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Species composition and medicinal uses of mangrove plants in Southwest Aceh, Indonesia

WINTAH[1,2,♥], MOH. HUSEIN SASTRANEGARA[3], KISWANTO[1], ALIN FITHOR[4]
[1]Department of Public Health Science, Faculty of Health Sciences, Universitas Teuku Umar. Jl. Alue Peunyareng, Aceh Barat 23681, Aceh, Indonesia. Tel./fax.: +62-281-642360, ♥email: wintah@utu.ac.id
[2]Graduate Program of Fisheries Science, Faculty of Fisheries and Marine Sciences, Universitas Teuku Umar. Jl. Alue Peunyareng, Aceh Barat 23681, Aceh, Indonesia
[3]Faculty of Biology, Universitas Jenderal Soedirman. Jl. Dr. Soeparno 63, Banyumas 53122, Central Java, Indonesia
[4]Coastal Resources Management, Research Center of Hydrodynamic Technology, National Research and Innovation Agency. Jl. Grafika No. 2, Sleman 55284, Yogyakarta, Indonesia

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Abstract. *Wintah, Sastranegara MH, Kiswanto, Fithor A. 2026. Species composition and medicinal uses of mangrove plants in Southwest Aceh, Indonesia. Biodiversitas 27 (3): d270321. https://doi.org/10.13057/biodiv/d270321.* Mangrove ecosystems are among the most productive ecosystems in the world, serving ecological, economic, and cultural functions. Mangroves play an important role in maintaining the biological integrity and resources of marine ecosystems. The village of Tadu Raya Sub-district, Nagan Raya District of South West Aceh has a mangrove forest covering 50 ha. The potential of the mangrove forest in this area is enormous, including medicinal plants. This study aims to identify plants with potential as medicines. The study used a survey method, with sampling conducted at three stations with transects perpendicular to the coast at fixed intervals. Vegetation sampling was conducted randomly at each station and repeated three times in 10 x 10 m plots for trees, 5 x 5 m plots for saplings, and 1 x 1 m plots for seedlings. Information on the use of mangroves through investigations of local communities and a review of the scientific literature. The study found nine medicinal plant species, including trees and undergrowth plants: *Acanthus ilicifolius*, *Avicennia marina*, *Bruguiera gymnorrhiza*, *Nypa fruticans*, *Rhizophora apiculata*, *Rhizophora mucronata*, *Rhizophora stylosa*, *Sonneratia alba*, and *Sonneratia caseolaris*. The local community uses these species as medicine for thrush, toothache, wounds, diarrhea, stomach ache, abdominal pain, bruises, chickenpox, fever, itching, and cough. The highest species importance value (IVI) at Station 1 (ST1) was *R. apiculata* (54.9%) with relative density (16.67%), relative frequency (18.75%), and relative dominance (19.53%). The highest species importance value (IVI) at Station 2 (ST2) was *R. apiculata* (56.66%), with relative density (20%), relative frequency (20%), and relative dominance (14.08%). Station 3 (ST3) had the highest species importance value (IVI) of *R. mucronata* (57.4%) with relative density (20%), relative frequency (20%), and relative dominance (17.35%).

Keywords: Aceh, ethnobotany, mangrove, potential medicine, species importance value

INTRODUCTION

The mangroves area in Indonesia is 334.076 ha (Ministry of Environment and Forestry of the Republic of Indonesia 2021). Mangroves serve as a link between land and sea, with a unique ability to adapt to tidal fluctuations and salinity (Wintah et al. 2023). Mangroves can survive in high-salinity environments, and have been widely used by communities for traditional medicinal purposes (Prasetya et al. 2024). Various parts of this plant have been used in traditional medicine to treat appendicitis, increase appetite and stamina, treat liver problems, treat malaria, treat sprains, and treat bruises (Mairing and Ariantari 2022). Mangroves are coastal ecosystems that play important ecological and economic roles (Wintah et al. 2021). Their ecological functions include serving as a food source for biota such as fish, crabs, shrimp, gastropods, and other biota; providing shelter for fish, invertebrates, mammals, and birds; producing detritus from fallen leaves, twigs, flowers, and fruit; and acting as a barrier against storms and tsunamis. Their economic functions include providing medicinal ingredients, timber, and fishery products.

As a tropical country, Indonesia boasts a wide variety of medicinal plants. The tradition has existed since ancient times to cure various types of diseases, both internal and external. Notably, plants are considered producers of medicinal compounds. Most drugs and antibiotics used in medicine are derived from plants, including penicillin, streptomycin, and chloramphenicol (Henny et al. 2017), and also produce bioactive compounds (Saranraj and Sujitha 2015).

Mangrove areas such as those dominated by *Avicennia alba* and *Sonneratia alba* flooded even at low tide. In contrast, *Rhizophora* sp. dominated in flooded medium tide areas, whereas Bruguiera sp. and *Xylocarpus granatum* dominated in flooded high tide areas (Sukuryadi et al. 2021). *A. alba* leaves exhibit analgesic, antidiabetic, anti-inflammatory, antihyperglycemic activities, and antidiarrheal (Mitra et al. 2022). *S. alba* leaves contain secondary metabolites in the form of alkaloids, tannins, saponins, steroids, and flavonoids that function as antibacterial agents (Syafitri et al. 2021). *Rhizophora apiculata* bark is used as an antitumor agent (Kurniawan et al. 2023). *R. apiculata* is used to treat skin diseases, inflammation, pain, diarrhea, and nausea, and serves as an antiseptic (Prasetya et al. 2024). The trunk of *X. granatum* contains saponins, flavonoids, and tannins (Dey et al. 2021). *Bruguiera* sp. contains antimicrobials and acts as a therapeutic agent (Sharma et al. 2024). The leaves of *X. granatum* contain anticancer and antidiabetic compounds (Darmadi et al. 2021).

