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Struktur Populasi Putat Laut (*Barringtonia asiatica* (L.) Kurz) di Kawasan Mangrove Tabanio Kabupaten Tanah Laut

(Population Structure of Putat Laut (Barringtonia asiatica (L.) Kurz) in the Tabanio Mangrove Area, Tanah Laut Regency)

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ABSTRACT. Plant population structure is a key ecological concept describing the presence and distribution of a plant group within a specific area. This study focuses on the Sea Poison Tree (*Barringtonia asiatica* (L.) Kurz) situated in the mangrove area of Tabanio, Tanah Laut Regency. The objective of this research was to examine the population structure of *B. asiatica* in this specific habitat. The study employed a total exploration method along a designated transect line. The results showed that the population structure consisted of 18.55 individuals/km² in the pre-reproductive phase, 27.67 individuals/km² in the reproductive phase, and 11.07 individuals/km² in the post-reproductive phase. These proportions form a disrupted vase- or urn-shaped pyramid, indicating a lower number of young individuals compared to mature ones. However, based on the density of mature individuals exceeding 25 individuals/km², the *B. asiatica* population in Tabanio is categorized as being in a safe and fairly developed condition.

INTRODUCTION

A population is a collective group of organisms of the same species occupying a certain area. A population can be defined as a group of individuals capable of interbreeding with one another and inhabiting a particular space[1]. The individuals forming a population are of the same species, both morphologically and genetically.

The population structure of plants refers to the arrangement of plant populations within a given area. The Tabanio coastal forest area is utilized by the local community for agriculture, plantations, and tourism. Population structure age stratification within the population, such as pre-reproductive, reproductive, and post-reproductive stages. This study is generally based on plant height and stem diameter, which reflect the structure of plants in the population [2].

The Sea Poison Tree (*Barringtonia asiatica* (L.) Kurz) is a species that grows in coastal forests, rocky beaches, and occasionally in mangroves. It thrives both on land and in aquatic environments. Its fruits are often found floating along coastlines, allowing them to disperse over long distances. Mangroves are one of the common habitats of this species. Mangrove ecosystem is a coastal ecosystem influenced by tidal fluctuations and dominated by characteristic trees or shrubs capable of growing in saline/brackish waters [3].

The mangrove ecosystem is a complex system consisting of plants, animals, and environmental factors interacting with one another. However, its utilization is often unsustainable, such as logging for firewood, aquaculture ponds, and reclamation, which damage the environment and disrupt the life cycles of marine biota and other fauna such as birds, fish, shrimp, and crabs [4]. These conditions highlight the importance of studying the population structure of the Sea Poison Tree in mangrove ecosystems.

Several studies on plant population structures have been conducted in different locations, such as *Peronema canescens Jack.* in Danau Sari Embun, Yellow bamboo (*Bambusa vulgaris*) in Danau Sari Embun, Rukam (*Flacourtia rukam*) in the Maluka Riverbank area [5]. These studies show that different plant species possess different population structures.

The Tabanio mangrove area was chosen for this study because it contains a variety of plants that help prevent coastal abrasion and tolerate variations in water quality. The Sea Poison Tree was selected as the research object since no prior studies had focused on its population structure, despite its potential for daily use. Furthermore, preliminary surveys indicated that its population has declined, making further study necessary.

Ecologically *Barringtonia asiatica* is a littoral plant that grows on sandy beaches, coral-sand coasts, and mangrove swamps at elevations of 0–350 m above sea level. It is widely distributed across tropical regions of the Indian and western Pacific Oceans, including Java, Bali, Sulawesi, Nusa Tenggara, and Kalimantan. In South Kalimantan, it is commonly found along the Tabanio coast and in mangrove forests. However, wetland areas in Tabanio village have been largely converted into plantations and agricultural land, reducing natural habitats [6].

Based on the issues outlined above particularly the habitat conversion and lack of specific data, this study is necessary to analyze the population structure of the Sea Poison Tree in the Tabanio Mangrove Area. This research aims to provide valid ecological information that can be utilized as a learning resource based on local potential, serving as a basis for the following problem formulation.

RESEARCH METHOD

This study employed a descriptive observational approach within a vegetation ecology framework to analyze the population structure of *Barringtonia asiatica* (Sea Poison Tree) in the Tabanio Mangrove Area, Tanah Laut Regency. The analysis focused on density, dominance, size-class distribution, and age-phase structure (pre-reproductive, reproductive, and post-reproductive), following the concept of population structure [7].

