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Mangrove flora as an ecotourism attraction in the Perancak Mangrove, Jembrana Bali

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Abstract

The coastal mangroves of Perancak Jembrana Village cover an area of around 177.09 hectares, some of the area (around 10 ha) has been developed into a tourist attraction. The tourism being developed is ecotourism based on ecology, biodiversity, conservation of natural resources, environmental education and economic empowerment of local communities. The aim of the research is to identify and describe the diversity of mangrove flora. Analysis of mangrove vegetation uses the square method, the parameters determined are the number of individuals of each species, the area of canopy cover for each species and the frequency of presence. Diversity was calculated with the Shanon-Wiener index. The research results showed that in the Perancak ecotourism area, 25 mangrove flora were found, consisting of 16 species of true mangrove flora and nine species of associated mangroves. The species that dominate are *Rhizophora mucronata* (important value 52.63), *Rhizophora apiculata* (important value 31.93), *Avicennia marina* (28.70), *Rhizophora stylosa* (important value 24.81), *Avicennia officinalis* (important value 17, 73) and *Sonneratia alba* (important value 16.39). The diversity index (H) is 2.89 and the species evenness index is 0.90. Species diversity in mangrove vegetation with a diversity index >1 and evenness approaching 1 means that the condition of the Perancak mangrove is in the stable/good category. Interpretation of the diversity of mangrove flora, habitus characteristics, fruit morphology, root types, typical substrate types is an interesting attraction for ecotourism activities.

Keywords: *Mangrove flora*; Interpretation; Ecotourism attractions; Perancak mangroves

1. Introduction

The coastal mangrove forest area of Perancak Jembrana Village covers an area of around 177.09 hectares, some of the area (around 10 ha) has been developed into a tourist attraction. The tourism developed in this mangrove area is "Pancak-Bali mangrove ecotourism". The development is managed by the Perancak Traditional Village-Owned Enterprise (BUM-Desa) and under the auspices of the Jembrana Regency Government and the Ministry of Maritime Affairs and Fisheries, for Ecotourism. Ecotourism activities are based on three concepts, namely the preservation of mangrove forest flora and fauna is maintained, there is sustainable economic value and local communities play a role in its management. In this area, several supporting facilities for ecotourism activities were built, including a wooden track for tracking, a ticket booking office, ecotourism information boards and toilets. All facilities are built with an environmentally friendly concept [8,14].

Mangrove forests in general have a diversity of mangrove vegetation consisting of a group of true mangroves which generally grow in the back, middle and front zones and associated mangroves, which are land plants that are able to adapt to the conditions of the mangrove habitat, especially in the back zone of the mangrove. Several species of true mangrove plants in the Perancak mangrove have been reported by Gultom et al. (2021) [8] and Kartikasari and Sukojo (2015) [12] including the species *Rhizophora* spp., *Avicennia* spp., *Bruguiera* sp., *Sonneratia* spp. and *Nypa* sp. The diversity of mangrove flora is also important for providing habitat for various fauna including birds, mollusks, crustaceans, reptiles and fish.