Plants with medicinal properties are still largely unknown. Mangroves have the potential to directly benefit human life, for example, as a source of food and medicine. Mangrove plants are used as traditional medicine. The potential for medicinal plants in mangrove forests is relatively high. However, most of this potential remains unexplored (Syamsuddin et al. 2019). Mangrove plants have been used as traditional medicinal plants, including those applicable as remedies for antibacterial (Syafitri et al. 2021), anticancer (Darmadi et al. 2021), diarrhea and diabetes (Mitra et al. 2022), antitumor (Kurniawan et al. 2023), antimicrobials (Sharma et al. 2024), skin diseases, nausea, vomiting, and antiseptics (Prasetya et al. 2024). The utilization of mangroves is minimal, as potential raw materials for herbal medicines remain very limited (Prasetyo et al. 2023).

The South West Aceh coastline faces the Indian Ocean and is covered with mangrove forests. Mangrove forests have enormous potential, including medicinal plants with antibacterial properties and traditional medicines. Information on the potential and use of mangrove vegetation as medicine remains limited, and many mangrove species with medicinal potential remain under-researched. Initial observations indicate that traditional medicines derived from mangroves have potential as preventive measures or treatments for several diseases, such as diarrhea (*R. apiculata*), swelling (*Acanthus ilicifolius*), stomachache (*S. alba*), and thrush (*Nypa fruticans*). The exploration of the potential of mangrove forests as a source of medicine involves an inventory of medicinal plants and their properties. This study aims to (i) measure mangrove diversity and conservation status across all stations, (ii) document medicinal uses of mangrove from local community. This study is expected to provide information and documentation for the community, researchers, government, and parties interested in mangrove vegetation management.

MATERIALS AND METHODS

Study area

The research was conducted in the mangrove forest area in Tadu Raya Sub-district, Nagan Raya District, Aceh Province, Indonesia (Figure 1) from June to September 2024. The research location was divided into three stations; Station 1 (3°57'24.84"N, 96°18'53.22"E), located in the mangrove forest facing the sea and thus directly affected by tidal waves; Station 2 (3°57'24.65"N, 96°18'55.21"E), located in the central area of the mangrove forest; and Station 3 (3°57'22.96"N, 96°18'57.42"E), located in an area close to the mainland.

Data collection

Species composition

Samples were collected at three stations with transects perpendicular to the coast at fixed intervals. Vegetation sampling was conducted randomly at each station and repeated three times. Observations were made on 10 x 10 m plots for the trees, 5 x 5 m plots for the saplings, and 1 x 1 m plots for the seedlings (Sutaryo 2009), with a 100 m spacing between plots and a total of 9 plots.

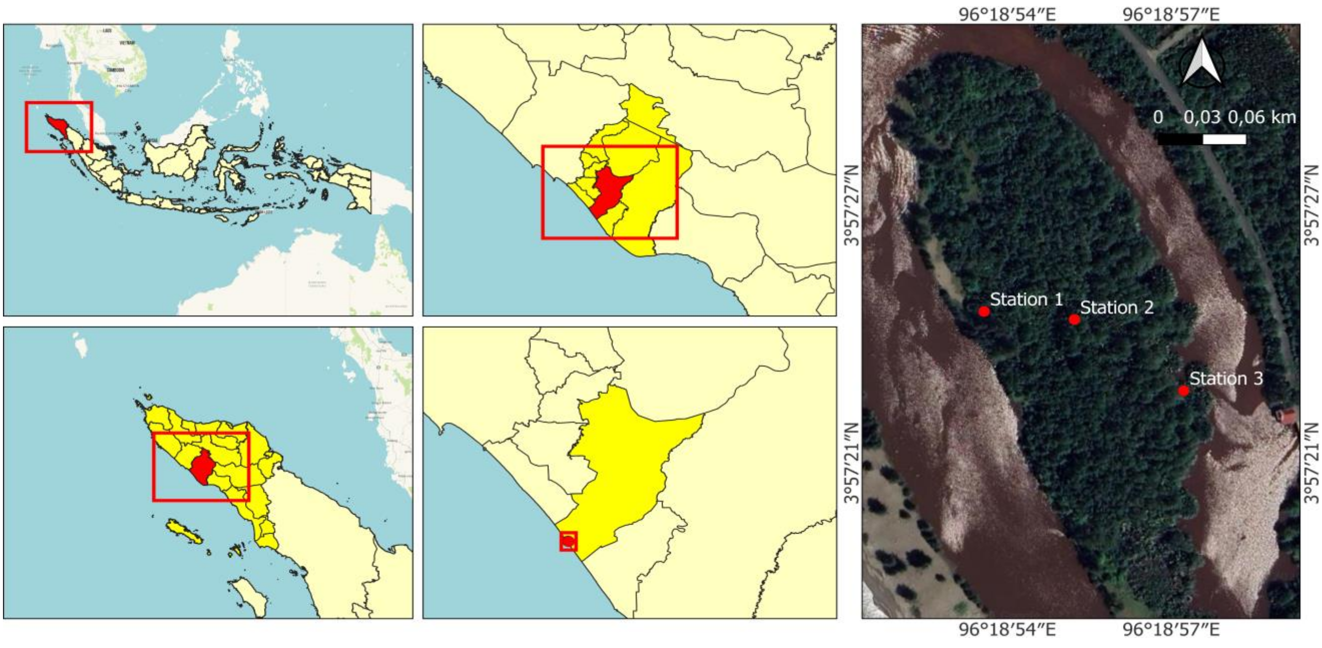

Figure 1. Location of the study area in the mangrove forest of Tadu Raya Sub-district, Nagan Raya District, Aceh Province, Indonesia

