose of this study was to identify mangrove vegetation on Bama beach. Mangrove sampling is done purposive sampling by making plots on transect lines intermittently. Sizes 20 x 20 m^2 for trees, 10 x 10 m^2 for poles, 5 x 5 m^2 for stake and 2 x 2 m^2 for seedlings. Each plot identified the type and measured the diameter of the trunk and the number of individual mangroves. Important value index (IVI) is obtained by calculating species density, relative density, type frequency, relative frequency, type dominance, and relative dominance. The results showed that on the coast of Bama Baluran National Park, there are four types of mangroves, namely *Rhizophora apiculata, Rhizophora stylosa, Ecoecaria agallocha, and Terminalia catappa*, where *Rhizophora stylosa* is a species that dominates.

Keywords: Mangrove, vegetation analysis, Baluran National Park, the coast of Bama

Abstrak: Abstrak: Telah dilakukan penelitian tentang analisis vegetasi mangrove di pesisir pantai Bama Taman Nasional Baluran Kabupaten Situbondo pada bulan Februari 2021. Tujuan dari penelitian ini adalah untuk mengidentifikasi vegetasi mangrove di pesisir pantai Bama. Pengambilan sampel mangrove dilakukan secara purposive sampling dengan membuat plot pada jalur transek secara berselang-seling. Ukuran 20 x 20 m^2 untuk pohon, 10 x 10 m^2 untuk tiang, 5 x 5 m^2 untuk pancang dan 2 x 2 m^2 untuk bibit. Setiap plot mengidentifikasi jenis, mengukur diameter batang dan jumlah individu mangrove. Nilai indeks penting (INP) diperoleh dengan menghitung kerapatan jenis, kerapatan relatif, frekuensi jenis, frekuensi relatif, dominasi jenis dan dominasi relatif. Hasil penelitian menunjukkan bahwa di pesisir pantai Taman Nasional Bama Baluran terdapat 4 jenis mangrove yaitu *Rhizophora apiculata*, *Rhizophora stylosa, Ecoecaria agallocha* dan *Terminalia catappa* dimana *Rhizophora stylosa* merupakan spesies yang mendominasi.

Kata kunci: Mangrove, analisis vegetasi, Taman Nasional Baluran, pesisir pantai Bama.

INTRODUCTION

Indonesia is a country that has a lot of biodiversities, one of which is the mangrove ecosystem. The mangrove ecosystem is a potential ecosystem that supports the existence of a diversity of flora and fauna in it (Eddy et al., 2018; Mursalim et al., 2020; Satyanarayana et al., 2011). It has many benefits for ecology, among others, as a biota habitat, fauna stopover, coastal protection, sediment traps, and spawning, nurturing, and foraging for various fauna (Cannicci et al., 2021; Fudloly et al., 2020; Hussain & Badola, 2010). Other benefits of mangrove ecosystems are as an area of pond fish cultivation, recreation, and wood sources

(Bismark et al., 2008; Hussain & Badola, 2010; Nugraha et al., 2018). Therefore, mangrove ecosystems need to be preserved to continue providing benefits for life (Yuliana et al., 2019).

Mangrove is known to be divided into two types, namely true mangrove, which is a group of mangrove types that form muni stands (major), or that dominate in mangrove communities and mangrove associations, namely mangrove type groups that not / rarely form pure stands, and do not dominate structures and communities (Noor et al., 2012; Purnawan et al., 2019). Thirty-eight types of mangroves grow in Indonesia, among them the Rhizophora, Avicennia, Sonneratia, Barringtonia, and Luminitzera (Bismark et al., 2008). In Indonesia, mangroves are a source of ecosystem services such as storm protection and carbon sequestration (Miteva et al., 2015); even mangrove fruit can be used as food products for the community (Baderan & Musa, 2021). A study in one area of Indonesia showed that there were 53 species from 32 families classified into 28 associate mangroves and 25 true mangroves and found one species, Scyphiphora hydrophyllacea, which is threatened with extinction (Utina et al., 2019).

