

CHARACTERISTICS OF TURTLE NESTING HABITAT ON POPARENG BEACH, TATAPAAAN DISTRICT, SOUTH MINAHASA REGENCY, BUNAKEN NATIONAL PARK AREA

Randi Bobby Mukuan¹, Helen J Lawalata², Anita Tengker³, Iriani Setyawati⁴,
Revolson Alexius Mege⁵

Biology Departement, Faculty of Matehematics and Natural Science, Universitas Negeri
Manado, Indonesia.

*Corresponding author: randimukuan@gmail.com

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Abstract

Turtles They are among the world's protected animals and one of the rare, almost extinct species. The preservation of their habitat and knowledge of the traits of turtle-friendly habitats are two ways that the rescue and protection of these turtles must go on. For rescue operations, turtle sustainability, and sustainable coastal management, research is being conducted on the features of the turtle nesting habitats on Popareng Beach. This research aims to determine the characteristics of turtle nesting habitats and identify the parameters that hinder turtles from nesting at Popareng Beach, Tatapaaan District, South Minahasa Regency. The method used in this research is the descriptive-exploratory method. With characteristic parameters consisting of beach width measurement, beach slope, sand temperature, sand humidity, sand texture, beach vegetation, and the presence of predators. From the research results, it shows that station 1 and station 2 have results that are suitable for turtle nesting habitats, with values obtained at station 1 being 88.33% and station 2 being 92%. Meanwhile, at station 3, with an evaluation score of 72%, it is considered fairly suitable and the station has tolerable limitations.

Keywords: Nesting Habitat, Popareng Beach, Turtles

INTRODUCTION

Indonesia is rich in maritime resources. A large portion of their biodiversity is still preserved or has not been fully utilized. Furthermore, it is indisputable that Indonesia's biodiversity has been used, but not all of it has been done so with human understanding and kindness. The turtle is one of the biodiversity among them that is currently in danger of being extinct (Walujan, 2022).

Turtles are one of the rare animals that are nearly extinct and are among the protected animals in the world. Human activities such as poaching, turtle egg theft, and beach pollution are some of the factors causing the drastic decline in the population of these rare animals. In the world, there are 7 types of turtles, and 6 of them are found in Indonesia. The types of turtles found in Indonesia are the green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), olive ridley turtle (*Lepidochelys olivacea*), leatherback turtle (*Dermochelys coriacea*), flatback turtle (*Natator depressus*), and loggerhead turtle (*Caretta caretta*).

The existence of turtles in Indonesia is protected under Law Number 5 of 1990 concerning the Conservation of Biological Natural Resources and Their Ecosystems. Protected by Government

Regulation (PP) Number 7 of 1999 concerning the Preservation of Plant and Animal Species. And the opportunity for its utilization through breeding regulated by Government Regulation (PP) No. 8 of 1999 concerning the Utilization of Plant and Animal Species. In Article 50 Paragraph (3), it states that: "Anyone who takes wild plants or wild animals from their natural habitat without permission or does not comply with the provisions as referred to in this article, may be subject to an administrative fine and prohibited from utilizing wild plants and animals" (Walujan, 2022).

The turtle nesting habitat can be said to be a very sensitive habitat; if one aspect is not met for it to become a nesting site, then the turtles will not nest on that beach. A conducive landscape condition is essential to increase the turtle population. One of the efforts for the sustainability of natural resources and biota, namely turtles at Popareng Beach, is to understand the characteristics of turtle nesting habitats. The rescue and protection of these turtles must continue, one of which is by preserving their habitat and understanding the characteristics of suitable habitats for turtles, especially at Popareng Beach. Therefore, this research is conducted to identify the characteristics of turtle nesting habitats at Popareng Beach. Research related to the characteristics of turtle nesting habitats at Popareng Beach has not been conducted before. This is very necessary to be done considering it as an effort for the rescue, sustainability of turtles, and sustainable coastal management, especially in Popareng Village.

