Suitability and development strategy for Turtle Ecotourism in Kapoposang Islands Marine Tourism Park, South Sulawesi, Indonesia

Ahmad Bahar, Ambo Tuwo and Faiz Fachri Masalan
Faculty of Marine Sciences and Fisheries, Hasanuddin University, Makassar 90245, Indonesia

Email: amb2270@yahoo.com

Abstract. Turtles are a tourist attraction that can be developed using an ecotourism approach. This approach is expected to provide economic benefits without neglecting the conservation aspects of protected marine life, including turtles in the Kapoposang Islands Marine Tourism Park (TWP), Pangkep Regency, South Sulawesi, Indonesia. This study aimed to assess the suitability of turtle ecotourism and determine a strategy for developing turtle ecotourism in Kapoposang Island. This research was conducted in February and March 2020. The data collected during this study were divided into 3 groups of data with the aspects studied including; biophysics (beach slope, coastal vegetation, beach width, light intensity, distance from settlement and tides), biological (secondary data), and social community. The analysis performed were a tourism suitability index analysis, SWOT analysis, and descriptive analysis. The results indicate that the suitability of four stations in the Kapoposang Island for turtle nesting tourism ranges from "appropriate" to "unsuitable" categories. The suitability analysis results for station I (57.58%), station II (57.58%), and station IV (63.64%) were in the appropriate category while Station III (46.97%) was in the unsuitable category. The incubation process of newly hatched eggs and hatchlings carried out by the “Bahari Lestari” community group was no longer operating. The recommended development strategy directions based on the SWOT analysis are: (1) capacity building training and assistance to organize community groups in an integrated manner, (2) repairs, maintenance, and additional supporting facilities for tourism with a scenario to guide organized turtle tourism activities, (3) conduct study tours to areas that are considered successful in optimizing the potential of ecotourism.

1. Introduction
Ecotourism activities are now one of the most widely carried out tourist activities by both foreign and domestic tourists. The increase in the number of tourists every year is proof that tourist activities have a considerable appeal. This can be seen from the number of foreign tourists throughout February 2018, which amounted to 1.20 million people, then increased by 1.27 million people throughout February 2019 [1], while the number of domestic tourist visits in December 2018 reached 1,100.67 people, and increased to 1,158,162 people in January 2019 [1]. This is because tourism activities have many attractions, such as the diversity of flora and fauna, unique ecosystems, and cultural diversity.

Sea turtles are a type of wild animal that has a very high commercial value, including as a source of animal protein (eggs and meat), basic materials for making bags and clothes (skin), cosmetic needs (oil), making fertilizer (bones) and home accessories (carapace/shell). As a result, the turtle population...
is now threatened with extinction so that it is categorized as a protected species based on Government Regulation No.7 of 1999. Development of turtle enjoyment ecotourism is an alternative use that does not threaten the sustainability of turtles.

Kapoposang Island is one of the nesting habitats for turtles in the Spermonde Islands. Since 2010, there have been 73 turtles laying eggs on Kapoposang Island. There are two species of turtles that are most often found laying eggs on the island managed by the Kupang National Marine Protected Area (BKKPN), namely the Green Turtle (*Chelonia mydas*) and Hawksbill Turtle (*Eretmochelys imbricata*).

Since 2011 a group of turtle conservationists "Bahari Lestari" has been formed which manages the nesting area for turtles on Kapoposang Island, but currently, it has not been running optimally. Turtle egg hunting activities still occur in the community. When entering the spawning season, people compete to find eggs on the beach for consumption. Turtle eggs are a favorite for household-scale consumption when entering the turtle reproductive season in Kapoposang.

The development of turtle ecotourism is expected to provide economic benefits for the local community from tourists so that it can foster a sense of belonging so that the sustainability of the turtles is maintained. In principle, ecotourism is a recreational activity in the wild or open, in which there are also conservation activities. It is hoped that it can be an alternative solution to several problems, such as the threat of disturbing the nesting habitat of turtles or illegal harvesting of turtle eggs. The problems that exist in Kapoposang Island need to be studied more deeply in order to provide a better concept of turtle ecotourism management. Therefore, it is necessary to conduct research to assess the suitability of tourism and turtle ecotourism development strategies in Kapoposang Island.