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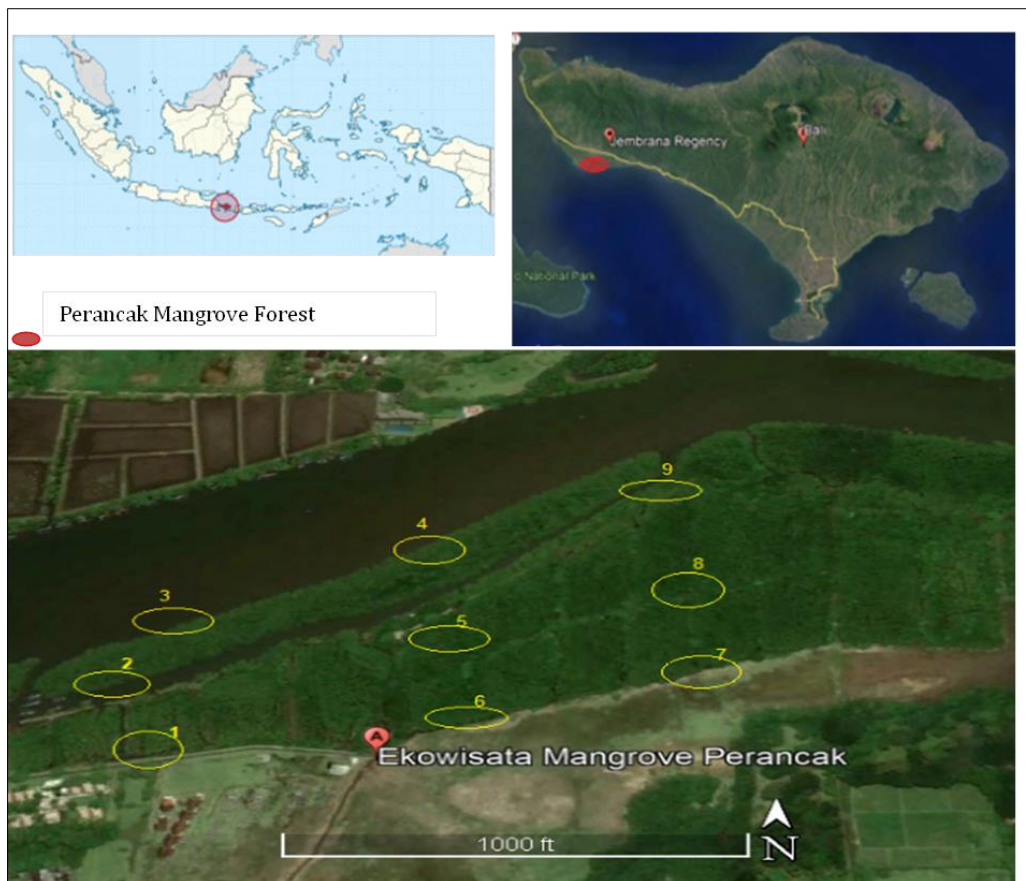
Ecotourism in mangrove areas is based on three main pillars, namely ecology, which is a vehicle for nature conservation, sustainable economics and empowerment of surrounding (local) communities [3, 11,17, 19]. Recently, the paradigm of mangrove forest use has changed from land conversion for fisheries to sustainable use. Which means utilization while maintaining the ecology of the mangrove ecosystem. One of the sustainable management efforts is to utilize the mangrove ecosystem for ecotourism activities [9, 16, 20].

The development of mangroves for ecotourism is not just about the beauty/uniqueness of the flora and fauna, the uniqueness of the habitat and the facilities provided, but it is also important to have a biological and ecological interpretation of the diversity of existing mangrove flora. Interpretation of mangroves can be based on the ecological aspects of vegetation, their unique species diversity, their typical root types (stilt roots, pneumatophores, knee roots), their various fruit shapes (ball-like, chili-like, heart-shaped, bean-shaped), their unique growing habitat, namely in intertidal (tidal) area. Considering that the Perancak mangrove area is rich in mangrove flora diversity and the importance of interpreting the diversity of mangrove flora for ecotourism attractions, this research aims to identify and describe mangrove species in the Perancak Jembrana Mangrove area.

2. Material and methods

2.1. Time and Location

The research will be carried out in April-June 2023 , field surveys will be carried out 6 times in 3 months. The research was conducted in the Perancak Jembrana mangrove ecosystem area. Sampling was carried out at 9 sites/locations, with a distance of 150 m between one site and another (Figure 1).



(Map source : google earth, image © 2022 Maxar)

Figure 1 Map of research location

2.2. Methods

Analysis of mangrove vegetation. Mangrove vegetation was analyzed using the square method at nine mangrove habitat sites. The vegetation parameters measured in each square plot are the number of individuals of each species and the

area of species cover in the sampling plot. The density of each species is determined based on the number of individuals per sampling area, the dominance of each species is determined based on the estimated canopy cover area relative to the plot area and the frequency of presence is determined based on the number of plots a particular species is found. Identify mangrove plant species. Identify species of mangrove plants based on the following characteristics: habitus (herbs, shrubs, trees); root type (stiltroot, knee root, pneumatophore root, buttress root, normal root); fruit type (cylindrical, ball, heart, bean-like); inflorescence type and flower color; leaf shape and leaf layout. The characteristics of each species were photographed with a digital camera. Identification was carried out at the species level referring to Kitamura *et al.* (1997) [22].

