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The Biophysical Characteristics of Sea Turtle Spawning Beaches: A Study in Mas Popaya Raja Nature Reserve

Meriyanti Ngabito[1], Ahmad Fahrizal[2], Muh Yasin Umsini Putra Olii[3], Elce A Polimango[4], Asniati Ningsi [5]

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Abstract

This article contains the biophysical characteristics of turtle nesting beaches on Pobaya Island. The research was conducted in the Mas Pobaya Raja Nature Reserve. The method was an exploratory survey of the biophysical characteristics of the turtle nesting beach. It consists of beach width, sand temperature, beach slope, coastal vegetation and predators around the turtle nesting beach. The results showed that the width of the intertidal zone beach was 7.2 m - 31.7 m and the width of the supratidal zone beach was 11.6 m - 21.4 m. The highest sand temperature measurement at station 6 is 26 – 34.5 °C and the lowest at station 3 is around 24 – 31.5°C. The coastal slope includes stations 1, 2 and 3 with sloping categories ranging from 5.8o - 8.4o the direction of the beach slope at stations 4, 5 and 6 is steep, namely 14.24o - 17.87o. Two turtle species were found, namely Chelonia mydas and Eretmochelys imbricate. There were 14 types of vegetation found, station 5 had the lowest number of vegetation and the lowest was at station 6. Natural predators that often appear in turtle nesting habitats are monitor lizards, crabs, and insects. Air quality parameters during the study included water temperatures reaching 27 -32 oC, pH still in a stable condition, namely 7 - 8 and DO ranging from 12.4 - 15.3 mg/L.

[1]Department of fisheries and marine, Gorontalo University, Gorontalo, Indonesia.
Coresponding Email: meriyantingabito8yg6@gmail.com
[2] Departement of aquatic resources management, Sorong Muhammadiyah University, Papua, Indonesia
Email : a.fahrizal.ab@gmail.com
[3] Department of fisheries and marine, Gorontalo University, Gorontalo, Indonesia.
Email : umsiniputra@yahoo.com
[4]Department of fisheries and marine, Gorontalo University, Gorontalo, Indonesia.
Email: elcepolimangoo@gmail.com
[5]Department of fisheries and marine, Gorontalo University, Gorontalo, Indonesia.
Email : aningsihazis@gmail.com

1. Introduction

North Gorontalo is one of the regencies in Gorontalo Province- Indonesia, with a coastline length of ± 230 km. It is an area that has the longest coastline in Gorontalo Province. North Gorontalo Regency has 52 islands out of 123 small islands in Gorontalo Province. Two of them are permanently inhabited, namely Ponelo Island and Dudepo Island, 2 islands are marine tourism areas, namely Saronde Island and Lampu Island, and 3 other islands, namely Mas Island, Popaya Island and Raja Island was declared a Mas Popaya Raja Nature Reserve area.

One of these islands, namely Popaya Island, is a Nature Reserve Area in Gorontalo Regency. Turtle is one of the protected species. It go through a very slow growth period and take decades to reach reproductive age. This animal is a group of species that is getting closer to extinction. This is due to the high level of exploitation in the form of trade in turtle meat, trade in turtle eggs and the use of turtles for tourism purposes which ignores the survival rate of the turtles themselves.

Popaya Island is located in Dunu Village, Monano District, North Gorontalo Regency which has an area of ± 2.24 ha and is surrounded by a beach length of about 621.44 meters with a geographical location of 00040'40 "NL - 122042'33" East Longitude, with a distance of 1.5 miles from the mainland of Dunu Village and is between ±25 minutes by fishing boat. According to information from the local villagers, this island is often used as a place for turtle migration and landing for spawning activities. Literature studies from the results of previous studies are still very minimal regarding the conditions and characteristics of the beach which will become a turtle nesting place. This is the basis for researchers to conduct further research because the condition of coastal characteristics is the main factor and determinant of the sustainability of turtle species in their reproductive stage. The purpose of this study is to determine the biophysical characteristics, biological parameters and physics of turtle nesting beaches on Popaya Island, the Mas Popaya Raja Nature Reserve.