Fieldwork was conducted between July and December 2024 along a transect line of approximately 2.13 km, extending from the estuarine zone to the innermost mangrove zone. Sample plots were systematically placed along the transect, and all *B. asiatica* individuals encountered within the plots were recorded as research samples. Each individual was measured for its diameter at breast height (DBH) and height, and then classified according to reproductive phase. Environmental parameters such as air temperature, relative humidity, soil moisture, light intensity, wind speed, altitude, and soil pH were also measured at representative points to characterize habitat conditions. Morphological features of the plants were documented, and short interviews with local residents were conducted to provide contextual ecological information.

The variables, operational definitions, units, and measurement methods are summarized in Table 1.

Table 1. Operational definitions of variables in this study.

Variable	Operational Definition	Unit	Measurement Method
Density (D)	Number of individuals per unit area	ind./m² (or ind./ha)	Count all individuals within the plot; D = *n*/plot area
Dominance (Do)	Basal area as a proxy of space occupation	cm² or m²/ha	Measure DBH (1.3 m above ground); basal area = $\pi \times (DBH/2)^2$
Size distribution	Distribution of individuals by diameter/height classes	cm or m	Measure DBH/height of all individuals; classify into small–medium–large
Age phases	Proportion of pre-reproductive, reproductive, post-R	%	Score based on reproductive morphology of each individual

Data were analyzed descriptively. Density, dominance, size-class distribution, and age-phase proportions were summarized in tables and figures to illustrate population structure patterns. GPS coordinates were mapped on Google Earth to visualize spatial distribution. Finally, the ecological findings were compared with the conservation framework to provide a preliminary assessment of the species' population status in the study area [8].

RESULTS AND DISCUSSION

Results

1. Population Structure of *Barringtonia asiatica* (L.) Kurz in the Tabanio Mangrove Area, Tanah Laut Regency

This study identified the population structure of *Barringtonia asiatica* (Sea Poison Tree) in the Tabanio Mangrove Area, Tanah Laut Regency, using a total exploration method. The observations revealed that individuals in the reproductive phase dominated the population compared to those in the pre-reproductive and post-reproductive phases. This indicates that most of the population is in an active growth stage with strong potential for regeneration.

Morphologically *B. asiatica* possesses a taproot system, woody stems with sympodial branching, lanceolate leaves, trumpet-shaped flowers with striking corollas, and single berry-type fruits that often float along coastal waters. Visual documentation of these morphological characteristics was carried out to strengthen species identification in the field.

Morphometric measurements further distinguished the age phases of the population. Pre-reproductive individuals were characterized by heights of less than 2 m and stem diameters below 19 cm, without any reproductive activity. Reproductive individuals reached heights of 4–10.2 m and stem diameters ranging from 39 to 79 cm, and displayed clear flowering and fruiting activity. Post-reproductive individuals, on the other hand, were identified by damaged stems, absence of foliage, or evidence of cutting, representing the terminal stage of the life cycle.

The dominance of reproductive-phase individuals suggests that *B. asiatica* populations in the Tabanio mangrove area are largely composed of actively growing and regenerating trees.

Table 2. Characteristics of Population Structure of *Barringtonia asiatica.*

Parameter	Pre-reproductive Phase	Reproductive Phase	Post-reproductive Phase
Height (m)	< 2 m	4 – 10.2 m	> 1.27 m
Stem diameter (cm)	< 8 – 19 cm	39 – 79 cm	> 12 cm
Other features	Not flowering or fruiting; small stems	Flowering and fruiting; larger stems with more branching	Damaged, dead, cut, or leafless stems

Population structure can be determined based on density across age phases: pre-reproductive (height < 220 cm and not flowering/fruiting), reproductive (height 221–350 cm and flowering/fruiting), and post-reproductive (height > 350 cm, no longer flowering/fruiting, dead, or damaged) [9].

In the study area of 0.542 km², the population structure of *Barringtonia asiatica* showed that reproductive-phase individuals were the most dominant, with a density of 27.67 ind/km², followed by pre-reproductive individuals at 18.55 ind/km², and post-reproductive individuals at 11.07 ind/km². The overall distribution pattern formed a disturbed vase- or urn-shaped pyramid, indicating the dominance of mature individuals and the low regeneration rate of younger individuals.

Table 3. Population Structure of *Barringtonia asiatica.*

No	Growth Phase	Total Individuals (Ind/15.20 Ha)	Individuals per Hectare (Ind/Ha)	Individuals per Square Kilometer (Ind/km²)
1	Pre-reproductive	10	0,18	18,55
2	Reproductive	15	0,27	27,67
3	Post-reproductive	6	0,11	11,07

Based on the data presented in Table 3, the population structure of *Barringtonia asiatica* in the Tabanio Mangrove Area, Tanah Laut Regency, consists of three phases: pre-reproductive, reproductive, and post-reproductive. The pre-reproductive phase was recorded at 0.18 ind/ha, the reproductive phase at 0.27 ind/ha, and the post-reproductive phase at 0.11 ind/ha.

