

Land Suitability of the Marine Ecotourism in Mantehage Village, Wori District, North Minahasa Regency, North Sulawesi Province

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Article Information	ABSTRACT
<i>Article History</i> Accepted : 12 Febuary 2020 Revised : 15 March 2020 Published : 31 March 2020	Bunaken National Park has five small islands, one of which is Mantehage Island. This island is one of the small outer islands of Indonesia in Wori District, North Minahasa Regency, North Sulawesi Province. This island has a wealth of excellent natural resources, including coral reefs, seagrass beds, and mangroves. This study aims to analyze the suitability of the dive tourism area of Mantehage Village by using the parameters of water brightness, coral cover, species of fish, type of life form, current speed, and depth of coral reef. The data is analyzed using Multi-Criteria Analysis (MCA) to obtain the criteria for the area. The results of this study indicate that the waters of the Mantehage Village are very suitable for the development of marine ecotourism. This location is supported by excellent waters conditions that support the sustainable management of the island's marine tourism. This study should be continued with an analysis of the carrying capacity of the area, to calculate the optimal value of the utilization of the small island coastal area so that the resources remain sustainable.
Keywords: Land Suitability Dive Mantehage	

Kata kunci:	ABSTRAK
Kesesuaian Lahan Selam Mantehage	Taman Nasional Bunaken memiliki lima pulau kecil, salah satunya adalah Pulau Mantehage. Pulau ini merupakan salah satu pulau kecil terluar Indonesia yang berada di Kecamatan Wori, Kabupaten Minahasa Utara, Provinsi Sulawesi Utara. Pulau ini memiliki kekayaan sumberdaya alam yang sangat baik, antara lain terumbu karang, padang lamun dan mangrove. Kajian ini bertujuan menganalisa kesesuaian lahan wisata selam Desa Mantehage dengan menggunakan parameter kecerahan perairan, tutupan karang, jenis ikan, jenis life form, kecepatan arus, dan kedalaman terumbu karang, selanjutnya data tersebut dianalisa menggunakan Multi Criteria Analysis (MCA) untuk mendapatkan kriteria kawasan tersebut. Hasil kajian ini menunjukkan bahwa perairan Desa Mantehage sangat sesuai untuk pengembangan ekowisata bahari, hal ini didukung oleh kondisi perairan yang sangat baik yang mendukung keberlanjutan pengelolaan wisata bahari pulau ini. Kajian ini sebaiknya dilanjutkan dengan analisis daya dukung kawasan, untuk menghitung nilai optimal dari pemanfaatan wilayah pesisir pulau kecil agar sumberdaya yang ada disana tetap lestari.

Introduction

The paradigm of the use of coastal areas that previously exploited goods began to switch to the use of services (services). It is beneficial for an area that has natural resources such as Mantehage Island in North Sulawesi Province. The human need for tourism makes the need for tourist destinations increase; this opportunity is owned by Mantehage Island, which has underwater beauty

accompanied by high biodiversity and also waters that support marine tourism activities. Marine Ecotourism is a tourism activity that utilizes the character of coastal and marine resources developed with a maritime conservation approach.

Marine ecotourism management is a management concept that prioritizes sustainability and uses natural resources and the