Mangrove vegetation sampling was carried out at three levels of mangrove growth, namely trees, saplings, and seedlings with the following characteristics: (i) Trees: plant height more than 1.3 m and diameter more than 10 cm, (ii) Saplings: plant height more than 1.3 m and diameter less than 10 cm; (iii) Seedlings: plant height less than 1.3 m (Boonee and Daniel 2012). There were three plots at each station for monitoring and measuring mangrove species and diameter at breast height (DBH). DBH measurements of mangroves are taken from the top of the highest supporting root to chest height. The field implementation stages include observation, exploration, and sample collection. The collected plant samples, labeled with information such as the local name, place name, collection number, date of collection, and other relevant characteristics, were photographed and placed in separate plastic bags marked for identification. Mangrove species were identified based on leaves, flowers, and fruits and using identification books (Kitamura et al. 1997; Giesen et al. 2006).

Medicial uses of mangrove

Mangrove data collection for medicinal purposes involved gathering information on medicinal plants used by the local community. A survey was conducted to identify medicinal plants in mangrove forests and their use by local communities. Free interview approach, involving interviews with local communities to gather insights from individuals with extensive knowledge of medicinal plants. Interviews were conducted with 12 local informants (7 women and 5 men), aged 40-80 years, who were acknowledged by the community as having extensive knowledge of local medicinal plants. Several references were used to verify respondents' information on the effectiveness of the plants as medicine.

Data analysis

The composition of medicinal plants in mangrove communities was analyzed using diversity parameters and species importance value index (IVI). The importance value index is the sum of relative density, relative frequency, and relative dominance. The highest species Importance Value Index (IVI) can be used as an indicator of a plant species' role in identifying the species or name of a vegetation or community (Odum 1971). It can be calculated based on the following equation:

$$Di = \Sigma\ ni/L$$

Where, Di: Species density/density, ni: Number of individuals of species i, L: Area of plot

Relative species density (RDi), which is the ratio between the number of individuals of species i (ni) and the total number of individuals of all species:

$$RDi\ (\%) = (ni / \Sigma\ n) \times 100$$

Where, Rdi: The relative density of species i (%), ni: The number of individual species i, Σn: The total number of individuals of all species.

Frequency (Fi) is the probability of finding species i in all sample plots established.

$$Fi = pi / \Sigma p$$

Where, Fi: Frequency of species i, pi: Number of sample plots established, Σp: Total number of sample plots established.

Relative Species Frequency (RFi), which is the ratio between the frequency of type-i (Fi) and the total frequency of all species $\sum \times$ 100%.

$$RFi\ (\%) = (Fi / \Sigma\ F) \times 100$$

Where, Rfi: The relative frequency of species i (%), Fi: The frequency of species i, Σ F: The total frequency of all species.

Cover is the proportion between the basal area occupied by plant species and the total habitat area. Species cover (Ci) is the cover of species i in an area.

$$Ci = \Sigma\ BA/A$$

Where, Ci: Coverage area of species i, BA: π DBH 2 /4, π = 3.14, DBH: Diameter of trees of species i, A: Total area of the sampling area.

DBH measurements of mangroves are taken from the top of the highest supporting root to chest height.

Species Relative Cover (RCi) is the ratio of the area of closure of species i (Ci) to the total area of closure for all species. Area of cover for all species.

$$RCi\ (\%) = (Ci / \Sigma\ C) \times 100$$

Where, Rci: The relative coverage of species i (%), Ci: The ith species' area of coverage, Σ C: The total area of all species' coverage.

Species Importance Value Index (IVI) is the sum of the values of relative density (RDi), relative frequency of species (RFi), and relative species closure (RCi):

$$IVI = RDi + RFi + RCi$$

To measure species diversity, we used the species diversity index (Shannon-Wiener) (Odum 1971) with the following formula:

$$H' = -\Sigma\ pi \ln pi$$

With $pi = ni/N$

Where: H'- Species diversity index, pi: the ratio between the number of individuals of species i (ni) and the total number of individuals (N), ni: Number of individuals of species i, N: Total number of individuals of all species. ln: Natural logarithm.

The Diversity Index (Shannon-Wiener) has several categories according to Odum (1971), which include three criteria based on the condition of the organism, as follows:

If $H' < 1$: Low diversity, If $1 < H' < 3$: Moderate diversity, If $H' > 3$: High diversity.

The dominance index is calculated using the formula (Odum 1971):

$$C = \Sigma(ni/N)^2$$

Where, C: Dominance index, ni: Number of individuals of species i, N: Total number of individuals of all species

If the dominance index value is close to 1, then the community is dominated by a specific species or phylum, and if the index is close to 0, then there is no dominant species or phylum in the community (Odum 1971).

