Ecological suitability of mangrove tourism_Bioflux Journal

by Rignolda Djamaluddin 17

Submission date: 24-Jul-2023 10:05AM (UTC+0700)
Submission ID: 2135777321
File name: Ecological_suitability_of_mangrove_tourism_Bioflux_Journal.pdf (401.34K)
Word count: 4676
Character count: 24252

Ecological suitability of mangrove tourism in Mantehage Island as the outermost small island in North Sulawesi, Indonesia

Esry T. Opa, Rene C. Kepel, Ridwan Lasabuda, Janny D. Kusen, Carolus P. Paruntu, Rignolda Djamaluddin, Farnis B. Boneka, Desy M. H. Mantiri

Faculty of Fisheries and Marine Science, Sam Ratulangi University, Manado, North Sulawesi, Indonesia. Corresponding author: R. C. Kepel, renecharleskepel65@gmail.com

Abstract. Mantehage Island is the outermost small island located in North Minahasa Regency, North Sulawesi Province, Indonesia, and is included in the Bunaken National Park. Mantehage Island is surrounded by mangroves and has the potential to be developed into an ecotourism location as well as a conservation-based economic alternative. The criteria/parameters used to determine the suitability of ecotourism land are emphasized on the condition of the mangrove ecosystem resources. This study aims to determine the suitability of mangrove land for ecotourism in Mantehage Island. This study uses a continuous quadratic method. There are 3 stations: I) Paniki Island; II) West Mantehage; III) East Mantehage. At each station, measurements and data collection were carried out in the form of mangrove species, species density, mangrove thickness, biota, analysis of the ecological suitability of mangrove ecosystems, and tides. All field values of each parameter measured were divided into categories, and values of each parameter are the multiplication of the field value and the score. The suitability index was calculated from percent ecological level based on the total value of all parameters. Results showed that station I had 5 mangrove species, with a density of 9.21 ind 100 m^{-2}, thickness of 297.3 m, and 12 biota groups. Station II had 4 mangrove species with a density of 15.50 ind 100 m^{-2}, thickness of 355.3 m, and 16 biota groups. Station III had 8 mangrove species with a density of 24.15 ind 100 m^{-2}, thickness of 234.8 m, and 17 biota groups. All stations had mean tide of 1.9 m. The ecological suitability index was 1.85 for station I, 2.35 for station II, and 2.50 for station III. These data classified station I as not suitable, station II as suitable, and station III as very suitable to develop as an ecotourism area.

Key Words: biota, density, mangrove thickness, tides, tourism development.

Introduction. North Sulawesi Province has 12 outermost islands, one of which is Mantehage Island, which is located in the North Minahasa Regency, Indonesia. Mantehage Island is designated as one of the outermost small islands of Indonesia, bordering the Philippines (Presidential Decree No. 6 of 2017 on the Determination of The Outermost Small Islands). Mantehage Island is included in the northern part of Bunaken National Park surrounding the island and overgrown with mangroves. This island area has 18.56 km^2 and contains 4 villages: Buhias, Tinongko, Bango, and Tangkasi (Opa et al 2019).

Small islands are defined based on 2 main criteria, namely the area of the island and the number of its inhabitants (Republic of Indonesia Law No. 27/2007). A small island has less than or 2000 km^2. In addition to these main criteria, some of the characteristics of small islands are: ecologically separate from main islands (mainland), clear and remote physical limits off the main island habitat, thus being insular; a large number of endemic species and typical and high-value diversity; unable to affect hydroclimate; a relatively small catchment area; social, economic and cultural characteristics of small island communities are typical compared to the main island.

The populations of outermost small islands have 3 main concerns: security and defence issues, welfare, and the environment/ecosystem. The potential of small islands outside the border is considerable and economically valuable, with a high environmental quality, so that it can be developed to improve the welfare of local people. Djamaluddin (2018) found 20 species of mangroves around Mantehage Island. There needs to be innovative efforts in utilizing all the potential mangrove ecosystems in this region to improve the welfare of local communities while maintaining sustainability. With the characteristic advantages of its natural resources, mangrove ecosystems in Mantehage Island have the potential to be developed into eco-tourism products. Ecotourism can be a conservation-based economic alternative due to the absence of negative environmental impacts (no destruction or extractive measures) (WWF 2009). By enforcing the concept of ecotourism, people can sell the beauty of nature that is still intact, culture, and local history, without damaging mangrove areas. This is in line with research of de Vasconcellos Pegas et al (2013), Shoo & Songorwa (2013), and Widodo et al (2018) on ecotourism, which has some positive impacts such as improving the community economy, empowering local communities, and conservation and environmental preservation. According to Gigovic et al (2016), to reduce the negative impact on the environment caused by conventional tourism, the concept of ecotourism as a form of tourism is increasingly important because it can contribute to the continuity of environmental protection and development of an area.