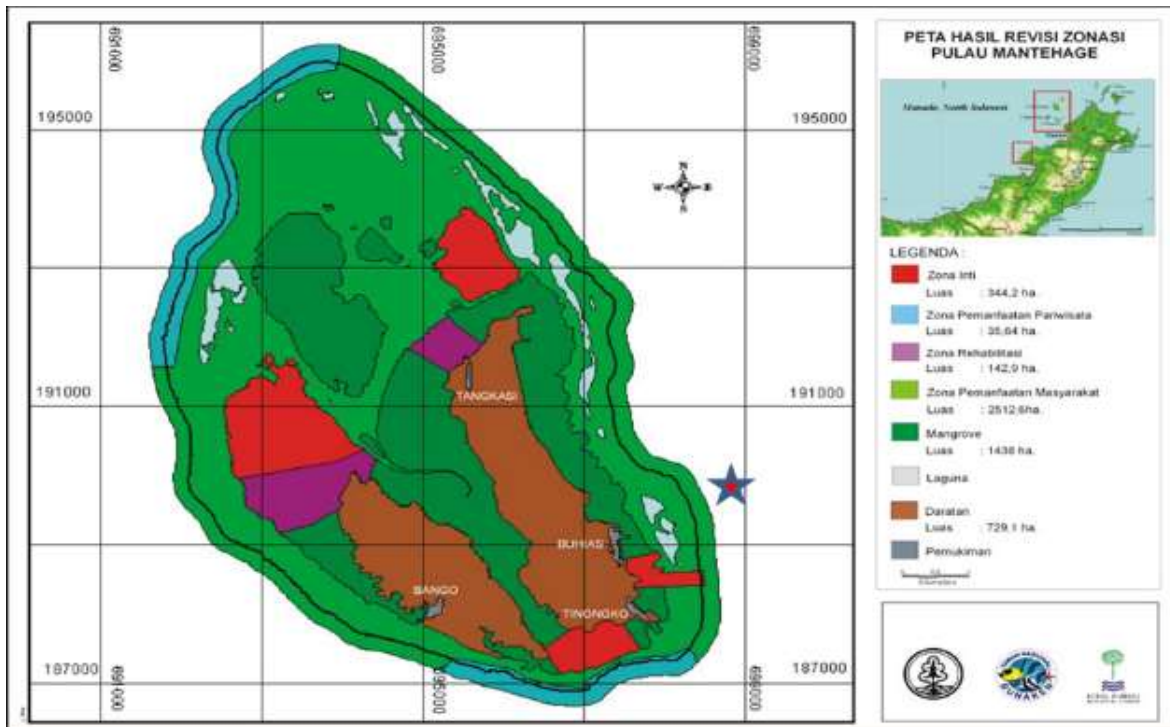


Figure 1 Map of Mantehage Island

community's culture. The objects of marine ecotourism in this concept are marine resources and the dynamics of seawater, mangrove ecosystems, coral reef ecosystems, and seagrass ecosystems and the biota that live around them. Tourism activities that can be developed with the concept of marine ecotourism can be grouped into two, namely coastal tourism and marine tourism. Coastal tourism prioritizes coastal resources and community culture, while marine tourism prioritizes underwater resources and seawater dynamics (Yulianda, 2007).

This study aims to analyze the suitability of the waters of the village of Mantehage as a marine tourism location, especially diving tourism, using several parameters accompanied by an analysis of determining the criteria of the area. The benefits of this study are as one of the inputs to the sustainability of integrated small island management.

Method

This study is located in the Mantehage Village of Buhias, Wori District, North Minahasa Regency, North Sulawesi Province, with coordinates $01^{\circ}42'40,7''$ North Latitude and

$124^{\circ}47' 00,8''$ East Longitude. This study was conducted in February 2020, using primary and secondary data. This study requires complete scuba equipment, secchi disks (brightness gauges), floater current meters and other supporting software (Excel; ArcGis; CPCe).

Measurement of Land Suitability Parameters

Brightness of waters

Water brightness is strongly influenced by the presence of suspended solids, dissolved substances, particles, and watercolor. Low water brightness can reduce the value of water productivity (Nybakken, 1992). The brightness of water is an indicator of the clarity of water associated with the penetration of light entering the water body column. The higher the brightness, the deeper the penetration of light that penetrates the waters. Effendi (2003) states that water brightness is a measure of water transparency that is determined visually using a Secchi disk.

Coral Community Cover and Life form type

The tools and materials needed for sampling for coral reef condition assessment use the

underwater photo transect (UPT) method (Suharsono & Sumadhiharga., 2014), while for processing data using Coral Point Count with Excel Extensions (CPCe) software (Kohler & Gill, 2006).

Type of reef fish

The Underwater Visual Census (UVC) method is one of the techniques often used in the study of reef fish community structures as part of an effort to assess the health of coral reef ecosystems (English et al., 1997; Green & Bellwood, 2009; Obura & Grimsdith, 2009). This method is a practical, accurate, and environmentally friendly method. The essence of this method is the mastery of scuba diving techniques and understanding of reef fish bioecology (Sasanti et al., 2014).