The results indicate that post-reproductive individuals were found in the lowest numbers, while reproductive individuals dominated the population compared to the pre-reproductive phase. Thus, it can be concluded that the most abundant individuals within the study area were those in the reproductive phase. This finding is consistent with the calculations presented in Table 3 and is further illustrated by the following population pyramid.

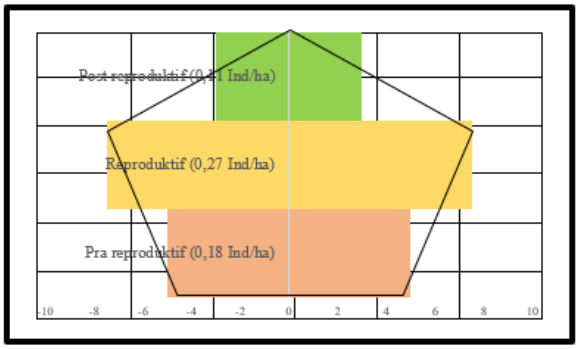

Figure 1. Population Structure Pyramid of *Barringtonia asiatica*

Based on the calculations and the population pyramid presented above, the number of *Barringtonia asiatica* individuals in the Tabanio Mangrove Area, Tanah Laut Regency, is categorized as a vase- or disturbed urn-shaped pyramid, indicating a declining population status. A normal population shift from one growth stage to the next should be around 10%. When the values exceed this threshold or when only two growth phases are represented, the resulting pyramid takes the form of a disturbed vase or urn [10].

In this study the population structure of *B. asiatica* is characterized by a greater number of mature individuals, producing a vase-shaped or disturbed vase pyramid. Following Odum's criteria this form is typically associated with a smaller number of young individuals compared to older cohorts [11]. Other literature also supports this interpretation, stating that if the number of young individuals is too small to replace the adults, the population structure can be categorized as declining [12].

Table 4. Environmental Parameter Measurements.
A. Abiotic Factors

No	Measured Parameter	Range (This Study)	Reference Range (Literature)
1	Temperature (°C)	33 – 34	22 – 37
2	Air humidity (%)	66 – 69	50 – 80
3	Soil moisture (%)	73 – 100	50 – 70
4	Soil acidity (pH)	5.5 – 6.0	6.0 – 6.53
5	Light intensity (Lux)	11,450 – >20,000	16,442 – >20,000
6	Wind speed (m/s)	0.0 – 4.0	5 – 10
7	Altitude (m asl)	0 – 4	5.6 – 87

B. Biotic Factors

1. Plant decay due to seawater intrusion.
2. Utilization of tree stems by local communities.

Based on the measurements of abiotic parameters in the Tabanio mangrove area, Tanah Laut Regency, the environmental conditions were found to be conducive to the growth of *Barringtonia asiatica*. Air temperature ranged between 33–34°C, with relative humidity recorded at 66–69%. Notably, soil moisture levels were relatively high, ranging from 73–100%. These conditions are consistent with the ecological preferences of *B. asiatica*, a littoral species that typically thrives on moist, sandy, or muddy substrates along coastlines, river mouths, and mangrove fringes. The combination of high humidity and water-saturated soils supports the physiological requirements of this species in coastal and mangrove habitats.

In addition to abiotic conditions, biotic factors were identified through interviews with local residents. The community reported that *B. asiatica* is a familiar species in the area, although taxonomic confusion occasionally occurs, with some residents mistaking it for *Terminalia catappa* (Ketapang). Ecologically, the species grows naturally and relies on hydrochory (water dispersal); its buoyant fruits are dispersed by tides and waves, allowing seeds to establish along coastal margins. However, despite this natural regeneration mechanism, residents noted that the species is becoming increasingly rare within the mangrove forests due to habitat disturbance.

The biotic dynamics of *B. asiatica* are significantly influenced by local utilization. Both vegetative and reproductive parts of the plant are harvested for economic and domestic purposes. Ethnobotanical data reveals that the fruit and bark are utilized as natural shampoo and soap, while young shoots are consumed as vegetables.

Crucially, the timber is frequently extracted for use as construction material for boards and household needs. While these practices highlight the socio-economic value of *B. asiatica*, they simultaneously represent a significant anthropogenic pressure. This uncontrolled exploitation likely contributes to the "disrupted" population structure and the declining trends observed in the Tabanio mangrove ecosystem.