In mangrove ecotourism development, the main steps that need to be reviewed and identified are the condition and potential of ecotourism in the region. Given that the concept of ecotourism places more emphasis on the nature, peculiarities, and authenticity of natural resources, then the criteria/parameters used to determine the suitability of ecotourism land should focus on the resource conditions of the mangrove ecosystem. Determination of the suitability of mangrove ecotourism land is based on the multiplication of weights and scores obtained from each measured parameter (Yulianda 2019).

The present study aims to determine the suitability of mangrove land for ecotourism of Mantehage Island. The results of this research are expected to be considered in the development and management of ecotourism activities in the mangrove forest area of Mantehage Island.

Material and Method

Sampling sites. The study was conducted in Mantehage Island, Wori District, North Minahasa Regency, North Sulawesi Province (Figure 1), from May to July 2019.

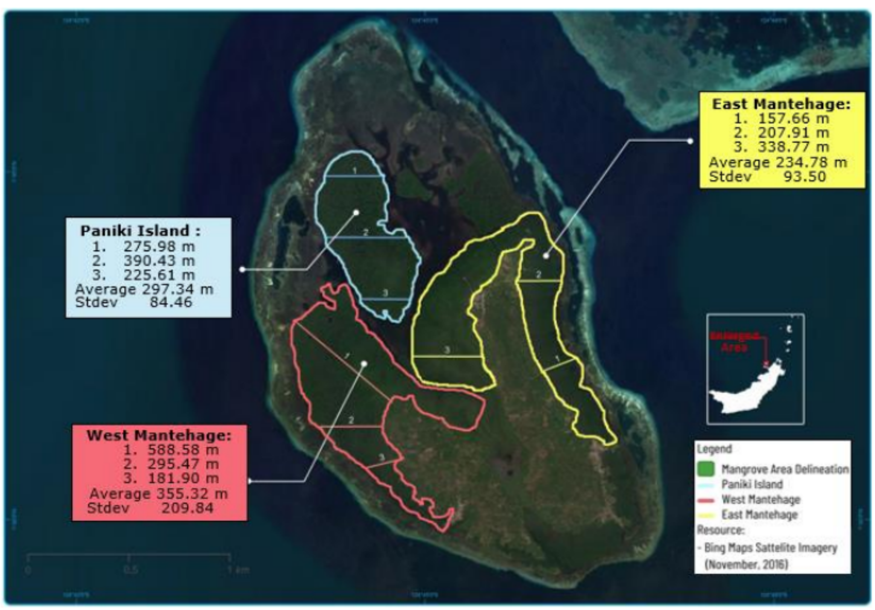

Figure 1. Map of sampling sites, Mantehage Island, Indonesia.

There are 3 stations selected as representative research points in connection with the purpose of this research. The study used primary data and secondary data. Mangrove cover data that has been collected includes density, thickness, tides, and biota associated with mangrove ecosystems. Data on mangrove species and their density was collected on 3 transect lines perpendicular to the shoreline towards land. 3 sampling plots were selected in each transect line, namely Q1 (near the sea), Q2 (middle), and Q3 (terrestrial) (Table 1). Each sample plot was divided in observational plots in line with growth level, i.e. seedling (diameter<2 cm) in 1x1 m^2 plot (A), sampling (diameter 2-10 cm) at 5x5 m plot (B), and tree (diameter≥10 cm) in 10x10 m plot (C) (RSNI 2011; Mariati 2016; Istomo et al 2017) (Figure 2).

Table 1

Coordinates point of sampling sites

Station	*Transect line (LT)*	*Coordinates*					
		Q1		*Q2*		*Q3*	
		Longitude	*Latitude*	*Longitude*	*Latitude*	*Longitude*	*Latitude*
I	LT 1	124°44' 08.77"E	01°44' 57.84"N	124°44' 23.65"E	01°44' 57.83"N	124°44' 38.53"E	01°44' 57.81"N
	LT 2	124°44' 08.36"E	01°44' 26.06"N	124°44' 29.41"E	01°44' 26.04"N	124°44' 50.47"E	01°44' 26.03"N
	LT 3	124°44' 27.42"E	01°43' 54.13"N	124°44' 39.59"E	01°43' 54.07"N	124°44' 51.75"E	01°43' 54.01"N
II	LT 1	124°43' 53.03"E	01°43' 42.64"N	124°44' 17.42"E	01°43' 22.20"N	124°44' 41.81"E	01°43' 01.77"N
	LT 2	124°44' 05.90"E	01°42' 48.08"N	124°44' 21.83"E	01°42' 48.13"N	124°44' 37.76"E	01°42' 48.19"N
	LT 3	124°44' 28.96"E	01°42' 26.57"N	124°44' 38.48"E	01°42' 28.96"N	124°44' 48.00"E	01°42' 31.34"N
III	LT 1	124°46' 17.42"E	01°43' 23.30"N	124°46' 09.48"E	01°43' 20.24"N	124°46' 01.55"E	01°43' 17.17"N
	LT 2	124°46' 09.74"E	01°44' 03.65"N	124°45' 58.53"E	01°44' 03.61"N	124°45' 47.32"E	01°44' 03.58"N
	LT 3	124°44' 53.15"E	01°43' 24.50"N	124°45' 11.41"E	01°43' 24.46"N	124°45' 29.68"E	01°43' 24.42"N