2.3. Data analysis

The diversity of mangrove flora is calculated using the Shannon-Wiener diversity index (H), where $H = -\sum [ni/N \times \ln ni/N]$, where ni = the importance of the i th species and N = the total importance of all species. The important value is determined from the sum of the relative values of the parameters density (Kr), dominance (Dr) and frequency of presence (Fr), so that $ni = Kr + Dr + Fr$. Relative density (Kr) = $(Ki/\sum K) \times 100\%$, where Ki = density of species- i , $\sum K$ = total density of all species. Relative dominance (Dr) = $(Di/\sum D) \times 100\%$, where Di = dominance of the i th species, $\sum D$ = total dominance of all species. Relative frequency (Fr) = $(Fi/\sum F) \times 100\%$, where Fi = frequency of presence of species- i , $\sum F$ = total frequency of all species. Diversity index values are grouped into three categories, namely $H < 1.0$, including the low category; $1.0 < H < 3$, including the moderate category; and $H > 3$, including the high category [2, 18].

3. Results and discussion

3.1. Diversity of Perancak Mangrove Flora

Each mangrove plant species has unique morphological characteristics (habitus, roots, leaves, flowers and fruit), this is the basis for species identification. These characteristics include the root system (support roots, knee roots, breath roots), fruit type (spherical shape, cylindrical, like beans/chilies, like a vase, heart shape), and the growth zone in the mangrove area. Species of mangrove plants in the Perancak ecotourism area have identified 16 species of true mangrove plants and 10 associated mangrove plants. Of the 16 true mangrove species, 12 species are in the major group (major component), species that can form pure stands and 4 species in the minor group (minor component). True mangrove plant species with their characteristics are presented in Table 1.

Table 1 Characteristics of true mangrove plant species in the Perancak Ecotourism area

No	Species	Local name (English name)	Characteristics
1	<i>Rhizophora mucronata</i>	Bakau genjah (Black mangrove)	Tree habitus, tree height reaches 20 m; stilt roots with pale white root bark; single leaf, opposite layout, elliptical leaf shape, aristate/apiculate tip, widest leaf among the Rhizophora genus (length ± 18 cm); Samosa compound flowers, 4-8 flowers, 4 white crowns, 4 green petals; cylindrical fruit with a green-yellow hypocotyl, fruit length about 65 cm.
2	<i>Rhizophora apiculata</i>	Bakau merah (Red mangrove)	Tree habitus, reaching 14 meters high; stilt roots with reddish root skin; single leaf, opposite layout, leaf blade elliptical, tip apiculate; cylindrical fruit with a green-brown hypocotyl, fruit length about 24 cm.
3	<i>Rhizophora stylosa</i>	bakau kurap (white mangrove)	Shrub habitus, up to 6 meters high; stilt roots with white root skin; single leaf, opposite layout, elliptical leaf shape, aristate tip; Samosa compound flowers, 8-18 flowers on each stalk, 4 white corollas, 4 lobed petals yellowish green, 8 stamens; cylindrical type fruit with a yellowish-green hypocotyl, fruit diameter about 2 cm, length about 30 cm
4	<i>Avicennia marina</i>	Api-api (Gray mangrove or white mangrove)	Tree habitus, height reaches 8 m; respiratory roots (pneumatophore/pencil-like); single leaf, opposite layout, elliptical leaf sheet; compound flowers, 4 flower crowns, yellow and slightly orange, 5-lobed petals, 4 stamens; The fruit has a rounded tip with a short beak shape, the diameter of the fruit is about 2 cm, the length is about 2 cm, the color of the fruit is pale green, the surface of the fruit has smooth hair.