### Table 1. Data group, aspects, data collection techniques and data types

| Data Group       | Data Category                        | Data Retrieval Technique | Type of Data |
|------------------|--------------------------------------|--------------------------|--------------|
| biophysical      | Coastal vegetation                  | Field observation        | Primary      |
|                  | The slope of the beach               | Field observation        | Primary      |
|                  | The width of the beach.              | Field observation        | Primary      |
|                  | Light intensity                      | Field observation        | Primary      |
|                  | Distance from settlement             | Field observation        | Primary      |
|                  | Tide                                 | Field observation        | Primary      |
| biological       | Turtle nesting behavior and season   | Indepth interview & study of literature | Secondary |
| social community | Characteristics and perceptions of society | Questioner               | Primary      |

### 2. Material and methods

#### 2.1. Study area

This research was conducted on Kapoposang Island, Mattirodeceng Village, Liukangtupabiring District, Pangkajene Islands Regency, South Sulawesi, Indonesia, from 29 February to 11 March 2020. There are four research stations which are turtle nesting sites on Kapoposang Island, namely: station 1 is at the eastern tip, station 2 is at the northside at the center, station 3 at the southside at the center, and station 4 on the western tip of Kapoposang Island.

#### 2.2. Data collection

The data collected was divided into 3 categories with the aspects studied, namely: biophysical, biological and social community as described in Table 1 below:
Turtle breeding conditions | Interview and field observation | Primary

Plant vegetation data were obtained by observing the types of vegetation found along with each observation location (line transect). A straight line was drawn along 10 x 10 m [2]. Then identify plant categories and record the names of coastal plant species contained in the meter transect. Beach slope data were taken using clinometers, by aiming from the shoreline towards the vegetation line and measuring the distance between the assessor and the subject being studied. Data collection for beach width was carried out using a rolling meter, from the boundary of the vegetation (supratidal) to the shoreline area where the waves were wet for the first time. Light intensity is measured by a lux meter, carried out at night with a height of 10 cm from the top of the sand. Data collection was carried out at 3 points, namely the coastline, mid habitat line, and vegetation line. Building distance data is measured using a rolling meter by drawing a straight line and the measured part is the distance between the building and the upper coast where vegetation is found. Measurements were made in 3 repetitions [3]. The tide data is measured using a 3-meter long wood that has been equipped with a tide scale (measuring signs) in centimeters. The tide board is installed on a stable seabed, at the highest tide it is not submerged and at the lowest tide, it is still inundated by water. The tide can be seen from the lowest and highest tide measurements carried out for 39 hours with an interval of 1 hour [3].

The socio-economic conditions of the community are analyzed through interview techniques according to [4] by using a questionnaire to the community to find out the socio-economic criteria that support the development of turtle ecotourism. Determination of respondents using a purposive sampling method by selecting the adult population or the age above 20 years who live in the research location. The number of people interviewed was 22 people. Selection of respondents, considering the age of adulthood on the grounds that they have the potential to be involved in ecotourism activities.

2.3. Data analysis
The study of the suitability of the tourist area was carried out through a habitat suitability matrix divided into 3 classes, namely very suitable, appropriate, and unsuitable (Table 2). Turtle habitat suitability index using the formula according to [5], namely:

\[ IKW = \sum \left( \frac{Ni}{Nmaks} \right) \times 100 \% \]

Information:
IKW: Suitability Index (%)
Ni: The value of the parameter i (Weight x Score)
Nmaks: Maximum score of a tourism category (Σ maximum weight x maximum score)

**Table 2. Suitability matrix for turtle nesting tourism.**

| Parameters                  | Unit | Weight | Category                  | Score |
|-----------------------------|------|--------|---------------------------|-------|
| The slope of the beach (°)  | 5    | S1     | 10–30                     | 3     |
|                             |      | S2     | 3–9; 30–35                | 2     |
|                             |      | S3     | <3; >35                   | 1     |
| Coastal Vegetation          | 5    | S1     | *Pandanus tectorius*      | 3     |
|                             |      | S2     | *Spinifex littoreus, Vigna marina.* | 2     |
|                             |      | S3     | *Ipomea pescaprae, Gynura procumbens.* | 1     |
| The width of the beach (m)  | 5    | S1     | 30–60                     | 3     |
|                             |      | S2     | >60                       | 2     |
|                             |      | S3     | <30                       | 1     |
3. Results and Discussion

Measurement of the suitability parameters for turtle nesting tourism is carried out based on 7 parameters, namely: beach slope, sand particle size, beach vegetation, beach width, light, building distance, and tides. The slope of the coast at 4 observation stations on Kapoposang Island ranges from 6° - 2°. The highest slope is at station 2 with a value of 6°. While the lowest beach is at station 3 with a slope of 2°. Station 4 is 3° and station 1 is 5°. Turtle nesting sites are flat-sloping beaches located above the shore [8]. The slope of the beach on Kapoposang Island is a suitable category for nesting turtles. The steep slope will affect the turtles in choosing the nesting site. This is because turtles cannot see at an angle of 150° downwards [9].