Note: Q1 - quadrant 1 (area near the sea); Q2 - quadrant 2 (mid-area); Q3 - quadrant 3 (area towards land).

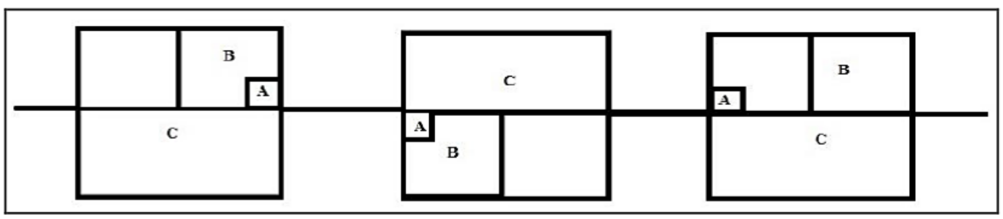

Figure 2. Sampling unit design (line transect method).

The number of species was recorded for each sample tile, includes trees, stands, and seedlings. The species were also identified. Observations were carried out perpendicularly from the coastline towards land. Mangrove thickness was measured on each station's transect line. To identify biota associated with mangroves, such as fish, shrimp, mollusks, crustaceans, and birds, the proposed documentation used digital cameras. Tidal data was obtained from the TNI AL (Indonesian Navy) Hydrographic and Oceanography Center (2019). Equipment used included GoPro Hero+ camera, line meters (1.5 m and 50 m), Garmin eTrex 10 Global Positioning System (GPS), data recording paper, wooden poles, plastic ropes, plastic bags, and mangrove identification manuals.

Determined parameters and data analysis. Mangrove thickness measurements were conducted using GPS, ArcGIS 10.2.2 software, and images from Bing Maps on each transect line at all three research sites.

Estimation of mangrove species (number of species per unit of area) was carried out using the following formula (Bengen 2001):

$$Di = ni/A$$

Where: Di - species density (ind m^{-2}); ni - the total number of species i; A - sampling area.

Species identification used mangrove identification guidelines (Rusila et al 2006). Mangrove-related animals were collected and identified using a guide book (Setyawan et al 2002).

Several environmental parameters are used in determining the potential mangrove ecosystem development, namely density, type, tides, and biota that live in mangrove ecosystems. The suitability of mangrove tourism has taken into account 5 parameters. Each parameter is rated separately, with 4 classification scoring values (Table 2). The determination of ecological conformity of mangrove ecology was based on the multiplication between the score and the effect of each parameter. The Tourism Suitability Index (IKW) was calculated from the conformity value based on the total of all parameters (Yulianda 2019):

$$IKW = \sum_{i=1}^{n} (BixSi)$$

Where: IKW - Tourism Suitability Index; Bi - weight of the i^{th} parameter; Si - parameter score of the i^{th}. If IKW > 2.5, the area is very suitable for ecotourism; if the IKW is between 2 and 2.5, the area is suitable for ecotourism; if the IKW value is between 1 and 2, the area is not suitable for ecotourism; and if the IKW is less than 1, the area is very unsuitable for ecotourism.

Table 2

Parameters of resource suitability for mangrove tourism

No	*Parameter*	*Weight*	*Category*	*Score*
1	Mangrove thickness (m)	0.38	>500	3
			>200-500	2
			50-200	1
			<50	0
2	Mangrove density (100 m^2)	0.25	> 15-20	3
			>10-15	2
			5-10	1
			<5	0
3	Mangrove species	0.15	>5	3
			3-5	2
			1-2	1
			0	0
4	Tides (m)	0.12	0-1	3
			>1-2	2
			>2-5	1
			5	0
5	Organism object	0.1	fish, crustaceans, mollusks, reptiles, birds	3
			fish, crustaceans, mollusks	2
			fish, mollusks	1
			One of the organisms	0

Note: modified from Yulianda (2019).