Current speed

Measurement of coastal currents is using a current meter manually done to determine the speed and direction. Measurements were taken from the boat in a stationary state moored to the observation station. Furthermore, after the device is released, the buoy moves according to the tool's current carried along the rope length of 5 meters at the time of the tension rope. The change in time is recorded using a stopwatch, while the direction of the current movement is seen when the float moves as far as 5 meters using a compass. Data obtained in the form of observation time (T),

float time moved as far as 5 meters (S), and the direction of displacement of Floater (00 = north).

The depth of the coral reef

The depth of the coral reef was measured together when the divers surveyed the percentage of closure and type of life form using a dive com or pressure gauge. In addition to measuring depth, the diver also informs underwater morphology as another consideration in the analysis process. Data on the level of water in the Mantehage Village was obtained from a bathymetry map issued by the Indonesian Navy's Dishidros.

Land Suitability Analysis

Each tourism activity has resources and environmental requirements that are suitable for the tourism object to be developed. The formula used for the suitability of beach tourism and marine tourism is $IKW = (\sum Ni / Nmax) \times 100\%$ with $IKW =$ Tourism Suitability Index; $Ni = i$ parameter value (Weight x Score); $Nmax =$ Maximum value of the tourism category (Yulianda 2007).

Results and Discussion

Water Brightness Conditions

According to research results by Suharsono and Yosephine (1994) showed there is a positive correlation between the brightness of the waters with the percentage of coral cover on 27 islands in the Kepulauan Seribu. The higher the transparency of water, the greater the proportion of live coral

Table 1. Matrix of Area Suitability for Ecotourism in the Dive Tourism Category.

No	Parameter	Weight	Category S1	Score	Category S2	Score	Category S3	Score	Category N	Score
1.	Brightness of waters (m)	5	16-20	4	13-16	3	7-13	2	<7	1
2.	Coral community cover (%)	5	> 75	4	> 50-75	3	25-50	2	<25	1
3.	Lifeform type	4	> 12	4	< 7-12	3	4-7	2	<4	1
4.	Type of reef fish	4	> 100	4	50-100	3	20- <50	2	<20	1
5.	Current speed (cm/s)	3	0-15	4	> 15 -30	3	>30-50	2	>50	1
6.	The depth of the coral reef (m)	3	6-15	4	> 15-20	3	>20-30	2	<30	1

Maximum Value = 96

S1 = Very suitable, with value 80-100%

S2 = Quite appropriate, with value 60- <80%

S3 = As conditional, with value 35- <60%

N= Incompatible, with value < 35 %

cover, and vice versa, the lower the clarity of the water, the smaller the percentage of live coral cover. Field data shows that the brightness of the seas of Mantehage Village ranged from 15-18 meters. Its location far from the mainland makes these waters have good brightness values and fewer pollutants.

Condition of Coral Community Life Cover & Life form

One indicator of the health of water is the existence of coral reefs with a relatively high coral cover. The category to measure the percentage of coral cover that is often used is referring to the concept proposed by Gomes and Yap (1998) with the class 0 - 24.9%, then classified as in lousy condition, 25 - 49.9% is moderate, 50 - 74.9 % is good, and 75-100% is excellent. Yulianda (2007), in the suitability matrix of the ecotourism land, submits that the number of life-form types required for the appropriate class is more than ten species. For conditionally suitable class are four to ten species, whereas if the number of life-form species is less than four species or no coral at all, then the waters are not suitable for diving ecotourism. This concept was later adopted as one of the parameters of suitability in marine tourism. The coral community cover in Mantehage Village is 52.45%, which is in the good enough category, while the type of life form in these waters is ten; this is in the suitable category. Both of these conditions support the waters of Mantehage Village to be used as dive points that are no less interesting than Bunaken Island.

Condition of reef fish species

The diversity of reef fish species is an essential parameter in marine tourism, especially for diving.