Ecologically the utilization of mangrove ecosystems that are not managed properly will have a negative impact (Bismark et al., 2008; Delfan et al., 2021). Dwindling mangrove ecosystems can threaten life, such as the loss of tropical rainforests (Nugraha et al., 2018). It is known that in 2015 the area of mangrove forest spread throughout the coast of Indonesia suffered damage of about 1,818,000 Ha (Setyaningrum et al., 2021) from a total area of 3,489,141 Ha (Mursalim et al., 2020). Many factors that cause damage to mangrove ecosystems include conversion into fish and shrimp ponds, conversion of mangrove areas into agricultural land and settlements, and overexploitation by local communities (Eddy et al., 2018; Purnawan et al., 2019; Sahadevan et al., 2021). An increase follows the increasing human population in economic needs, which causes them to have to use the mangrove area to meet their needs (Katili et al., 2017)

Based on research by Eddy et al. (2018), in 2013, primary forests in the east coast mangrove area of Sumatra island only left about 52% of the overall area. The same thing also happened in the mangrove area of West Manggarai regency about 7,810 ha of mangrove forest area suffered damage with varying levels of damage (Hidayatullah & Pujiono, 2014). Research conducted by Arifanti et al. (2019) in the Mahakam Delta of East Kalimantan showed that the mangrove area had been lost by 62%, which caused a considerable loss of carbon (if equal to 226 years of soil carbon accumulation in natural mangroves). Another research in Riau province, precisely in Teluk Belitung Village, showed that there had been severe damage (Umayah et al., 2016). This research found that the mangrove forest ecosystem with a total density value of 626.67 trees/ha and on all types below 50%.

Baluran National Park is geographically located at 7°29'10" - 55" LS and 114°39'10" BT with an area of ± 25,000 Ha, with an overall mangrove forest area of 416,093 Ha (Putrisari, 2017). Bama Beach is one of the conservation objects in Baluran National Park that is expected to optimize the potential and management of coastal areas (Fudloly et al., 2020). But in fact, there is a theft of *Rhizophora apiculate* and *Sonneratia moluccensis* roots by the community and drifting shipping waste, causing inhibition of mangrove development (Putrisari, 2017). Based on the above description, it is necessary to conduct studies related to identifying mangrove vegetation on the coast of Bama Baluran National Park, Situbondo Regency, East Java.

METHOD

Interventional studies involving animals or humans and other studies that require ethical approval must list the authority that provided approval and the corresponding ethical approval code.

This research includes quantitative descriptive research to identify mangrove vegetation on the coast of Bama Baluran National Park (Dharmawan et al., 2019). The location that was used as a research area is in the mangrove area of the old pier of Bama Beach Baluran National Park of Situbondo Regency, covering an area of ± 4 Ha (Figure 1). Mangrove sampling is done by purposive sampling by making plots on transect lines intermittently modified (Dharmawan et al., 2019).

The sampling plan is listed in Figure 2. Zoning determination is done by making a path perpendicular to the coastline and observing every plant that is along the line (Putrisari, 2017). At the station placed four transects with a distance between transects of 20 m^2 and a distance between plots of 20 m^2. On each transect is placed an observational plot, as many as three plots that are placed intermittently. All the samples found were measured in circumference and counted in number on each plot.

The tools used in the study are a refractometer, salinometer, DO meter, anemometer, Lux meter, meter, digital camera, but shoes, pegs, and raffia straps. The materials used in the study consisted of samples of mangroves, paper and pens, plastic bags, label paper, 70% ethanol/ formaldehyde, and the identification book "guidance on mangrove recognition in Indonesia."

All samples collected were taken to the Baluran National Park Hall to be identified and verified by experts to determine the types of mangroves found. An overview of mangrove vegetation that is the research object is done by measuring the Important Value Index (IVI). Acquisition of IVI by calculating type density, relative density, type frequency, relative frequency, type dominance, and relative dominance (Li et al., 2013; Sahadevan et al., 2021).