The plant evenness value is calculated using the species evenness index with the formula:

$E = H'/ \ln S$

Where, E: Species evenness index, H': Shannon-Wiener diversity index, S: Number of species

The evenness index ranges from 0-1. A value of 0 indicates that the plant species in the community are very unevenly distributed, while a value close to 1 indicates that almost all species have the same abundance (Magurran 1988).

RESULTS AND DISCUSSION

Species composition

Mangrove diversity

The mangroves at the research site are natural forests and belong mainly to the Rhizophoraceae family. The highest mangrove diversity index was found at Station 2 (ST2) at 0.89, followed by Station 1 (ST1) at 0.87, and Station 3 (ST3) at 0.83. A total of 9 species from 4 families of true and false mangroves were found in Tadu Raya, namely: *Acanthus ilicifolius*, *Avicennia marina*, *Nipa fruticans*, *Bruguiera gymnorrhiza*, *Rhizophora apiculata*, *Rhizophora mucronata*, *Rhizophora stylosa*, *Sonneratia alba*, and *Sonneratia caseolaris* (Figure 2). These medicinal plants belong to 4 families, namely Rhizophoraceae, Lythraceae, Acanthaceae, and Arecaceae.

Species Importance Value Index (IVI)

The Species importance value index (IVI) describes the influence or role of a mangrove species in an observed mangrove community. The higher the importance value of a species, the greater the role of that mangrove species in the mangrove community. The importance value of mangrove species at Station 1 (Figure 3.A), *R. apiculata* is the most important species at Station 1 (ST1). Station 2 (Figure 3.B), *R. apiculata* is the most important species at Station 2 (ST2). Station 3 (Figure 3.C), *R. mucronata* is the most important species at Station 3 (ST3). Analysis results for species importance value measurements from the three stations (Table 1). Dominance and evenness at the tree level of the three stations (Table 2).

Medicinal uses of mangrove

There are seven true mangrove species with medicinal potential in the Tadu Raya Mangrove Forest in South West Aceh, namely *A. marina, B. gymnorrhiza, R. apiculata*, *R. mucronata*, *R. stylosa*, *S. alba*, *S. caseolaris*, and two associated mangrove species with medicinal potential, namely *A. ilicifolius* and *N. fruticans* (Table 3).

Discussion

Species composition

Mangroves are woody plants that grow in areas where land meets the sea, creating an environment with high salinity, extreme tides, strong winds, and muddy soil (Wintah et al. 2025). Mangroves are a unique ecosystem supplied with saltwater from the sea and freshwater from peat swamps (Arbiastutie et al. 2021). Mangrove ecosystems are part of marine and coastal resources that play an important role in supporting human life (Rohmah and Cintamulya 2025).

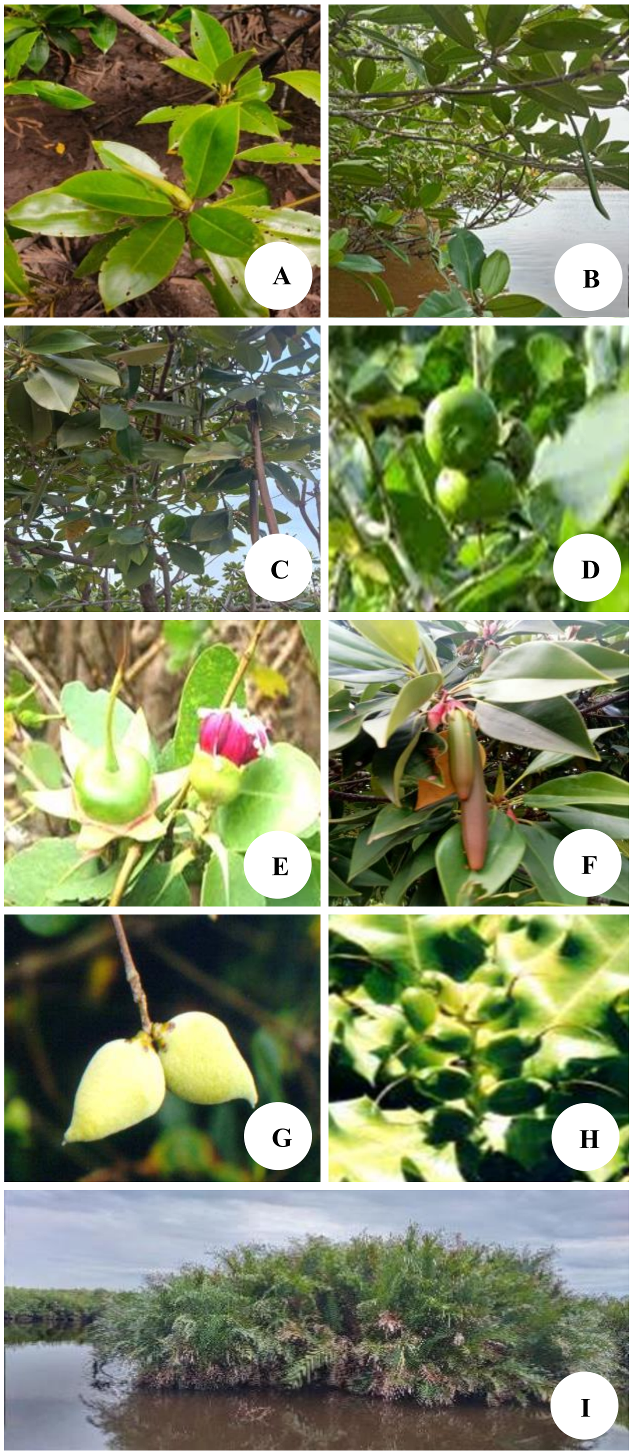

Figure 2. Mangrove diversity in Tadu Raya Sub-district, Nagan Raya District of South West Aceh, Indonesia. A. *Rhizophora stylosa*, B. *Rhizophora mucronata*, C. *Rhizophora apicula*, D. *Sonneratia alba*, E. *Sonneratia caseolaris*, F. *Bruguiera gymnorrhiza*, G. *Avicennia marina*, H. *Acanthus ilicifolius*, I. *Nypa fruticans*