RESEARCH METHODS

This research is an exploratory descriptive study, which involves conducting primary data collection activities, such as measuring beach width, beach slope, sand temperature, sand humidity, sand texture, and vegetation, directly in the field. Then, the data is analyzed by calculating scoring weights and interpreting the data to create a description of the events that occurred during the research. The data collection technique was carried out through direct field observation. The location of this research is conducted at Popareng Beach, Popareng Village, Tatapaan District, South Minahasa Regency, North Sulawesi, Bunaken National Park area. This research will take place over a period of 2 months, starting from October to November 2024.

Analysis

Data is processed by calculating the scoring weight from the processed data for the assessment of the relative condition of turtle nesting sites using the relative condition index formula proposed by Setiawan (2018). The higher the score obtained, the more important the location.

The suitability of turtle nesting habitat locations is determined by the following formula: Evaluation Score = Total score of each station/3 x 100%. The criteria for the suitability of turtle nesting locations are as follows: (1) Score 85-100% (suitable; the station has no significant barriers), (2) 60-84% (fairly suitable; the station has tolerable barriers), and (3) < 60% (not suitable; the station has severe barriers) (Setiawan, 2018).

Table 3.1 Parameter Weighting and Scoring

Parameter	Criteria	Law of Value	Score Value
Sand Temperature	29-32	3	0,9
	26-28	2	0,6
Substrate Moisture (%)	≤40 ≥85	1	0,3
	65-85%	3	0,9
	40-60%	2	0,6
	≤40 80≥	1	0,3
Beach Slope (%)	3 – 8	3	0,9
	8 – 16	2	0,6
	≥16	1	0,3
Sand Texture	Smooth	3	0,45
	Medium	2	0,30
	Rough	1	0,15
Type of Vegetation	≥75%	3	0,3
	50 - 75%	2	0,2
	≤50%	1	0,1

Research Procedure

Observation of turtle nesting habitat characteristics at each station includes beach width, beach slope, sand temperature, sand humidity, sand texture, beach vegetation, and the presence of predators.

RESULTS AND DISCUSSION

Result

Beach Width

The results of the research conducted at the three stations on Popareng Beach, Bunaken National Park area. At station 1, the beach width obtained was 40 meters, and at station 2, the width obtained was 20 meters, while at station 3, the lowest width was 15 meters. From the measurements conducted at the three stations, the ideal nesting site for turtles is only found at station 1 with a width of 40 meters. This is because the ideal beach width for turtle nesting habitats is around 30 – 80 meters (Nuitja, 1992). At stations 2 and 3, it is not an ideal place for turtles to lay their eggs. This is because the width of these locations does not fall within the ideal range for turtle nesting. However, according to information from the local community, stations 2 and 3 have been used as nesting sites by turtles. And at that time, because the width significantly affected the turtle eggs, the local community built barriers made of wood or boards to protect the turtle eggs from water entering the nests and damaging the turtle eggs. The value of the beach width can be seen in Table 4.1.

Beach Slope

The average slope of Popareng beach is 10 - 15%. From the measurements that have been conducted, the slope value obtained at station 1 is 15% and the slope value obtained at station 2 is 15%, while at station 3 the slope value obtained is 10%. Based on these measurement results, the lowest slope

is at station 3 with a value of 10%, while stations 1 and 2 have slopes suitable for turtles to lay eggs in those locations. Station 3 still falls within the category of an ideal turtle nesting site. This is in accordance with Nuijta's theory (1992) that the condition of a sloping beach (3 - 8%) and steep (8 - 16%) can facilitate turtles in reaching their nesting sites. With the results obtained, the slope of Popareng beach is classified as a sloping beach and becomes an ideal place for turtles to lay their eggs. For the overall slope value of the beach, it can be seen in Table 4.1