Results and Discussion

Mangrove species analysis. The results of mangrove species observations conducted at 3 stations show 5 mangrove species at the station I, 4 mangrove species at station II, and 8 mangrove species at station III (Table 3). Referring to the matrix of mangrove ecotourism conformity (Table 2), the parameter score of mangrove species at station I is 2, at station II is 2, and at station III is 3. The value of this conformity is in line with the number of mangrove species. Station III is the station with the most mangrove species and is categorized as very suitable for ecotourism followed by stations I and II, which are suitable.

Table 3

Composition of mangrove species in Mantehage Island

No	*Species*	*Station*		
		I	*II*	*III*
1	*Sonneratia alba*	+	+	+
2	*Rhizophora mucronata*	+	+	+
3	*Rhizophora stylosa*	+	-	+
4	*Rhizophora apiculata*	+	+	+
5	*Bruguiera gymnorrihza*	+	+	+
6	*Lumnitzera racemosa*	-	-	+
7	*Xylocarpus moluccensis*	-	-	+
8	*Ceriops tagal*	-	-	+

Mangrove density analysis. From the analysis of mangrove tree density at station I, it was found that the average total value was 9.21 ind 100 m^{-2}, and, out of the 5 species found, the highest density was that of *Rhizophora mucronata*, while the lowest was that of *Rhizophora stylosa*. Station II had an average total density of 15.47 ind 100 m^{-2}, with 4 mangrove species found. *Bruguiera gymnorrihza* had the highest density, while *Sonneratia alba* had the lowest density. At station III, 8 species were found with an average total density of 24.15 ind 100 m^{-2}. *Ceriops tagal* had the highest density, and *Sonneratia alba* had the lowest density. Based on the mangrove ecotourism suitability matrix (Table 2), station I has a score of 1 (total individuals average 5-10 ind 100 m^{-2}) and was included in the unsuitable category. Stations II and III have a score of 3 (total individual average > 15 ind 100 m^{-2}) and were included in the very suitable category (Table 4).

Table 4

Mangrove species	*Mean density of the tree (Ind 100 m^{-2})*		
	Station I	*Station II*	*Station III*
Sonneratia alba	1.63±2.23	0.07±0.12	0.01±0.03
Rhizophora mucronata	5.47±7.15	5±4.36	0.1±0.2
Rhizophora stylosa	0.07±0.12	-	3.05±5.7
Rhizophora apiculata	1.2±1.31	4.93±4.27	6.1±7.83
Bruguiera gymnorrihza	0.87±0.61	5.47±8.62	0.45±0.41
Lumnitzera racemosa	-	-	5.45±10.9
Xylocarpus moluccensis	-	-	1±2
Ceriops tagal	-	-	7.55±15.1
Total mean density	9.23±2.1	15.47±2.54	23.71±3.03

Mangrove thickness analysis. Measurements of mangrove thickness at all 3 stations in Mantehage Island are presented in Table 5. The average mangrove thickness in station I was 297.3 m, in station II was 355.3 m, and in station III was 234.7 m. The data shows that the three stations have a score of 3 referring to the matrix of the suitability of mangrove ecotourism (Table 2), and belong to the suitable category (mangrove thickness between 200-500 m).

Table 5

Mangrove thickness and average in Mantehage Island

Station	*Line transect*	*Thickness (m)*	*Mean (m)*
	1	276.0	
I	2	390.4	297.34±84.46
	3	225.6	
	1	588.6	
II	2	295.5	355.32±209.84
	3	181.9	
	1	157.7	
III	2	207.9	234.78±93.5
	3	338.8	

Tidal analysis. Tidal data of Mantehage waters for May, 2019 was obtained from the TNI AL Hydrographic and Oceanography Center (2019). The pattern of sea-level movement categorized the tides of Mantehage Island waters as mixed tides prevailing semi-diurnal. Considering Mantehage Island waters are part of the Sulawesi Sea and belong to eastern Indonesia, that there are multiple tides with water level ranging from 100-150 cm (Nontji 1987). Tides in Mantehage Island waters on May 2019 have indicated that the highest tide had 3.6 m, and the lowest tide had 0.5 m. Based on this data, the average tidal range was 1.9 m (Figure 3). Tidal data in Mantehage Island waters had a score of 2 in all stations and corresponds to the suitable category (sea level height was 1-2 m) (Table 2).