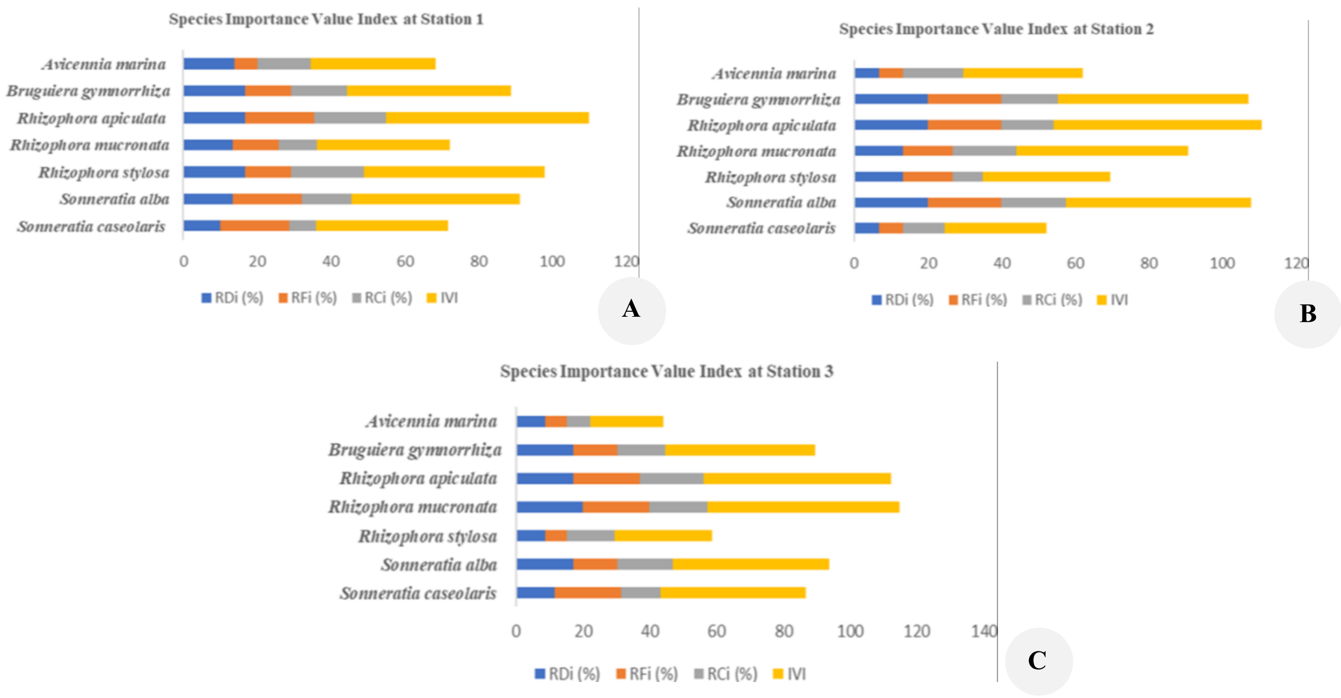

Figure 3. Species importance value index (IVI) of trees at: A. Station 1, B. Station 2, C. Station 3

Diversity is necessary to understand the structure and composition of a mangrove ecosystem. Mangrove diversity in Tadu Raya, located in South West Aceh, ranges from 0.83 to 0.89, indicating low diversity. Species diversity analysis aims to measure the number and variation of mangrove species in a particular area. This analysis provides information on ecosystem's health, ecological functions, and potential. In general, 9 mangrove species were recorded at the study site.

The diversity of species in a habitat is not affected by the dominance of a particular species. The dominance index at the research site was 0.01-0.04, classified as low, and the evenness index ranged from 0.09-0.14, also classified as low. The factors that affect the evenness index are the number of individuals and the number of species. The greater the number of individuals and the smaller the number of species, the greater the evenness index value that will be obtained in that habitat. Several factors, including ecosystem balance, nutrient availability, and stable environmental conditions, influence the number of individuals and species found. Small populations are more vulnerable to extinction, a risk compounded by habitat destruction (Sodhi et al. 2009). Asril et al. (2022) argue that habitat change and destruction are causes of extinction. Habitat destruction renders the lives there.

The diversity index is a vegetation parameter most useful for comparing communities, particularly for studying the effects of environmental or abiotic factors on them and for understanding their succession and stability. The number of species determines species diversity. A decrease in plant diversity at a given time occurs because each vegetation type requires a different amount of time to complete its life cycle, and changes in plant communities co-occur with changes in growing conditions, which influence ecological succession. Ecological succession is influenced by climate, water availability, edaphic conditions, interactions between biotic and abiotic factors, species distribution patterns, and habitat dynamics (Baderan et al. 2021).