2. Materials and Methods

This research was carried out for 3 months, starting from October – December 2019, the research location was located on Popaya Island, Mas Popaya Raja Nature Reserve Area, North Gorontalo Regency, Gorontalo Province. Considering the shape of the island of Popaya, which has beaches in certain parts, which are often hit by waves at high tide, the research location is divided into 6 stations determination of stations at random (Cremer, 1999; Satriadi, 2004). In data collection, the observation of the biophysical characteristics of the sea turtle nesting site was carried out using the exploratory survey method.

Primary data

1) Beach Width

The width of the beach can be measured from the shoreline to the outermost vegetation boundary. The measurement of the beach width is determined at each station point in an area that represents the beach width of each station point.

2) Sand Temperature

The sand temperature measurement using a thermometer is carried out at the base of the substrate. The temperature is measured by digging the sand first by determining the depth of the turtle nest

about 40-50 cm so that the thermometer can be inserted into the sand for approximately one minute.

3) Beach Slope

The slope of the beach can be measured using a 100 m scale rope to measure the length, while to get the height by using a 2 m scale stick. Measurement starts from the outermost vegetation to the shore is first wet by the waves. The slope value can be calculated using the formula (Lin et al., 2008).

Formula : $\tan = \frac{Y}{X}$

$a = \arctan \frac{Y}{X}$

Note : a = Angle of the beach slope (°)

Y = Total beach height (1+2+3+4) The distance for the perpendicular line formed by the horizontal wood with the sand surface below.

X = Distance Number of beaches (a+b+c+d)

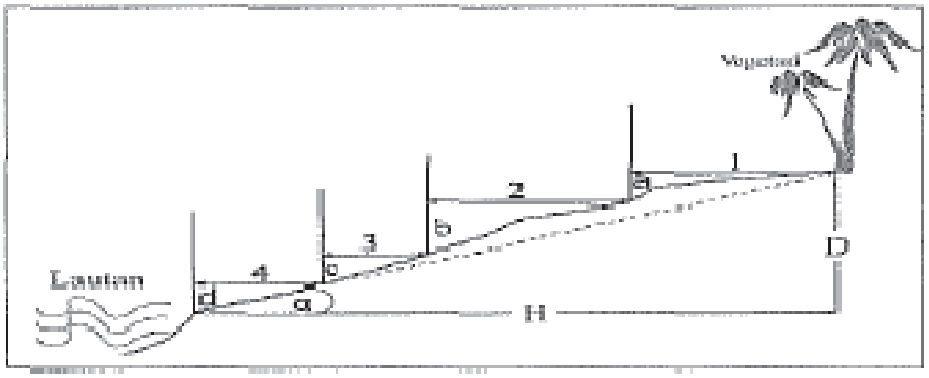


Figure 1.
Techniques for Measuring Coastal Slope The number of beaches (a+b+c+d)

4) Beach Vegetation

In the observation of coastal vegetation, it is measured using a roll meter that is drawn parallel to the beach that has been selected as a station point, then measure the length of the vegetation found and not vegetated so that the percentage of vegetated and non-vegetated beaches can be known.

5) Natural Predators

Predators are a threat for turtles to lay their eggs, by doing visuals directly at the research location and seeking information from the local community, we can find out what predators are in the location.

6) Water Quality Parameters

Measurements were made to determine the optimal water quality for turtle nesting conditions. In this study, measuring water quality parameters such as temperature, DO, and pH was carried out 3 times during the study, measured in the morning and evening.

Data analysis

The data obtained during the study were the results of observations observed in direct measurements from the field (primary data) which consisted of data on the bophysical characteristics of the coast on the island of Popaya. Data analysis in this study is descriptive, namely by knowing several biophysical characteristics of turtle nesting beaches such as beach width, beach slope, sand temperature, vegetation, natural predators and water quality parameters. The results of the data obtained will be presented in the form of tables and figures (Burns & Groove, 2014).

3. Results and Discussions

Beach Width

Popaya Island has an area of ± 2.24 ha and a length of about 621.44 m, in this study the observed beaches were divided into 6 stations. The width of the beach consists of the suprtidal zone and the intertidal zone. The results of measuring the width of the beach can be seen in Figure 2.