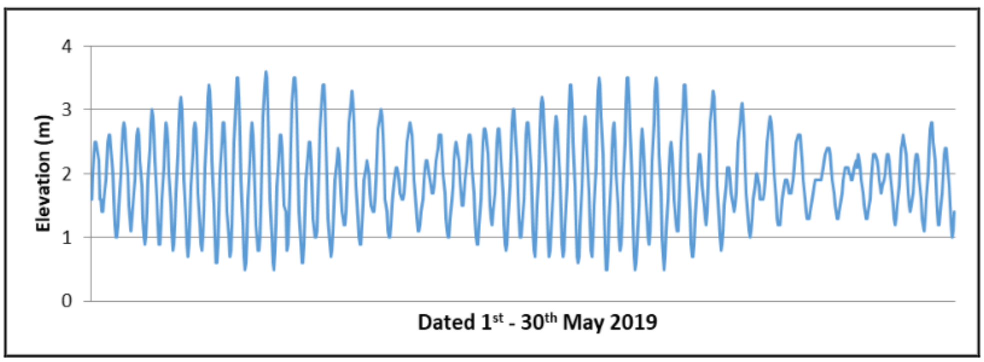

Figure 3. Tidal chart at Mantehage Island; source: TNI AL Hydrographic and Oceanography Center (2019).

Associated biota analysis. Biota found at 3 stations in the mangrove area of Mantehage Island is presented in Table 6. All stations have biota such as fish, shrimp, crabs, mollusks, reptiles, and birds. The entire mangrove forest in Mantehage Island belongs to the very suitable category in terms of biota parameters according to the matrix of mangrove ecotourism conformity.

Table 6

Fauna of mangrove ecosystem in Mantehage Island

Biota	*Scientific name*	*Common name*	*Station I*	*Station II*	*Station III*
Fish	*Periopthalmus* spp.	Mudskipper	+	+	-
	Lutjanus argentimaculatus	Mangrove red snapper	+	+	+
	Epinephelus bleekeri	Duskytail grouper	+	+	-
	Neotrygon kuhlii	Bluespotted stingray	-	+	+
	Siganus canaliculatus	Whitespotted spine-foot	-	+	+
	Toxotes jaculatrix	Banded archerfish	-	+	-
Crustacea	*Uca* spp.	Fiddler crab	+	+	-
	Scylla serrata	Mangrove crab	+	-	-
	Scylla spp.	Mud crab	+	+	-
	Metapenaeus sp.	Prawn	+	+	-
Mollusk	*Littorina scabra*	Mangrove periwinkle	+	-	-
	Anadara granosa	Blood clam	+	-	+
	Polymesoda erosa	Mud clam	+	-	+
	Crassostrea spp.	Oyster	-	+	-
	Indothais gradata	Sea snail	-	-	+
	Chicoreus capucinus	Mangrove murex	-	-	+
	Volegalea cochlidium	Spiral melongena	-	-	+
	Nerita articulata	Lined nerites snail	-	-	+
Reptile	*Boiga dendrophila*	Mangrove snake	+	+	+
	Veranus salvator	Asian water monitor	-	-	+
	Fordonia leucobalia	Crab-eating water snake	-	-	+
Mammal	*Cynopterus barachyoti*	Lesser short-nosed fruit bat	+	+	+
Bird	*Ciconia ciconia*	White stork	-	+	+
	Ducula bicolor	Pied imperial pigeon	-	+	+
	Haliaeetus leucogaster	White-bellied sea eagle	-	+	-
	Spilopelia chinensis	Spotted dove	-	+	+
	Sterna sumatrana	Black-naped tern	-	-	+

Suitability analysis of mangrove ecotourism of Mantehage Island. This analysis is based on 5 parameters: mangrove thickness, density, species, tides, and biota. Each parameter was weighted and scored, and calculated by multiplying the weight and score. For each station, the total value was the summation of all 5 parameters. Table 7 shows that station I has a total value of 1.85, while stations II and III have total values of 2.35 and 2.5, respectively. The results of the ecological area's tourism suitability index (Yulianda 2019) show that station I belongs to an unsuitable category, station II belongs to the suitable category, while station III belongs to the very suitable category for development as a mangrove ecotourism area. In general, the ecological potential of mangrove areas in Mantehage Island can be developed as a sustainable mangrove ecotourism area, especially the areas of stations II and III.

In Indonesia, research on tourism suitability show the suitability tourism index in the Tanjungbalai District was very suited for mangrove tourism development, including the villages of Bagan Asahan, Asahan Mati and Asahan Apung. Ecologically, mangrove forests in the district of Tanjungbalai could serve as a mangrove ecotourism area (Fahriansyah & Yoswaty 2012). The suitability tourism index for mangrove ecotourism in the estuary of Musi River placed it in the very suitable category in some parts, and in the suitable category in other parts (Agussalim & Hartoni 2014). The suitability tourism index

Sayafi and Liwo islands placed them in the suitable and very suitable categories (Koroy et al 2017). The suitability tourism index in the Gonda mangrove ecosystem area placed it in the very suitable category to become a mangrove ecotourism area (Sadik et al 2017). The mangrove area has the potential to be a mangrove ecotourism site in North Sulawesi, precisely in Labuan Uki Bay, Bolaang Mongondow Regency. Lasabuda et al (2019) mentioned that, of the 3 stations studied, there were 2 stations in the suitable category and 1 station in a very suitable category for development as a mangrove ecotourism area. The suitability tourism index for mangrove ecotourism in Siahoni Village, Buru Utara Timur Regency, Maluku Province showed that some areas were in a suitable category (Latupapua et al 2019). The potential mangrove area in Muara Kubu suitable for ecotourism development is included in the very suitable and suitable ccategories (Nugroho et al 2019). In Kutang beach, Lamongan, East Java Province, the suitability of the ecosystem for ecotourism is dependent on tide; at high tide, the area is less suitable, while at low tide it is more suitable for ecotourism (Malihah & Romadhon 2020).
.