Coastal plants found at the observation station, namely: *Casuarina equisetifolia* (sea cypress), *Morinda citrifolia* L. (noni), *Terminalia catappa* L., *Scaevolla taccada*, *Ischaemum muticum*, *Wedelia biflora*, *Axonopus compressus* (grass), *Colubrina asiatica*, *Cocos nucifera* (coconut) and *Terminalia catappa*. Meanwhile, plants included in the suitability matrix are; *Ipomoea pescaprae*, *Vigna marina*, *Spinifex littoreus*, and *Gynura procumbens*. According to [10], turtles have an interest in different vegetation. The types of plants or coastal vegetation formations that are usually found along the turtle nesting areas in general closest to the sea are *Ipomoea pes-caprae*, *Spinifex littoreus*, and *Pandanus tectorius* [8].

Based on the results of measurements in the field, the width of the beach at the observation station ranges from 11.76 m - 5.40 m. The widest beach is at station 4 with an average of 11.76 m. While at station 2 is 5.40 m, station 3 is 6.50 m and station 1 is 11.40 m. According to [11], the width of the beach correlates with the amount of space available for nesting turtles. The wider the beach, the more turtles will land. Sea turtles lay their eggs more on wider beaches than on narrower beaches.

The measurement results obtained, the location exposed to light is at station 3 with a value of 0.01 Lux, the light source comes from a residential area. Whereas at stations 1, 2, and 4 there is no light disturbance for turtle nesting activity with a result of 0.00 Lux. Lighting in the nesting habitat area will affect the nesting behaviour of the mother turtles and the passage of hatchlings [12]. According to [13], the appropriate lighting range for the nesting habitat of turtles is 0 - 3 lux. Light or artificial
light can prevent turtles from laying eggs because turtles are quite sensitive to light. The eye retinal cones in turtles have visual pigments that can absorb wavelengths of 500 - 505 nm [11].

The distance of the building at the observation location greatly influences the turtle nesting activity. Based on observations in the field, the distance between the upper shore where the turtles make their nests and the building ranges from 16.2 m - 111.86 m. According to [11], buildings that do not interfere with turtle nesting are more than 1 km away.

Measurement of tides at the study site using tide signs at coordinates LS = 04°70'23" and BT = 118°96'62". The results of the analysis of tidal data show that the water level at the study site, at the time of the highest tide reaching 212 cm occurred at 22.00 PM and the water level at the lowest low tide was 111 cm occurred at 14.00 AM. Meanwhile, the mean sea level of tides obtained is 153 cm and MSL with a prediction of 15 days will be in the range of 115 cm. The tide chart is presented as follows (figure 1).

3.1. Suitability analysis of turtle ecotourism locations
Based on the results of the analysis of the biophysical parameter data, it is known that the percentages for stations 1, 2, and 4 are included in the appropriate category, with the value; ST1 57.6%, ST2 57.6%, and ST4 63.6%. Whereas station 3 it is classified as not in accordance with the tourism suitability index value of 47.0% (Table 3).

3.2. Turtle laying season
Based on data obtained from technical managers, it was recorded that in 2010 - 2018 the turtle broods on Kapoposang Island spawned at a certain period. The nesting season for turtles on Kapoposang Island occurs from November to July, where there are 1 - 16 broods with an average of 1 - 3 broods laying eggs every month. The peak season ranges from January to April (10 - 16 turtle broods) and February as the peak spawn for 16 turtle broods (Figure 2).
Table 3. Suitability index of turtle nesting habitat on Kapoposang Island.