5	<i>Avicennia officinalis</i>	Api-api/sia-sia putih Indian mangrove	Tree habitus, height reaches 8 m; pencil root (Pneumatophore); single leaf, opposite layout, obovate-elliptical leaf shape, rounded tip; spika compound flowers, 7-10 flowers on each stalk, crown 4 yellow, petals 5 lobes; fruit heart shape pale yellow, diameter about 2.5 cm, length about 3 cm.
6	<i>Sonneratia alba</i>	Prapat/pidada (Mangrove apple)	The habitus of the tree, often referred to as apple mangrove, reaches 15 meters in height; respiratory roots (pneumatophores); single leaf, oblong sheet, opposite leaf layout; Flowers with 6-8 lobed petals, green and red inside, white corolla, many stamens; ball-shaped fruit with smooth surface, green color, fruit the size of an apple (diameter about 4-7 cm).
7	<i>Sonneratia caseolaris</i>	Pidada merah (Mangrove apple)	Tree habitus, up to 15 meters high; respiratory roots (pneumatophores); single leaf, oblong sheet, opposite leaf layout; Flowers with 6-8 lobed petals, green and red inside, red corolla, many stamens; ball-shaped fruit, smooth, glossy surface, green, fruit the size of an apple (diameter about 6-8 cm)
8	<i>Xylocarpus molucensis</i>	Nyiri batu (Mollucas)	The tree is between 5-20 m high. Has a cup-shaped respiratory root. The bark is smooth, while the main stem has deep scratches on the surface. The leaves are arranged in pairs (generally 2-3 per stalk) and some are solitary. Unit & location: compound & opposite. Shape: elliptical - inverted ovoid. Tip: tapered. Flower clusters (6-18.5 cm long) emerge from the axils of the leaf stalks and the flower stalks are 2-10 mm long. Location: in the armpit. Formation: random clusters (10-35 flowers per cluster). Corolla: 4; yellowish white, oval, rounded edges, 6-7 mm long. Petals: 4 lobes; yellowish green, about 1.5 mm long. Stamens: 8, fused; creamy white. The fruit is green, round like a Bangkok guava, the surface is skinned and inside there are 4-10 tetrahedral shaped seeds. Size: fruit: diameter 8-15 cm.
9	<i>Xylocarpus granatum</i>	Nyirih (Cannonball Mangrove)	The tree's habitus can reach a height of 10-20 m. It has plank roots that spread to the sides, twisting and forming gaps. The bark is light brown-yellowish, thin and peeling, while on young branches, the bark is wrinkled. Leaves are paired (generally 2 pairs per stem) and some are solitary. Unit & Location: compound & opposite. Shape: inverted elliptical-ovoid. Edge: rounded. Flowers consist of two sexes or female only. The flower clusters (2-7 cm long) emerge from the base (axil) of the leaf stalk and the flower stalk is 4-8 mm long. Location: in the armpit. Formation: random clusters (8-20 flowers per cluster). Corolla: 4; oval, rounded edges, greenish white, 5-7 mm long. Petals: 4 lobes; light yellow, 3 mm long. Stamens: creamy white and fused in a tube. Fruit like a ball (coconut), weight can be 1-2 kg, skinned, brownish green. Inside the fruit there are 6-16 large seeds, woody and tetrahedral in shape.
10	<i>Xylocarpus rumphii</i>	Nyirih, Nyirih batu (Cedar mangrove)	The tree's habitus height can reach 6 m. Has aerial roots but not obvious. The rough bark is brown and peels off like small, narrow stripes. The leaves are paired (generally 3-4 pairs per stem) and some are solitary. Dark green color. Unit & Location: compound & opposite. Shape: oval-elongated. Edge: tapered. Flower corolla: 4; cream-greenish white. Petals: 4 lobes; yellowish green. Stamens: fused to form a tube; creamy white. Green, round like a Bangkok guava, smooth, shiny surface and inside there are 4-10 tetrahedral shaped seeds. Size: fruit: about 8 cm in diameter (fruit size is slightly smaller than <i>X. granatum</i>)
11	<i>Excoecaria agallocha</i>	buta-buta (Blind tree)	Tree habitus, up to 10 m high; has no aerial roots; single leaf, alternate layout, elliptical leaf shape, acute tip; Spica inflorescences, yellowish green, milky white gummy, dangerous if in contact with eyes/skin, fruit in the form of 3 combinations of small balls, fruit diameter about 0.5 cm, green.
12	<i>Bruguiera cylindrica</i>	Tanjang putih/lindur (Oriental mangrove)	Habitus is an evergreen tree, with knee roots and plank roots that spread to the sides at the base of the tree, the height of the tree sometimes reaches 23 meters. The bark is gray, relatively smooth and has a number of small lenticels. The bright green leaves are slightly yellowish green on the underside. Unit & Location: simple & opposite. Shape: elliptical. Tip: slightly