Table 7

Valuation of the ecological suitability of mangrove ecotourism in Mantehage Island

No	Parameter	Weight	Station 1		Station 2		Station 3	
			Score	Value	Score	Value	Score	Value
1.	Mangrove thickness (m)	0.380	2	0.76	2	0.76	2	0.76
2.	Mangrove density (100 m^2)	0.150	1	0.25	3	0.75	3	0.75
3.	Mangrove species	0.150	2	0.30	2	0.30	3	0.45
4.	Tides (m)	0.120	2	0.24	2	0.24	2	0.24
5.	Biota object	0.100	3	0.30	3	0.30	3	0.30
	Tourism comformity index		1.85		2.35		2.50	
	Category of suitability		not suitable		suitable		very suitable	

This study aims to safeguard mangrove forest ecosystems and improve the welfare of the surrounding communities. Mangrove ecotourism management can be done well in Mantehage Island if the goal is to support sustainable tourism development in North Sulawesi. The principle of management is based on the principle of ecotourism, namely environmental balance, ecosystem management, and mangrove ecotourism development.

Conclusions. Mantehage Island has a potential mangrove area, which can be developed into a mangrove ecotourism area. Station II with a total value of the ecological suitability index of 2.35 is in the suitable category and station III, with a total value of 2.5, is in the very suitable category for mangrove ecotourism in the future. Station I, a small island with a total value of 1.83, in the not suitable category, is expected to be a conservation site.

References

Agussalim A., Hartoni, 2001 [Mangrove suitability potential as ecotourism area in estuary coastal of Musi River, Banyuasin Regency]. Maspari Jurnal 6(2):148-156. [In Indonesian].

Bengen D. G., 2001 [Technical guidelines for introduction and management of mangrove ecosystems]. Pusat Kajian Sumberdaya Pesisir dan Lautan, IPB, Bogor, Indonesia, 61 p. [In Indonesian].

de Vasconcellos Pegas F., Coghlan A., Stronza A., Rocha V., 2013 For love or for money? Investigating the impact of an ecotourism programme on local residents assigned values towards sea turtles. Journal of Ecotourism 12(2):90-106.