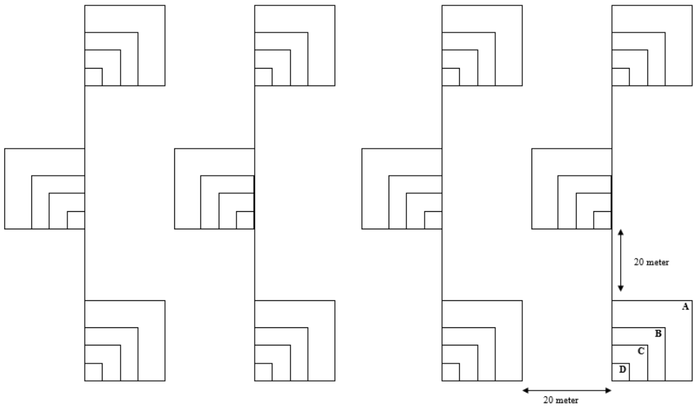

Figure 1. Sample-taking plot plan

RESULTS AND DISCUSSION

Based on the results of observation and identification (Table 1) found, three families and four species of mangroves in Bama beach Baluran National Park. The first family is *Rhizophoraceae* consisting of *Rhizophora apiculate* and *Rhizophora tylosa;* the second family is *Euphorbiaceae, with* the species *Excoecaria agallocha.* Both families are true mangrove species (Eddy et al., 2018; Laulikitnont, 2014; Li et al., 2013). True mangroves are a leading indicator of the mangrove ecosystem itself (Pi et al., 2009; Yuliana et al., 2019). The third family found is *Combretaceae* with the species *Terminalia catappa, w*hich is a type of mangrove association (Patra et al., 2011; Satyanarayana et al., 2011). Environmental conditions on the coast of Bama Baluran National Park affect the number of species found (Ashuri & Patria, 2020; Cannon et al., 2020).

Table1 Types of mangroves found in research plots

Family	Species	Species Type
Rhizophoraceae	*Rhizophora apiculate*	True mangroves
Rhizophoraceae	*Rhizophora stylosa*	True mangroves
Euphorbiaceae	*Excoecaria agallocha*	True mangroves
Combretaceae	*Terminalia catappa*	Mangrove association

Table2 Mangrove density at the research site

Mangrove Name	Density				Relative density (%)			
	Tree	Post	Stake	Seedling	Tree	Post	Stake	Seedling
Rhizophora apiculate	0.018	0.06	0.25	1	36.84	35.29	42.86	80
Rhizophora stylosa	0.023	0.09	0.33	0.25	47.37	52.94	57.14	20
Excoecaria agallocha	0.003	0.01	-	-	5.26	5.88	-	-
Terminalia catappa	0.005	0.01	-	-	10.53	5.88	-	-

The highest relative densities at the levels of trees, poles, stake, and seedlings are *Rhizophora stylosa* at 47.37%, 52.94%, 57.14%, and 20%. It is suspected that environmental conditions at the research site support the spread and growth of the Rhizophoraceae family (Wang et al., 2011). When the density of trees gets higher, then the intensity of sunlight that enters the base of mangrove forests becomes lower (Ashuri & Patria, 2020). It is known that the Rhizophoraceae family has a better ability to adapt to its environment than other types of mangroves (Hidayatullah & Pujiono, 2014; Setiyowati, 2018).

In addition to being able to adapt well, it is known that the *Rhizophoraceae* family develops with fruit that has germinated while still at the parent's request (Eddy et al., 2018; Hidayatullah & Pujiono, 2014; Wang et al., 2011). This causes if the fruit falls, it will be carried away by the current and then settles and forms a new parentage somewhere (Boone Kauffman et al., 2017; Eddy et al., 2018). The lowest relative density is owned by *Excoecaria agallocha* (5.26%). The results of mangrove vegetation analysis for relative frequency and frequency levels can be seen in Table 3.