			tapered. Flowers in clusters, appearing at the end of the bunch (bundle length: 1-2 cm). The outer side of the lower flower usually has white hairs. Location: at the tip or armpit of the flower stalk/bundle. Formation: at the tip or axil of the flower stalk/bundle. Crown leaves: white, then turn brown as they get older, 3-4 mm. Flower Petals: 8; yellowish green, bottom like a tube. The hypocotyl (often confused with fruit) is elongated cylindrical, often curved. Green near the base of the fruit and purplish green at the tip. The base of the fruit is attached to the flower petals. Size: Hypocotyl: 8-15 cm long and 5-10 mm in diameter
13	<i>Bruguiera gymnorhiza</i>	Tanjang (Black mangrove)	Tree habitus, height ± 15 m; knee roots and small buttris roots at the base of the stem; single leaf, opposite layout, elliptical sheet shape, acuminate tip; large flowers, white-brown crown, red petals with 10-14 lobes; cylindrical fruit, fruit color dark green-brown, smooth surface, diameter about 1.9 cm, length about 22 cm.
14	<i>Ceriops tagal</i>	Mentigi (Yellow mangrove)	The tree's habitus reaches a height of 5 m; roots are buttres-shaped at the base, and develop into knee roots; single leaf, opposite layout, obovate leaf shape rounded tip; compound flowers, 5 white and brown crowns, 5 lobed green petals; cylindrical type fruit, fruit diameter about 1 cm, length about 20 cm, green-brown color.
15	<i>Ceriops decandra</i>	Kenyongnyong (Decandra mangrove)	Shrub habitus, up to 3 m high; roots like stilt roots with a plank shape at the base; single leaf, opposite layout, leaf blade obovate, rounded tip; Flowers are clustered, located in the leaf axils, with 2-4 flowers per group, 5 petals, white and brownish when old, 2.5-4 mm long, 5 flower petals green. The specific epithet "decandra" means ten males, referring to the number of stamens on the flower being 10; The fruit is cylindrical, the fruit diameter is about 1.1 cm, the length is about 14 cm, the surface of the fruit is warty, the color is brown to dark red when rip.
16	<i>Nypa fruticans</i>	Nipah (Nipa palm)	Habitus is a palm without a trunk on the surface, forming clumps. Stems are underground, strong and strong. Height can reach 4-9 m. The arrangement of the leaves is like the arrangement of coconut leaves. Length of bunch/leaf handle 4 - 9 m. There are 100 - 120 pinnate leaves on each leaf cluster, shiny green on the upper surface and powdery on the bottom. Shape: lanceolate. Edge: tapered. Andans of bisexual flowers grow from near the top of the stem on stalks 1-2 m long. The female flowers form circular heads 25-30 cm in diameter. Bright yellow male flowers. The fruit is round, brown, stiff and fibrous. On each fruit there is one egg-shaped seed. Size: fruit head diameter: up to 45 cm. Seed diameter: 4-5 cm.

Some true mangrove flora show unique characteristics, including the unique supporting root system of *Rhizophora mucronata* and *Rhizophora stylosa*, the type of fruit (propagule) which is cylindrical in *Rhizophora mucronata*, *Rhizophora stylosa*, *Bruguiera gymnorhiza* and *Ceriops decandra*, the spherical fruit of *Sonneratia alba* and Heart-shaped fruit on *Avicennia marina* (Figure 2)



(A: *Rhizophora mucronata*; B. *Rhizophora stylosa* ; C: *Avicennia marina*; D: *Sonneratia alba*; E: *Bruguiera gymnorrhiza*; F: *Ceriops decandra*)

Figure 2 Several characteristics of mangrove flora in the Perancak mangrove forest