Waters can be categorized as suitable for marine diving tourism if there are at least 75 species of reef fish, and 20 - 75 species for classes according to conditional. Whereas if the number of species is less than 20 species the waters, it is not suitable for marine diving tours. According to the DPK (2003), based on the results of a visual census conducted at several points in the waters of Southeast Maluku District. Shows that the density and spare parts supply of reef fish is relatively high, especially in the area of coral waters near the coast. The number of reef fish species identified in the waters around Mantehage Village is 48 species. It is very supportive of tourism activities because the object of diving other than coral reefs is the diversity of reef fish.

Current speed conditions

The speed of the flow is crucial for diving tourism activities and coral reef ecology. According to Jokiel and Morrissey (1993), current movements affect community structure and distribution of coral species in an area. Overall the condition of coral reefs in open areas has a relatively low percentage of coral cover. Strong currents correlate with an increased displacement of coral fragments that will disrupt the coral recovery process. Besides that, the current speed is a factor related to the safety of the diver.

Yulianda (2007), in the ecotourism land suitability matrix for diving, revealed that the current velocity required for the appropriate class is between 0 - 25 cm/sec. For conditionally suitable classes is 26 - 50 cm/sec, whereas if the current velocity is more than 50 cm/sec, then it is not ideal for diving ecotourism. This concept was also later adopted as one of the parameters of suitability in marine tourism. The measurement of current velocity

Table 2. Matrix of Area Suitability for Ecotourism in the Dive Tourism Category.

No	Parameter	Value	Weight	Score	VxS
1	Brightness of waters (m)	18 m	5	4	20
2	Coral community cover (%)	52,45 %	5	3	15
3	Jenis life form	10	4	3	12
4	Type of reef fish (Sp)	48 Sp	4	2	8
5	Current speed (cm/s)	20 cm/det	3	4	12
6	The depth of the coral reef (m)	5 - 8 m	3	4	12
Total value of weight x score				79	
Maximum Value				96	
Suitability Value				$(79:96) \times 100 = 82.29$	

when collecting field data shows that the current velocity ranges between 15-20 cm/sec, thus fulfilling the required range.

The condition of the depth of the coral reef

The depth of the waters is a limiting factor for the life of coral reefs; clear waters allow coral reefs to grow well due to the photosynthesis process that goes well. In this condition, coral reefs can grow to depths of 50 meters. According to Nybakken (1992), coral reefs cannot develop in waters deeper than 50 - 70 meters. Most coral reefs grow at depths of less than 25 meters. Yulianda (2007), in the suitability matrix of ecotourism for diving, said that the depth of coral reefs required for suitable classes is between 3 - 20 meters. Conditional class is 21 - 30 meters, whereas if the depth of coral reefs is less than 3 meters or more than 30 meters, then it is not suitable for diving ecotourism. Field data shows that the coral reefs in the research location are at a depth of 5-15 meters, so they meet the range required for the dive site.

The suitability of the diving tourism land considers 6 suitability parameters, namely reef fish species; waters brightness; coral community cover; type of life-form; depth of coral reefs; and current speed. Based on the results of land suitability analysis, the table above shows that Mantehage Village has very suitable waters (82.29%) to be developed as dive sites. This is different from the study conducted by Sudjud et al, (2018) who conducted research in Batu Layar Pangandaran, the average land suitability value of the area was 56.02% included in the conditional fit category, this is due to the condition of coral cover and current that less supportive of diving activities there.

Conclusion

The condition of the waters of Mantehage Village, Wori Subdistrict, North Minahasa Regency, North Sulawesi Province is included in the category which is very suitable for the development of marine ecotourism, especially diving tourism. The percentage of good coral cover, coral fish diversity is quite high, the currents are not too fast, and the clarity of the waters makes this location worthy of

being one of the dive spots in the Bunaken National Park area. This study will be excellent if it is continued with the calculation of the carrying capacity of the environmental area, and also the vulnerability of the resource. This is to reduce the degradation of coastal and marine resources, especially small islands, from the threat of damage to ecosystems due to exploitation that exceeds the resilience of an ecosystem.

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