Discussion

The results of this study show that *Barringtonia asiatica* growing in the Tabanio Mangrove Area exhibits distinctive morphological traits in each organ. Its root system is a taproot with many branches, conical in shape, brownish-orange in color, and capable of expanding the absorption area for water and nutrients [13] [14]. The stem is woody, grows upright with sympodial branching, has a diameter ranging from 8–79 cm, and a height of 0.39–10.2 m depending on the growth phase. The stem surface is rough, light brown with white patches, and tends to grow toward sunlight. These features are consistent with the descriptions. The leaves are lanceolate, glossy dark green on the upper surface, light green and slightly rough on the underside. The fruit is a berry type, conical to ovoid with four truncated corners, green when young and turning dark green with brown spots when ripe [15]. The flowers are trumpet-shaped with green sepals, pale cream-reddish petals, a single pink stigma, and numerous yellow stamens. They are arranged in racemes or long hanging spikes at branch tips, in line with the literature stating that *Barringtonia* flowers are elongated and bloom seasonally [16].

The population structure is divided into three phases: pre-reproductive, reproductive, and post-reproductive. Pre-reproductive individuals are characterized by heights of <2 m and stem diameters of 8–19 cm, with no flowering or fruiting. Reproductive individuals range from 4–10.2 m in height and 39–79 cm in diameter, and already show flowering or fruiting activity. Post-reproductive individuals are characterized by damaged, dead, or leafless stems with diameters of around 12 cm. Density calculations revealed that reproductive individuals dominate with 0.27 ind/ha, followed by pre-reproductive individuals with 0.18 ind/ha, and post-reproductive individuals with 0.11 ind/ha. This pattern forms a vase- or disturbed urn-shaped pyramid, where the number of young individuals is lower than that of mature individuals. Such a pyramid shape reflects low regeneration and a declining population status [17] [18].

Several factors influence this population structure, including natality, mortality, abiotic conditions, and biotic disturbances. Natality is relatively low, as indicated by the small number of pre-reproductive individuals [19] [20]. Mortality is high due to uncontrolled logging, stem damage caused by ocean waves, and weather-induced decay, consistent with Odum's ecological mortality concept. Abiotic measurements show air temperature of 33–34°C, air humidity 66–69%, soil moisture 73–100%, soil pH 5.5–6, light intensity 11,450–>20,000 lux, wind speed 0 m/s, and altitude 0–4 m above sea level. These values fall within the tolerance ranges for mangrove-associated plants [21] [22] [23] [24] [25]. Biotic factors also play a role: local communities use stems as firewood or building material, young leaves as vegetables, and fruits and bark as traditional shampoo or soap. Without conservation efforts, such utilization accelerates the population decline [26].

In this paragraph, the reference to IUCN serves as the authoritative international standard for Red List criteria, providing the basis for the author to assess and categorize the local *B. asiatica* population as "declining" based on the specific threat indicators observed. Introduced to provide a comparative context regarding the latest global conservation status, highlighting the contrast that while the species is globally listed as "Least Concern," the local population is dwindling due to specific environmental pressures. The ecological analysis is further substantiated who provides the theoretical framework to interpret the "disturbed vase-shaped pyramid," scientifically confirming that the dominance of mature individuals over younger ones is a definitive sign of an imbalance in population regeneration [27] [28] [29] [30].

CONCLUSION

Based on the results of this study, the population structure of Sea Poison Tree (*Barringtonia asiatica* (L.) Kurz) in the Tabanio Mangrove Area, Tanah Laut Regency, can be concluded as follows:

1. The population structure of *B. asiatica* consists of three growth phases: pre-reproductive, reproductive, and post-reproductive.
2. The density values for each phase were 18.55 ind/kmS² for the pre-reproductive phase, 27.67 ind/km² for the reproductive phase, and 11.07 ind/km² for the post-reproductive phase.
3. The population distribution formed a vase- or disturbed urn-shaped pyramid, with reproductive individuals dominating over pre-reproductive and post-reproductive phases. This pattern indicates low natural

regeneration, although the population in the study area is not considered critical since more than 25 mature individuals were recorded per km².

Recommendations

1. Future research should expand the study area to cover a wider range of mangrove ecosystems in Tabanio and other coastal regions, in order to obtain a more comprehensive picture of *B. asiatica* population structure.
2. Field studies are recommended to be conducted between January and February, coinciding with the flowering and fruiting season of *B. asiatica*, to ensure more accurate reproductive data.
3. Community outreach programs are necessary to raise awareness on sustainable use, maintenance, and conservation of *B. asiatica*, considering its declining presence in the mangrove area.
4. Active conservation efforts, such as logging restrictions, habitat protection, and replanting (revegetation), are required to maintain the sustainability of *B. asiatica* populations in mangrove ecosystems.

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