The highest species importance value (IVI) at Station 1 (ST1) was *R. apiculata* (54.94%) with relative density (16.67%), relative frequency (18,75%), and relative dominance (19.53%). The highest Species Importance Value (IVI) at Station 2 (ST2) was *R. apiculata* (56,66%), with relative density (20%), relative frequency (20%), and relative dominance (14,08%). Station 3 (ST3) had the highest Species Importance Value (IVI) of *R. apiculata* (57.4%) with relative density (20%), relative frequency (20%), and relative dominance (17.35%). Stations 1 and 3 had the highest Species Importance Value (IVI) values for Rhizophoraceae because species in this family are more adaptable to various environmental conditions, as supported by the sandy loam substrate. In accordance with the opinion of Rambu et al. (2019), they stated that mangroves in the Rhizophoraceae family relatively prefer sandy loam or clay loam substrates. The Rhizoporaceae family has excellent habitat adaptability, enabling it to form strong pure stands, thereby reducing the likelihood of other species growing in those habitats (Partama et al. 2024). The Rhizoporaceae are a family of true mangroves that have specific root morphology characteristics, enabling them to compete with minor mangrove families. Station 3 had the highest INP value for the Lythraceae family, namely *S. caseolaris*, which can grow well on sandy loam substrates. In accordance with the opinion of Djamadi et al. (2024), sandy loam substrate conditions can promote the growth of *Sonneratia* sp.

Table 1. The results of the species importance index analysis from three stations

Species	Station 1				Station 2				Station 3			
	RDi	RFi	RCi	IVI	RDi	RFi	RCi	IVI	RDi	RFi	RCi	IVI
Avicennia marina	13.79	6.25	14.46	34.04	6.67	6.67	16.16	32.51	8.57	6.67	6.79	22.03
Bruguiera gymnorrhiza	16.67	12.5	15.26	44.43	20.00	20.00	15.46	51.59	17.14	13.33	14.31	44.79
Rhizophora apiculata	16.67	18.75	19.53	54.94	20.00	20.00	14.08	56.66	17.14	20.00	19.00	56.14
Rhizophora mucronata	13.33	12.5	10.25	36.09	13.33	13.33	17.34	46.80	20.00	20.00	17.35	57.35
Rhizophora stylosa	16.67	12.5	19.81	48.98	13.33	13.33	8.26	34.50	8.57	6.67	14.12	29.36
Sonneratia alba	13.33	18.75	13.56	45.64	20.00	20.00	17.40	50.31	17.14	13.33	16.47	46.95
Sonneratia caseolaris	10	18.75	7.12	35.87	6.67	6.67	11.29	27.63	11.43	20.00	11.95	43.38
Total	100.0	100.00	100.00	300.00	100.00	100.00	100.00	300.0	100.0	100.0	100.0	300.00

Table 2. Dominance and diversity at the tree level at three stations

Species	Dominance			Evenness		
	ST1	ST2	ST3	ST1	ST2	ST3
Avicennia marina (Forssk.) Vierh.	0.02	0.01	0.01	0.12	0.10	0.09
Bruguiera gymnorrhiza (L.) Lam.	0.03	0.03	0.03	0.12	0.13	0.12
Rhizophora apiculata Blume	0.03	0.05	0.03	0.13	0.14	0.12
Rhizophora mucronata Lam.	0.02	0.03	0.04	0.12	0.13	0.13
Rhizophora stylosa Griffith	0.03	0.02	0.01	0.13	0.11	0.09
Sonneratia alba Sm.	0.02	0.02	0.03	0.12	0.11	0.12
Sonneratia caseolaris (L.) Engl.	0.01	0.01	0.01	0.10	0.10	0.10

Table 3. Mangroves with medicinal potential in the Tadu Raya Mangrove Forest, South West Aceh

Scientific name	Local name	Family	Type of mangrove	Part used	Usage	Diseases treated	Reference
Acanthus ilicifolius	*Jeruju*	Acanthaceae	Associates	Fruit	Pureed, boiled	Cough, stomachache, and itching	Ramadhan et al. (2023)
Avicennia marina	*Api-api*	Acanthaceae	Related	Leaf, fruit	Pureed	Burn and Itch	Sachithanandam et al. (2019)
Bruguiera gymnorrhiza	*Bakau merah*	Rhizophoraceae	Related	Leaf	Pureed, boiled	Burns and fever	Sasidhar and Brahmajirao (2021)
Nypa fruticans	*Nipah*	Arecaceae	Associates	Fruit	Boiled	Fever reducer and Thrush	Fikroh et al. (2021); Prasetya et al. (2024)
Rhizophora apiculata	*Bakau*	Rhizophoraceae	Related	Leaf, fruit	Pureed, boiled	Mouth ulcers, toothache, and wounds	Prasetya et al. (2024); Randongkir et al. (2019)
Rhizophora mucronata	*Bakau*	Rhizophoraceae	Related	Leaf, fruit	Pureed, boiled	Diarrhea, stomach ache, and skin wounds	Arbiastutie et al. (2021); Henny et al. (2017)
Rhizophora stylosa	*Bakau*	Rhizophoraceae	Related	Leaf, fruit	Pureed, boiled	Mouth ulcers, toothache, and wounds	Arbiastutie et al. (2021; Prasetyo et al. (2023)
Sonneratia alba	*Perepat*	Lythraceae	Related	Leaf, fruit	Pureed, boiled	Stomach ache and bruises	Mairing and Ariantari (2022); Wieke et al. (2023)
Sonneratia caseolaris	*Perepat*	Lythraceae	Related	Fruit	Pureed, boiled	Bruises, contusions, and Wounds	Audah and Anisa (2024)