Djamaluddin R., 2018 The mangrove flora and their physical habitat characteristics in Bunaken National Park, North Sulawesi, Indonesia. Biodiversitas 19(4):1303-1312.
Fahriansyah, Yoswaty D., 2012 [Ecotourism development in Tanjung Balai District, North Sumatera: Mangrove forest ecological factors]. Jurnal Ilmu dan Teknologi Kelautan Tropis 4(2):346-359. [In Indonesian].
Gigovic L., Pamucar D., Lukic D., Markovic S., 2016 GIS-Fuzzy DEMATEL MCDA model for the evaluation of the sites for ecotourism development: a case study of "Dunavski kljuc" region, Serbia. Land Use Policy 58:348-365.
Istomo, Kusmana C., Naibaho B. D., 2017 Biomass potential on several mangrove planting models in Java Island, Indonesia. AACL Bioflux 10(4):754-767.
Koroy K., Yulianda F., Butet N. A., 2017 [Marine resource based ecotourism development of small islands in Sayafi and Liwo Island, Central Halmahera]. Jurnal Teknologi Perikanan dan Kelautan 8(1):1-17. [In Indonesian].
Lasabuda R., Lohoo A. V., Opa E. T., 2019 Ecological suitability of mangrove ecotourism in Labuan Uki Bay, Bolaang Mongondow Regency, North Sulawesi Province, Indonesia. AES Bioflux 11(1):41-50.
Latupapua Y. T., Loppies R., Fara F. D. S., 2019 [Mangrove suitability analysis as an object of ecotourism attraction in Siahoni Village, Buru Utara Timur Regency, Maluku Province]. Jurnal Sylva Lestari 7(3):267-276. [In Indonesian].
Malihah D. F., Romadhon, A. 2020 [Analysis of the support for the utilization of beach exotics in Kutang Lamongan beach, East Java]. Juvenil 1(3):391-399. [In Indonesian].
Mariati W., 2016 [Ecotourism development of mangrove area at Anak Setatah village, Meranti Islands Regency, Riau Islands Province]. Thesis, Bogor Agricultural Institute, Bogor, 64 p. [In Indonesian].
Nontji A., 1987 [Archipelago sea]. Djambatan, Jakarta, 368 p. [In Indonesian].
Nugroho T. S., Fahrudin A, Yulianda F., Bengen D. G., 2019 [Land suitability and carrying capacity analysis of the mangrove ecotourism at Muara Kubu mangrove areas, West Kalimantan]. Journal of Natural Resources and Environmental Mnagement 9(2):483-497. [In Indonesian].
Opa E. T., Kusen J. D., Kepel R. C., Jusuf A., Lumingas L. J. L., 2019 Community structure of mangrove in Mantehage Island and Paniki Island, North Sulawesi, Indonesia. AACL Bioflux 12(4):1388-1403.
Rusila N. Y., Khazali M., Suryadiputra I. N. N., 2006 [Introduction guide to mangroves in Indonesia]. Wetlands International – Indonesian Program, PHK/II, Bogor, 220 p. [In Indonesian].
Sadik M., Muhiddin A. H., Ukkas M., 2017 [Mangrove ecotourism adjusment reviewed based on biogeophysiscs aspecs of Gonda beach In the Villages of Laliko District of Campalagian Regency of Polewali Mandar]. Spermonde 2(3):25-33. [In Indonesian].
Setyawan A. D., Susilowati A., Sutarno, 2002 [Genetic biodiversity, species, and mangrove ecosystems in Java: guidelines for biodiversity practicum; mangrove case study]. Department of Biology, UNS Surakarta, Indonesia, 144 p. [In Indonesian].
Shoo R., Songorwa A., 2013 Contribution of ecotourism to nature conservation and improvement of livelihoods around Amani Nature Reserve Tanzania. Journal of Ecotourism 12(2):75-89.
Widodo M. L., Soekmadi R., Arifin H. S., 2018 [Analysis of stakeholders in Betung Kerihun National Park's ecosystem development, Kapuas Hulu District]. Jurnal Pengelolaan Sumber daya Alam dan Lingkungan 8(1):55-61. [In Indonesian].
Yulianda F., 2019 [Aquatic ecotourism: a concept of suitability and support for marine tourism and freshwater tourism]. IPB Press, Bogor, Indonesia, 87 p. [In Indonesian].
*** TNI AL (Indonesian Navy), 2019 Hydrographic and oceanography center.
***Presidential Decree No. 6 of 2007 on the determination of the outermost small islands. [In Indonesian].

***Republic of Indonesia, 2007 [Law on coastal and small island management]. [In Indonesian]
***RSNI, 2011 [Indonesian National Standard Draft-3. Survey and mangrove mapping]. Results of Consensus Meeting in Cibinong Bogor, February 28th 2011, 17 p. [In Indonesian].
***WWF (World Wildlife Fund), 2009 [Principles and criteria for community based ecotourism]. Ministry of Culture and Tourism and WWF, Indonesia. [In Indonesian].

Received: 14 September 2020. Accepted: 11 November 2020. Published online: 04 February 2021.
Authors:
Esry Tommy Opa, Sam Ratulangi University, Faculty of Fisheries and Marine Science Unsrat, Kampus Unsrat Bahu St., 95115 Manado, North Sulawesi, Indonesia, e-mail: esrytommyop@unsrat.ac.id
Rene Charles Kepel, Sam Ratulangi University, Faculty of Fisheries and Marine Science Unsrat, Kampus Unsrat Bahu St., 95115 Manado, North Sulawesi, Indonesia, e-mail: renecharleskepel65@gmail.com
Ridwan Lasabuda, Sam Ratulangi University, Faculty of Fisheries and Marine Science Unsrat, Kampus Unsrat Bahu St., 95115 Manado, North Sulawesi, Indonesia, e-mail: ridwanlasabuda@gmail.com
Janny Dirk Kusen, Sam Ratulangi University, Faculty of Fisheries and Marine Science Unsrat, Kampus Unsrat Bahu St., 95115 Manado, North Sulawesi, Indonesia, e-mail: papakelan@yahoo.com
Carolus Paulus Paruntu, Sam Ratulangi University, Faculty of Fisheries and Marine Science Unsrat, Kampus Unsrat Bahu St., 95115 Manado, North Sulawesi, Indonesia, e-mail: carolusparuntu@yahoo.com
Rignolda Djamaluddin, Sam Ratulangi University, Faculty of Fisheries and Marine Science Unsrat, Kampus Unsrat Bahu St., 95115 Manado, North Sulawesi, Indonesia, e-mail: rignolda@unsrat.ac.id
Farnis Bineada Boneka, Sam Ratulangi University, Faculty of Fisheries and Marine Science Unsrat, Kampus Unsrat Bahu St., 95115 Manado, North Sulawesi, Indonesia, e-mail: farinisb@gmail.com
Desy Maria Helena Mantiri, Sam Ratulangi University, Faculty of Fisheries and Marine Science Unsrat, Kampus Unsrat Bahu St., 95115 Manado, North Sulawesi, Indonesia, e-mail: dmh_mantiri@unsrat.ac.id