Substrate Moisture

The results of the sand moisture measurements at the three stations averaged 80 – 88%. At station 1, the moisture value obtained was 82%, and at station 2, the moisture value obtained was also 82%, while at station 3, the moisture value obtained was 87%. The similar moisture values at stations 1 and 2 were due to the fact that during the data collection, the two locations were only about 20 meters apart, resulting in similar moisture values at both stations. Meanwhile, at station 3, the moisture value was taken from a location farther away from stations 1 and 2 to ensure different moisture values at that station. With the results obtained at stations 1 and 2, they fall within the requirements for turtle nesting sites because, according to Septiana (2016), the requirements for turtle nesting sites are a humidity of 65 – 85%. Meanwhile, station 3 has a humidity value that does not meet the requirements for turtle nesting sites.

Table 4.1 Measurement results of beach width, beach slope, sand moisture content, and sand temperature.

Parameter	Station 1	Station 2	Station 3
Beach Width (m)	40	20	15
Beach Slope (%)	15%	15%	10%
Substrate Moisture(%)	82	82	87
Sand Temperature (°C)	31,58	31,58	30,60

Sand Temperature

From the measurement results of the beach sand temperature at Popareng, the average value at the three stations is 30 - 31°C. At station 1, the sand temperature obtained is 31.58°C, and the sand temperature at station 2 is also 31.58°C, while at station 3, the sand temperature obtained is 30.60°C. Therefore, based on the measurement results, the highest sand temperature is found at stations 1 and 2. According to Nuijta (1992), the appropriate nest temperature for turtle nesting is 28 - 35°C. Based on the results obtained, it can be said that at all three stations, the sand temperature is suitable for turtle nesting.

Sand Texture

From the measurement results of sand texture at the three stations, an average of 90% fine sand was found. This falls within the range of sand texture preferred by turtles because, according to Nuijta (1992), the texture composition of turtle nesting areas consists of at least 90% sand and the remainder being dust. Therefore, the sand texture at the three stations can be said to be the type of sand preferred by turtles. The structure of sand can affect whether the sand is suitable or not for turtle nesting sites. Turtles usually lay their eggs on beaches with medium to fine sand grain size, as the sand structure significantly influences the turtles when they dig their nests (Rachman, 2021).

Vegetation

Based on field research, the vegetation commonly found around turtle nesting sites includes the waru tree (*Hibiscus tiliaceus*) and coconut trees. At station 1, the type of vegetation found is the waru tree, and around station 1, the waru trees are quite abundant, allowing turtle nests to be shielded from excessive light entering the nests.

Table 4.2 Types of Plant Vegetation

Local name	Latin name	Station 1	Station 2
Waru Tree	<i>Hibiscus tiliaceus</i>	✓	✓
Coconut Tree	<i>Cocos nucifera</i> L.		✓

At station 2, the vegetation found includes the waru tree (*Hibiscus tiliaceus*) and the coconut tree (*Cocos nucifera* L.). The waru tree is still quite abundant at station 2 and is almost the same as at station 1, except that at station 2 there are coconut trees around the waru trees, and these coconut trees are relatively few compared to the waru trees. At station 3, the types of vegetation encountered include the waru tree and the coconut tree. Both types of vegetation are relatively few around the station but are still sufficient to cover the turtle nests from excessive sunlight. The types of vegetation can be seen in Table 4.2

Predator Presence

Based on the results of observations around the turtle nesting sites at Popareng Beach, there are several predators for turtle eggs and hatchlings. The sandy and expansive beach environment has many crab and ant nests, which can potentially prey on turtle eggs in the nests. Additionally, based on interviews with the local community, it was mentioned that there are several animals that could potentially be predators for the eggs and hatchlings, including monitor lizards and dogs. Other predators that pose a threat to turtles include eagles, which can prey on hatchlings when they are heading to the sea.