Conservation status

The conservation status categories in the International Union for Conservation of Nature (IUCN) Red List for endangered species found at the research site are: *A. ilicifolius*, *A. marina, B. gymnorrhiza*, *N. fruticans, R. apiculata*, *R. mucronata*, *R. stylosa*, *S. alba*, and *S. caseolaris* are classified as Least Concern. These species are threatened by the loss of mangrove habitats throughout their range, mainly due to logging and coastal land development. Global warming may also affect coastal areas (Ellison et al. 2010). The mangrove species found at the research site are threatened by deforestation. This situation necessitates local conservation efforts to protect these species from extinction. *R. stylosa*, *R. apiculata*, *R. mucronata* are commonly found in estuarine mouths. These species are generally found in open-sea waters on fairly exposed coasts, including living coral reefs and sandy beaches. These species can grow up to 30 m and cannot grow at depths of 5-10 m. These species are resilient, but if mature plants are disturbed, they can be difficult to recover, especially in the surf zone (Duke et al. 2010a, 2010b, 2010c). Conservation is the protection, preservation, and sustainable use of natural resources to maintain ecosystem sustainability. Conservation aims to ensure that biodiversity and natural resources remain sustainable for future generations.

Sonneratia alba and *S. caseolaris* are commonly found in mangrove ecosystems. These fast-growing pioneer species can dominate coastal areas. The species experienced a 20% decline in distribution since 1980. The decline in mangrove area is due to habitat loss or logging, but has not reached the threshold for threatened status (Kathiresan 2015).

Bruguiera gymnorrhiza is widely distributed and commonly found throughout its range. Its range in South Asia includes Indonesia, Cambodia, Brunei Darussalam, China, Hong Kong, India, Japan, Malaysia, Myanmar, the Philippines, Singapore, Sri Lanka, Thailand, Vietnam, and Bangladesh. These species are found in the upper to middle estuarine zone in areas with moderate to high tides. This species is tolerant of shade and salinity up to 50 ppt. It grows relatively slowly with a low regeneration rate. It cannot tolerate high salinity and requires shade and protection from surrounding trees to survive (Duke et al. 2010a, 2010b, 2010c).

Avicennia marina has experienced a global decline in its distribution area in many regions. Globally, the distribution of this species has experienced an average habitat decline of 0.8% per year (Duke et al. 2010a, 2010b, 2010c). *A. ilicifolius* does not face serious threats, although its global population trend is unknown (Bignoli 2013). *N. fruticans* is widespread and can be found naturally in sufficient numbers. There are several local threats to this species, including habitat loss and exploitation, but it is cultivated in many areas and used for various products. Although there has been an overall decline in distribution in many areas, this decline has not reached the threshold for threatened status (Ellison et al. 2015).

Medicinal uses of mangrove

The use of mangroves as medicinal plants dates back to ancient times, and they are believed to cure various diseases. Coastal communities hold local and traditional knowledge of using mangroves to treat various diseases. The knowledge obtained from their interaction with their environment and from the traditions of their ancestors, passed down from generation to generation.

Mangrove species in Tadu Raya, located in South West Aceh, have potential as traditional medicines. Medicinal plants are species of plants considered to have certain medical benefits. The properties of medicinal plants are usually divided into three categories: traditional medicinal plants, which are used as raw materials for traditional medicines; modern medicinal plants, which have been medically validated and scientifically proven to contain bioactive compounds that function as medicinal properties; and potential medicinal plants, which may have medicinal properties but have not yet scientifically proven to have medicinal properties (Arbiastutie et al. 2021). Due to their herbal content, mangroves can be used as medicine. Their bioactive compounds have therapeutic properties, as they can treat diseases (Egra et al. 2023).

There are nine species of mangroves used for medicinal purposesby communities living around mangrove forests, supported by scientific references. These consist of seven trees, namely *A. marina*, *B. gymnorrhiza*, *R. apiculata*, *R. mucronata*, *R. stylosa*, *S. alba*, *S. caseolaris*, and two mangrove-associated plants, namely *A. ilicifolius* and *N. fruticans.* To investigate the presence of medicinal plants in this study, the research site was checked against references used as basic guidelines in pharmacology. Interviews revealed that local communities have long used plants from mangrove forests to improve their health, and data from relevant guidelines support this. Leaves and fruits are the parts of plants used for medicine. Each of these plant parts is used to treat various diseases, including bruises, burns, chickenpox, fever, diarrhea, itching, skin wounds, stomach ulcers, stomach ache, thrush, and toothache. Empirically, based on pharmacological reference guidelines, leaves and fruits contain phenolics (Hardoko et al. 2020), polyphenols (Sasidhar and Brahmajirao 2021), saponins (Sharma et al. 2024; Syafitri et al. 2021; Sasidhar and Brahmajirao 2021), steroids (Syafitri et al. 2021), carotenoids (Sasidhar and Brahmajirao 2021), alkaloid (Syafitri et al. 2021; Sasidhar and Brahmajirao 2021), flavonoid (Sharma et al. 2024). Mangroves have potential as antibacterial, anticancer, antidiabetic, antifungal, anti-inflammatory, antitumor, and antiviral agents. Various mangrove species are effective against pathogens. Mangroves contain secondary metabolites such as alkaloids, phenolics, steroids, and terpenoids (Genilar et al. 2021).