The results of the analysis of true mangrove vegetation found 16 types of true mangrove plants. The dominant species were *Rhizophora mucronata* (important value 52.63), *Rhizophora apiculata* (important value 31.93), *Avicennia marina* (28.70), *Rhizophora stylosa* (important value 24.81), *Avicennia officinalis* (important value 17.73) and *Sonneratia alba* (important value 16.39). The dominant species are all major component mangroves. Wijaya *et al.*, 2023 [21], also noted that these mangrove species are quite dominant in the mangrove forests of Nusa Lembongan and Ngurah Rai Park Forest. Ewaldo *et al.* 2023 [4] also found several species of true mangroves that are quite common in the Pantai Indah Kapuk ecotourism area, Jakarta. The species *Bruguiera cylindrica*, *Bruguiera gymnorrhiza*, *Ceriops tagal* and *Nypa fruticans* are rarely found (low importance), even though these species are a major mangrove group [22]. This can be a concern regarding mangrove conservation in the aspect of replanting, but still pay attention to the suitability of the type of growing substrate. The diversity index (H) is 2.89. Species diversity in mangrove vegetation with a diversity index >1

is in the good category. Thus, the mangrove community in the Perancak ecotourism area is included in the good (good) category. The diversity of mangroves (true mangroves) in Perancak is presented in Table 2.

Table 2 Diversity of mangrove flora in the Perancak Mangrove Forest

no	Species	Vegetation group	Relative density	Relative dominance	Relative frequency	Importance Value
1	<i>Rhizophora mucronata</i>	major components	14.29	31.67	6.67	52.63
2	<i>Rhizophora apiculata</i>	major components	11.69	13.57	6.67	31.93
3	<i>Rhizophora stylosa</i>	major components	9.09	9.05	6.67	24.81
4	<i>Avicennia marina</i>	major components	12.99	9.05	6.67	28.70
5	<i>Avicennia officinalis</i>	major components	6.49	6.79	4.44	17.73
6	<i>Sonneratia alba</i>	major components	5.19	4.52	6.67	16.39
7	<i>Sonneratia caseolaris</i>	major components	5.19	2.26	4.44	11.90
8	<i>Xylocarpus molucensis</i>	minor components	1.30	2.26	4.44	8.01
9	<i>Xylocarpus granatum</i>	minor komponen	2.60	1.36	4.44	8.40
10	<i>Xylocarpus rumphii</i>	minor components	1.30	0.90	4.44	6.65
11	<i>Excoecaria agalloca</i>	minor components	2.60	4.52	6.67	13.79
12	<i>Bruguiera cylindrica</i>	major components	3.90	0.90	2.22	7.02
13	<i>Bruguiera gymnorhiza</i>	major components	3.90	2.26	2.22	8.38
14	<i>Ceriops tagal</i>	major components	1.30	0.90	2.22	4.43
15	<i>Ceriops decandra</i>	major components	1.30	1.36	4.44	7.10
16	<i>Nypa fruticans</i>	major components	1.30	0.90	2.22	4.43
17	<i>Hibiscus tiliaceus</i>	mangrove association	2.60	0.90	2.22	5.72
18	<i>Clerodendondron inerme</i>	mangrove association	1.30	0.90	2.22	4.43
19	<i>Calotropis gigantea</i>	mangrove association	1.30	1.36	2.22	4.88
20	<i>Eupatorium odoratum</i>	mangrove association	2.60	0.45	4.44	7.49
21	<i>Leucaena leucocephala</i>	mangrove association	1.30	0.45	2.22	3.97
22	<i>Acanthus ilicifolius</i>	mangrove association	1.30	0.90	2.22	4.43
23	<i>Terminalia cattapa</i>	mangrove association	1.30	0.60	1.10	4.88
24	<i>Sesuvium portulacastrum</i>	mangrove association	1.30	0.90	4.44	6.65
25	<i>Acrostichum aureum</i>	mangrove association	2.60	0.45	2.22	5.27
26	<i>Euphorbia tirrucali</i>	mangrove association	14.29	0.76	1.12	52.63