Table 4.3. Weighted Scoring Results for Parameters

Parameter	Station	Criteria	Law of Value	Score Value
Temperature	1	31,58	3	0,9
	2	31,58	3	0,9
	3	30,60	3	0,9
Sand Moisture	1	82	3	0,9
	2	82	3	0,9
	3	87	1	0,3
Beach Slope	1	15%	2	0,30
	2	15%	2	0,30
	3	10%	2	0,30
Sand Texture	1	90%	3	0,45
	2	90%	3	0,45
	3	90%	3	0,45
Vegetation	1	<50%	1	0,1
	2	>50%	2	0,2
	3	>50%	2	0,2

Table 4.4. Analysis of Sea Turtle Nesting Habitat Suitability

Station	Temperature	humidity	Slope	Sand Texture	Vegetation	Evaluation Value
1	0,9	0,9	0,30	0,45	0,1	88,33%
2	0,9	0,9	0,30	0,45	0,2	92%
3	0,9	0,3	0,30	0,45	0,2	72%

Based on Table 4.4, the evaluation scores obtained for stations 1 and 2 indicate results that are suitable for turtle nesting habitats, meaning that both stations have characteristic factors that are appropriate for turtle nesting sites. The evaluation score obtained at station 1 is 88.33% and at station 2 is 92%, while for station 3, the evaluation score is 72%, which means it is fairly suitable and the station has tolerable limits. This is due to the parameter that becomes the limiting factor for turtle nesting locations at station 3, which is humidity. The results of the weighting and scoring analysis for stations 1 and 2 fall into the category of 85 – 100% (suitable: the station has no limiting factors), and for station 3, it falls into the category of 60 - 84% (fairly suitable: the station has tolerable limits).

Discussion

The width of the beach affects the area available for turtles to land and nest. The measurement of beach width is conducted from the lowest low tide point to the outermost vegetation, which is divided into intertidal width and supratidal width. The intertidal width is the area affected by the highest tide and the lowest low tide. Meanwhile, the supratidal area is the area from the highest tide to the outermost vegetation (Setiawan et al:2018). A wide beach will prevent turtle nesting sites from being submerged and prevent turtle egg hatching failures. If the beach width is too wide, it will make it difficult for turtles to land because the duration required will be too long, and if the beach width is too narrow, seawater will reach the turtle nests and cause hatching failure. The width of a beach has an impact on turtles in their nesting activities. Turtles tend to choose wide beach locations with narrow lengths and widths to make it easier for them to return to the sea after laying eggs (Mansula, 2020).

The slope of the beach is one of the most influential factors in turtle nesting. This can be attributed to the fact that the slope of the beach affects the ascent of female turtles to the shore. The slope of the beach preferred by turtles is a gently sloping beach, as it greatly affects the turtles' accessibility to suitable nesting areas. The steeper the beach slope, the more difficult it is for turtles to reach the supratidal area (Setiawan et al; 2018). The steeper the beach, the more energy turtles need to ascend and create nests, and the harder it is for them to see objects far ahead (Akbar et al; 2020). A gently sloping beach with fine sand can facilitate turtles' movement to the land to find nesting locations (Fitri and Herawati, 2023).

The moisture of the sand in dry conditions or in a state of low humidity will cause the hatchlings to die inside before they can emerge from the nest, because if the sand moisture is low, it will result in the release of fluid from inside the egg. Thus, it makes the hatchlings inside the eggs difficult to emerge from the shell and they run out of energy to break the eggshell (Muliani, 2022). At night, the air humidity is high,

and during this time, turtles usually come ashore to lay their eggs because the temperature is relatively low with high air humidity. Conversely, turtles will not come ashore to lay their eggs during the day when the temperature is relatively high with low humidity (Septiana and Budiharjo, 2019). Maintaining the temperature within the optimum range can increase the hatching success rate, just as maintaining the sand's humidity.