| Parameters                      | Unit     | Weight | ST1 Data | Category | Score | Ni | ST2 Data | Category | Score | Ni | ST3 Data | Category | Score | Ni | ST4 Data | Category | Score | Ni |
|---------------------------------|----------|--------|----------|----------|--------|----|----------|----------|--------|----|----------|----------|--------|----|----------|----------|--------|----|
| The slope of the beach          | (°)      | 5      | 3-9;30 | 35       | -     | 2  | 10       | 6        | 3-9;30 | 35 | 2        | <3; >35  | 1     | 5  | 3        | 3-9;30 | 35 | 2  |
| Coastal Vegetation              |          | 5      | Vigna   | marina  | 2     | 10 | Spinifex | littoreus, Vigna | marina | 2  | 10       | Ipomea   | pescaprae | | Ipomea   | pescaprae & Gynura | procumbens | 1     | 5  | Spinifex | littoreus, Vigna | marina | 2  | 10 |
| The width of the beach          | (m)      | 5      | 10.83   | <30      | 1     | 5  | 10.83   | <30      | 1     | 5  | 5.40     | <30      | 1     | 5  | 11.76   | <30      | 1     | 5  |
| Light intensity                 | (lux)    | 3      | 0       | 0-0.25   | 3     | 9  | 0.01    | 0-0.25   | 3     | 9  | 0        | 0-0.25   | 3     | 9  | 0-0.25  | 3        | 9     |    |
| Distance from settlement        | (km)     | 3      | 0.03    | km <0.5  | 1     | 3  | 0.01    | <0.5     | 1     | 3  | 0.06     | 0.5–1    | 2     | 6  | 0.11    | 0.5–1    | 2     | 6  |
| Tide                            | (cm)     | 1      | 212     | >100     | 1     | 1  | 1       | >100     | 1     | 1  | 1        | >100     | 1     | 1  | 1       | >100     | 1     | 1  |
| Number                          |          |        | 38       |          | 38    |    |          | 31       |       |    | 42       |          |       |    |         |          |       |    |
| Number of suitability indeks    |          |        | 57.58    |          | 57.58 |    |          | 46.97    |       |    | 63.64    |          |       |    |         |          |       |    |
| Suitability category            |          |        | suitable |          | suitable |    |          | Not suitable |       |    | suitable |          |       |    |         |          |       |    |
3.3. Public conditions and perceptions
The number of interviewed respondents was 22 people with gender specifications; 15 men and 7 women, and various age levels. The highest percentage of age levels was 26-40 years as much as 54%, 23% for ages 19-25 years, and 23% over 41 years. Most (95%) of the community have an elementary education (elementary school), while 5% have a junior high school education (junior high school) and only 4% have a high school education (senior high school). The highest level of community work is as a fisherman as much as 48%, the community as a housewife (IRT) as much as 19%, the community who is a trader by 19%, the community who works as a guide 7% and 7% others.

Public understanding of ecotourism is quite familiar with the percentage value as much as 55%, 9% do not understand and do not understand by 36%. 45% are very interested in being involved in the development of turtle ecotourism, 41% are interested and only 14% are not interested. 36% of the people said that turtle egg hunting was still taking place, 55% said no and 9% said they did not know.

3.4. SWOT analysis
Determination of the planning direction for turtle ecotourism development strategies on Kapoposang Island, carried out using the SWOT method (Strength, Weakness, Opportunity, and Threats), to produce a description of activities and determine the priority of alternative development strategies that are most appropriate to be implemented. The direction of the turtle ecotourism development strategy in Kapoposang Island is presented in Table 4.

| Strength (S) | Weakness (W) |
|--------------|--------------|
| It has coastal and marine biodiversity which can become tourism objects for ecosystems such as mangrove and seagrass reefs. | The quality of the resources is still lacking and the management is not serious. |
| There are turtles that go up to lay eggs, release hatchlings, dive spot turtle points and feed the ground for turtle tourism activities. | Supporting facilities for turtle nesting tourism activities are still lacking and transportation facilities are still fairly difficult and expensive. |
| There are social/cultural tourism attractions that are still being maintained. | There is no organization for tourism activities and the lack of promotion of tour packages. |

**Table 4. Directions for ecotourism development strategies on Kapoposang Island**

| Opportunity (O) | SO | WO |
|----------------|----|----|
| Increasing community welfare through alternative livelihoods (side jobs). | Promoting various kinds of tourist objects that can be enjoyed on Kapoposang Island. | Capacity-building training and assistance to organize community groups in an integrated manner. |
| The enthusiasm (understanding, interest, and hope) of the community is quite large for the development of ecotourism. | Facilitating communities who wish to be involved to conduct FGDs and together formulate a sustainable turtle ecotourism development plan. | It is necessary to repair, maintain and add facilities to support tourism activities as well as the direction of the arrangement of organized turtle tourism activities. |
Conducting comparative studies to areas that are considered successful in optimizing the potential of ecotourism.

### Threats (T) ST WT

| The existence of coastal erosion and the threat of natural predators. | A better ecotourism management plan and provide firm action for those who break the rules. | Conducting outreach for local communities regarding the protection of turtle habitat and disseminating ecotourism development plans. |
| There is turtle egg hunting for household consumption. | |
| The understanding of the protection of nesting turtle habitat is still low and there is a lot of garbage found in the nesting habitat of turtles. | |

#### 4. Conclusion

Stations 1, 2, and 4 are suitable locations for turtle ecotourism activities on Kapoposang Island. 2. The turtle breeding activity carried out by the community group “Bahari Lestari” is no longer operating due to the lack of community capacity in managing the group. 3. The development strategy directions that need to be carried out are: (1) Capacity building training and assistance in organizing community groups in an integrated manner; (2) Need to repair, maintain and add supporting facilities for tourism activities as well as directions for organized turtle ecotourism scenarios; (3) Conducting comparative studies to areas considered successful in developing turtle ecotourism.

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