3.2. Mangrove Ecotourism

Sustainable use of mangroves is based on the concept of ecotourism referring to 3 main pillars, namely the value of empowering local communities in management, ecology and economic value [1,10, 19, 20]. The use of mangroves on the Perancak Coast has fulfilled the 3 pillars of ecotourism. In terms of community empowerment, the mangrove area is managed by the Perancak Traditional Village-Owned Enterprise (BUM-Desa) and under the auspices of the Jembrana Regency Government and the Ministry of Maritime Affairs and Fisheries whose members are the community, local community leaders who care about coastal environmental conservation. The ecological value of mangroves is maintained by the ecosystem and diversity of flora and fauna, and replanting efforts on open land continue to be carried out. In terms of economic value, this area was developed for educational tourism, research or natural recreation, both

for students and the general public. Tourists receive education about the ecological value and role of mangrove biodiversity for the coastal environment. For educational tourism programs, tours exploring mangroves, research on types of mangroves, Perancak mangrove ecotourism has built trails and huts/resting points made of wood. This trail was created with environmentally friendly principles and causes minimal damage to mangrove forests (Figure 3). These trails were created to make it easier for tourists to enter the mangrove area while getting to know the mangrove species, the typical characteristics of mangroves and the type of mangrove habitat (mud flats).

Several mangrove forest areas in Bali have also been developed for ecotourism activities, including the Segara Batu Lumbang, Pemogan, Kampong Kepiting, Tuban Badung mangroves, Nusa Lembongan mangroves and Pejarakan village mangroves. Ecotourism in mangrove forests makes the uniqueness, specificity of mangrove flora and habitat types a tourist attraction. Ecotourism development in the area also prioritizes the empowerment of local communities [6,7].



Figure 3 Trail at the Perancak Mangrove Ecotourism for access to the mangrove forest

The management of the Perancak mangrove forest for ecotourism is in line with the recommendations presented by Friess (2017) [5], namely that mangrove forest management must be based on five principles, namely; (1) diversity of natural attractions with unique flora and fauna, good environmental conditions for the survival of flora and fauna (2) There is educational value, meaning that tourism activities can provide environmental experiences and education, interpretive experiences and support environmental awareness and understanding of community culture, (3) there are benefits and participation of local communities. By participating in ecotourism activities, for example as a scout, providing transportation or food services, local communities can earn additional income while ensuring the conservation of biodiversity in their environment, (4) Encourage conservation awareness. Ecotourists are usually willing to volunteer or contribute to conservation activities in the area, this can be in the form of identifying flora and fauna, participating in ecosystem restoration projects and helping with plastic waste collection. In return, tourists get the satisfaction of having contributed to conservation. Providing awards or certificates that show that they have contributed to environmental protection can increase tourists' initiatives towards conservation, (5) Low impact and sensitivity to the environment are strategies to minimize the negative impacts of ecotourism activities. Mangrove forest management in Perancak is also in accordance with Government Regulation no. 73, 2012 [15] concerning the national strategy for managing mangrove ecosystems. This regulation clearly states that mangrove ecosystem management is an effort to preserve, protect and utilize mangroves for the welfare of the community. Preservation means that the diversity of individuals, species and ecosystems of mangroves must be maintained. Protection means the existence of a mangrove ecosystem. So, these government regulations are in line with the concept of ecotourism.

Duangjai *et al.* (2014) [3] stated that the existence of mangrove plants as an asset in ecotourism management can be based on the number of true mangrove species, namely true mangrove < 2 species is a low category; if 2-5 species are medium category; and >6 species are in the high category. Furthermore, Sari *et al.* (2015) [21] stated that the suitability of mangrove forest ecosystems for ecotourism activities can be viewed from the diversity of mangrove plant types (species richness), mangrove density (number of individuals/m²), mangrove thickness (length of the mangrove ecosystem from the coast to land), perception surrounding communities and also the condition of the mangrove forest. In terms of species richness, the species diversity of the Perancak mangrove area is included in the high category as an ecotourism asset, namely 16 types of true mangroves and 10 species of mangrove-associated plants. In terms of mangrove conditions in this area, it is still classified as good/stable based on the diversity index.

4. Conclusion

In the Perancak mangrove forest, 25 mangrove flora were found, consisting of 16 species of true mangrove flora and nine species of associated mangroves. Species diversity is in the moderate category (diversity index 2.89), which indicates that the Perancak mangrove forest is in good condition. The diversity of mangrove flora species, the unique characteristics of the root system, flower morphology, fruit morphology, leaves and growing substrate provide an interesting interpretation for ecotourism activities

Compliance with ethical standards

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Disclosure of conflict of interest

We declare that there are no conflicts of interest in the research and writing of this manuscript.

Author's declaration

We declare that the research process from planning to collecting data in the field, data analysis and writing scientific manuscripts is the result of the collaboration of all authors

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