Many plants contain phytochemicals, which are considered beneficial as natural medicines (Darmadi et al. 2021). Based on scientific information, the phytochemicals found in the root bark of *R. apiculata* exhibit cytotoxicity against bioactive phytosterols (Kurniawan et al. 2023). The leaf, flowers, fruit, and young roots of *R. apiculata* can treat mouth ulcers, sore throat, wounds, toothache, lower back pain, joint disease, liver disease, hepatitis, and malaria (Randongkir et al. 2019), as well as swelling, diarrhea, and vomiting (Henny et al. 2017). (Prasetya et al. 2024). *R. apiculata* plays an important role in medicine because this plant has anticancer bioactive compounds (Kurniawan et al. 2023). *R. stylosa* is used as a remedy for mouth ulcers, wounds, toothache, lower back pain, bone disease, joint disease, liver disease, itching, and hematuria (Arbiastutie et al. 2021; Prasetyo et al. 2023). The stem of *R. mucronata* can increase insulin secretion, which enhances insulin activity and can treat stomach ulcers and hematuria (Arbiastutie et al. 2021), wounds (Henny et al. 2017) and diarrhea (Prasetya et al. 2024).

Sonneratia alba contains alkaloids, flavonoids, phenolics, saponins, and steroids, which are used to treat malaria, bruises, sprains, appendicitis, liver problems, and to increase appetite and stamina (Tamalene et al. 2021; Mairing and Ariantari 2022). *S. alba* leaf contains secondary metabolites in the form of alkaloids, flavonoids, saponins, steroids, and tannins, that function as antibacterial agents (Syafitri et al. 2021). The leaf acts as an anticholesterol agent (Musa et al. 2019). The fruit contains phenolic compounds and flavonoids that function as antidiabetics (Hardoko et al. 2020). The roots contain stigmasterol, which functions as an antioxidant (Latief et al. 2020). About 3% of mangrove plants are used as traditional herbal medicine (Wieke et al. 2023).

Avicennia marina leaf contains alkaloids, flavonoids, glucosides, lupeol, polyphenols, steroids, terpenoids, and tannins. The leaves and fruits are traditionally used to treat chickenpox, hyperglycemia, rheumatism, and ulcers; as antioxidants; for sore throats; and for skin diseases (Sachithanandam et al. 2019), as well as for itching and burns (Prasetya et al. 2024). *S. caseolaris* is used for bruises, bleeding, hemorrhoids, sprains, swelling, and worms. The bark of ripe fruit is used as a worm medicine, whereas the half-ripe fruit is used as a cough medicine. The leaves are used in the treatment of hematuria, to accelerate wound healing, for bruises, as an astringent, antiseptic, to stop bleeding, and for chickenpox (Audah and Anisa 2024). *B. gymnorrhiza* contains flavonoids, gum, hydroquinone, phenols, steroids, saponins, tannins, and triterpenoids. The leaves and fruit are traditionally used in the treatment of analgesic eye diseases, antioxidants, antihyperglycemic (diabetes), antidiarrheal, burns, constipation, fever, herpes zoster, liver disorders, pain, and worms (Sasidhar and Brahmajirao 2021).

The stem, fruit, and root of *N. fruticans* are antibacterial and can be used to treat asthma, diabetes, leprosy, mouth ulcers or thrush, and rheumatism (Fikroh et al. 2021). Antidiabetic, analgesic, pain reliever, liver, sore throat, sedative, tuberculosis (Ebana et al. 2015; Sabri et al. 2018). The leaves and roots can reduce diabetes, fever, headache, and toothache (Prasetya et al. 2024). The roots, stems, leaves, and fruits of. *A. ilicifolius* can treat asthma, antidote, blood purifier, boils, cancer, coughs, diabetes, dandruff, gum inflammation, hepatitis, hypertension, itching, loose teeth, libido enhancer, leprosy, muscle fatigue, rheumatism, stomachaches, skin burns, and worm infestation (Ramadhan et al. 2023; Henny et al. 2017).

In conclusion, the mangrove forest of Tadu Raya Sub-district, Nagan Raya District (Southwest Aceh) represents an important biocultural resource where relatively low mangrove diversity (H´ = 0.83-0.89) still supports a clearly defined set of medicinal plants and associated local knowledge. Across three stations and growth stages, nine medicinal species were documented, comprising seven true mangroves (*A. marina*, *B. gymnorrhiza*, *R. apiculata*, *R. mucronata*, *R. stylosa*, *S. alba*, *S. caseolaris*) and two mangrove-associated taxa (*A. ilicifolius* and *N. fruticans*), used by communities to treat ailments such as thrush, toothache, wounds, diarrhea, abdominal pain, bruises, fever, chickenpox, itching, cough, and stomach complaints. Vegetation structure was strongly shaped by key Rhizophoraceae taxa, with *R. apiculata* showing the highest importance values at Stations 1 and 2, while Station 3 was dominated by *R. mucronata*, reflecting site-specific environmental filtering across the coastal-to-inland gradient. Although all recorded species are categorized as Least Concern, the manuscript highlights ongoing pressures from habitat loss and coastal development, implying that conservation actions are still warranted to maintain both ecosystem function and ethnomedicinal services. Overall, the study provides baseline documentation that can support mangrove management, community education, and future work to validate pharmacological efficacy and strengthen sustainable use.

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