The sand temperature at the optimum threshold for the ideal turtle nesting temperature is 25 – 35°C (Hamino, 2021). Therefore, it can be said that the three stations have suitable temperatures for turtle nesting. The sand temperature that is too high above (>35°) will make it difficult for turtles to build nests, and if the sand temperature is too low below (<25°), it will affect the incubation process, as the low temperature will damage the embryos in turtle eggs or cause failure in growth, development, and hatching (Dharmadi and Wiadnyana, 2017). The sand temperature also affects the gender of the hatchlings and prevents egg decay (Semboor, 2021). At a sand temperature of 29°C during the incubation period, it will produce male hatchlings, while a sand temperature above 29°C will produce female hatchlings (Winarto and Azahrah, 2022). In addition, turtles also nest at night because they prefer places with dry sand and not too high temperatures that meet the needs of their eggs to survive (Rachman et al; 2019).

The texture of the sand is one of the most important physical factors in the success of turtle nesting. These characteristics affect the ease of nest excavation, incubation temperature, and water drainage, which ultimately influence the hatching success rate. Research by (Parinding et al, 2022) on Venu and Wairundi Islands in Papua shows that turtles prefer sand with a medium texture over fine or coarse sand. Medium sand facilitates the digging process by the mother turtle and maintains a stable temperature and humidity within the nest. A study by (Utami et al, 2019) at Pasir Panjang Beach, Riau, revealed differences in preferences among turtle species: Green turtles (*Chelonia mydas*) prefer fine to very fine sand, as it is easier to dig and can retain high moisture levels. Hawksbill turtles (*Eretmochelys imbricata*) tend to prefer medium to coarse-grained sand, which provides better drainage on more humid beaches. According to (Damanhuri et al, 2019) in Pulau Laut-Sekatung, Natuna, coarse-textured sand has high absorption and drainage capacity. This reduces the risk of waterlogging that can rot the eggs. However, sand that is too coarse can cause the nest to collapse easily and become hotter during the day. Research on Kapoposang Island by (Eriawan et al, 2024) linked sand texture to hatching success: Nests with medium and clean sand showed a hatching success rate of up to 56.6%, while sand mixed with gravel or clay resulted in lower hatching rates due to unstable temperature and drainage.

Vegetation plays an important role for turtles in nesting to protect the eggs from direct sunlight, prevent sharp temperature changes in the surrounding area, and protect the nests from predator disturbances (Manurung, 2015). The density of coastal vegetation affects the intensity of incoming light. Low light intensity will impact the success rate of turtle nesting. Turtle nesting areas are closely related to vegetation conditions, especially density, which is associated with vegetation cover. The denser the vegetation, the greater the vegetation cover, as the density of the vegetation will block the intensity of light reaching the ground beneath the vegetation, providing tranquility or a sense of security when turtles are

about to lay their eggs in the nesting site. (Rachman et al., 2019). Eggs that are in open land have a shorter average incubation period of 48 days, while eggs that are under vegetation cover have a longer incubation period of around 50-52 days (Nugroho et al., 2018).

Turtles are vulnerable to predators such as wild boars, civets, wild dogs, eagles, sharks, and monkeys. From the research conducted by (Nieko et al, 2019), observations of the types of predators seen around the turtle nesting sites only include ghost crabs (*Ocypode cursor*). However, according to the conservation managers, monkeys, snakes, and dogs are sometimes seen at Taman Beach. The presence of predators on Popareng Beach is recorded to be only those according to information from the community. It is said that the existence and maintenance of these animals have been with the community since they settled in the area (Revolson, 2018).

CONCLUSION

Based on research results at Popareng Beach regarding the characteristics of turtle habitats, the average slope on Popareng Beach is 15%. The nest temperature ranges from 30.60°C to 31.58°C. The average humidity in the nest reaches 87%, while the sediment composition consists of 90% sand and 10% dust. The vegetation commonly found includes the Waru Tree (*Hibiscus tiliaceus*) and the Coconut Tree (*Cocos nucifera* L.), while the predators identified are monitor lizards and dogs

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