How to cite this article:
Opa E. T., Kepel R. C., Lasabuda R., Kusen J. D., Paruntu C. P., Djamaluddin R., Boneka F. B., Mantiri D. M. H. 2021 Ecological suitability of mangrove tourism in Mantehage Island as the outermost small island in North Sulawesi, Indonesia. AACL Bioflux 14(1):120-129.

Ecological suitability of mangrove tourism_Bioflux Journal

ORIGINALITY REPORT

13%	9%	7%	4%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Universitas Khairun Student Paper	3%
2	devotion.greenvest.co.id Internet Source	1%
3	digitalcommons.wku.edu Internet Source	1%
4	Saeed Reza Akbarian Ronizi, Marzieh Mokarram, Saeed Negahban. "Utilizing multi-criteria decision to determine the best location for the ecotourism in the east and central of Fars province, Iran", Land Use Policy, 2020 Publication	1%
5	coek.info Internet Source	1%
6	Mohammad Basyuni, Sigit D. Sasmito, Kangkuso Analuddin, Tengku Zia Ulqodry et al. "Chapter 16 Mangrove Biodiversity, Conservation and Roles for Livelihoods in	<1%

Indonesia", Springer Science and Business Media LLC, 2022
Publication

7	repository.lppm.unila.ac.id Internet Source	<1%
8	theses.lib.polyu.edu.hk Internet Source	<1%
9	www.abah.bioflux.com.ro Internet Source	<1%
10	Heinrich Walter, Siegmar-W. Breckle. "Ecological Systems of the Geobiosphere", Springer Nature, 1986 Publication	<1%
11	M. Fakhrudin, Luki Subehi, Hendro Wibowo. "Climatological and land use evaluation to maintain water supply in Pulai reservoir, Bintan island - Indonesia", IOP Conference Series: Earth and Environmental Science, 2019 Publication	<1%
12	biodiversitas.mipa.uns.ac.id Internet Source	<1%
13	journal.unj.ac.id Internet Source	<1%
14	mail.scialert.net Internet Source	<1%

Submitted to Universitas Airlangga

15	Student Paper	<1%
16	www.slideshare.net Internet Source	<1%
17	jurnal.untan.ac.id Internet Source	<1%
18	Submitted to Southville International School and Colleges Student Paper	<1%
19	coremap.oseanografi.lipi.go.id Internet Source	<1%
20	sylvalestari.fp.unila.ac.id Internet Source	<1%
21	Cecep Kusmana, Topik Hidayat, Tatang Tiryana, Omo Rusdiana, Istomo. "Allometric models for above- and below-ground biomass of Sonneratia spp.", Global Ecology and Conservation, 2018 Publication	<1%
22	D Apdillah, Wahyudin, T S Razai, C Chalet, A Suryanti, Y Zulkarnaen, D Azizah. "Carrying capacity of mangrove environment for development of river cruise ecotourism in Pengudang, Bintan Island, Indonesia", IOP Conference Series: Earth and Environmental Science, 2023 Publication	<1%

23	Mujiyanto, Y Sugianti, S E Purnamaningtyas, Sutrisna, A Rahmawati, F R Indaryanto, A Nurfiarini, D W H Tjahdjo. "Suitability of ecotourism in Tunda Island Serang Regency Banten Province, Indonesia", IOP Conference Series: Earth and Environmental Science, 2021 Publication	<1 %
24	apf2019.sis.ac.kr Internet Source	<1 %
25	repo.unsrat.ac.id Internet Source	<1 %
26	www.tandfonline.com Internet Source	<1 %
27	Mangrove Ecosystems of Asia, 2014. Publication	<1 %
28	Nyoman Utari Vipriyanti, I Gusti Ngurah Made Dharma Semadi, Ahkmad Fauzi. "Developing mangrove ecotourism in Nusa Penida Sacred Island, Bali, Indonesia", Environment, Development and Sustainability, 2022 Publication	<1 %
29	Joshian Nicolas William Sc. "Seawater Quality Analysis in Mantehage Island for Integrated and Sustainable Marine Tourism Development", Pakistan Journal of Biological Sciences, 2021 Publication	<1 %

Exclude quotes	On	Exclude matches	Off
Exclude bibliography	On		