Table 3. Mangrove frequency at the research site

***Mangrove* Type Name**	**Frequency**				**Relative Frequency**			
	Tree	**Post**	**Stake**	**Seedling**	**Tree**	**Post**	**Stake**	**Seedling**
Rhizophora apiculata	0.583	0.50	0.25	0.33	36.84	35.29	42.86	80
Rhizophora stylosa	0.750	0.75	0.33	0.08	47.37	52.94	57.14	20
Excoecaria agallocha	0.083	0.08	-	-	5.26	5.88	-	-
Terminalia catappa	0.167	0.08	-	-	10.53	5.88	-	-

According to Table 3, it is known that the highest relative frequencies at the level of trees, poles, stakes, and seedlings are *Rhizophora stylosa. At the same time, Excoecaria agallocha* is the mangrove species with the lowest relative frequency levels. This is due to unbalanced competition with the Rhizophoraceae family (Eddy et al., 2018; Noor et al., 2012; Suyadi & Manullang, 2020). The results of mangrove vegetation analysis for relative dominance and dominance levels can be seen in Table 4.

Table 4. Mangrove dominance at the research site

***Mangrove* Type Name**	**Dominance**		**Relative Dominance**	
	Tree	**Post**	**Tree**	**Post**
Rhizophora apiculate	50.304	18.42	24.14	25.09
Rhizophora stylosa	45.648	16.98	36.50	46.25
Excoecaria agallocha	126.009	25.50	25.19	17.37
Terminalia catappa	59.050	16.59	14.17	11.29

The relative dominance of mangroves in Baluran National Park's Bama Beach for *Rhizophora stylosa* species has the highest percentage of 36.50% at tree level and 46.25% at pole level. It is known that the dominance of a species is influenced by the geographical location and biophysical conditions of mangrove habitats (Hidayatullah & Pujiono, 2014; Muhammad Wahyu Setiyadi, Ismail, 2017; Purnawan et al., 2019), such as salinity, soil nitrogen and Na/K comparison (Hussain & Badola, 2010; Laulikitnont, 2014; Salminah & Alviya, 2019). (Yuliana et al., 2019) stated that changes in the composition of floristic mangrove orangutans are caused by several things such as changes in the environment, human activities, or a combination of both. The mangrove Essential Value Index (IVI) analysis results can be seen in Table 5.

Table 5. Mangrove IVI calculations at the research site

***Mangrove* Type Name**	**Important Value Index (IVI) (%)**			
	Tree	**Post**	**Stake**	**Seedling**
Rhizophora apiculate	91.59	94.36	85.71	160
Rhizophora stylosa	110.98	127.80	114.29	40
Excoecaria agallocha	55.37	44.67	-	-
Terminalia catappa	42.07	33.17	-	-

The IVI shows that the highest value is occupied by *Rhizophora stylosa*, which means that true mangroves overwhelmingly dominate the Bama coastal mangrove area of Baluran National Park (Nunaki & Damopolii, 2021; Rogers et al., 2017). It is known that true mangroves have a morphology that is supported in competition with minor mangroves and mangrove associations (Bloor & Wood, 2016; Supardjo, 2008; Younes et al., 2019). The same is seen in *Rhizophora stylosa*, which has a stick-shaped root type so that it is able to maintain the standing of trees from less stable muddy soil conditions (substrates) (Eddy et al., 2018; Fudloly et al., 2020; Pangastuti et al., 2016). This is what causes Rhizophora stylosa to dominate the Bama coastal mangrove area of Baluran National Park.

CONCLUSION

Analysis of mangrove vegetation found three families and four species of mangroves in Bama Beach Baluran National Park. The IVI shows that the highest value is occupied by *Rhizophora stylosa,* which means that true mangroves overwhelmingly dominate the Bama coastal mangrove area of Baluran National Park

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