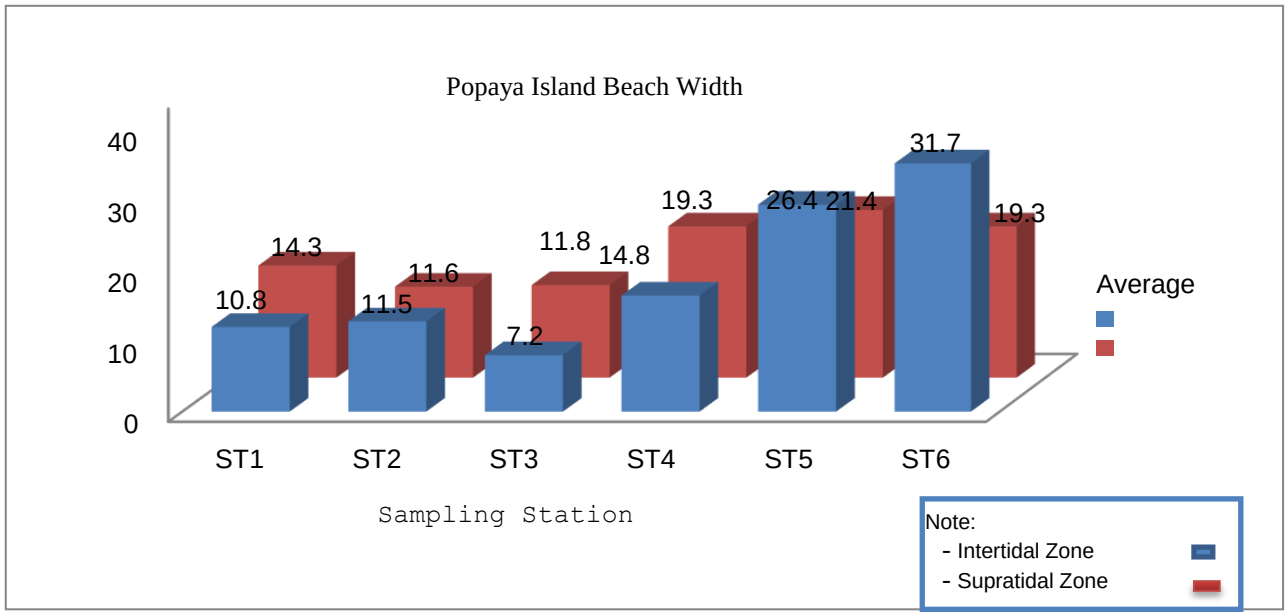


Figure 2.
The width of the Popaya Island Beach in the Intertidal Zone and the Supratidal Zone

Based on the figure above, the width of the intertidal zone beach is 7.2 m – 31.7 m and the width of the supratidal zone beach is 11.6 m – 21.4 m. In observing the width of the beach for the intertidal zone seen from the highest tide and the slope of an area, at station 6 is the largest intertidal zone because it is influenced by the stretch of coral reef ecosystem which is still dense compared to other stations. Lin et al. (2008) stated that the part of the coast facing the coral reefs has calm waves and causes the addition of the intertidal area. In contrast to the width of the beach at station 3 which has the lowest intertidal zone of 7.2 m, due to the position of the beach which is close to the open sea so that the waves are much stronger.

Sand Temperature

Based on observations, the highest sand temperature is at station 6 of 26-34.50 and the lowest is station 3 with temperatures between 24-31.5°C. The results of temperature measurements are shown in table 1 below:

Table 1.
Measures of Sand Temperature on Popaya Island

Station	Send Temperature(°C)
1	24 - 33
2	26 – 32
3	24 – 31.5
4	25 – 34
5	26 – 34
6	25 – 34.5

Source: Primary Data, 2019

Temperature greatly affects the process of laying turtles, in incubating turtle eggs, an optimal temperature is needed for the formation of embryos and maintaining the humidity of the nest so that it does not rot easily. According to Zug et al. (1998), the optimal temperature for embryo development in turtle egg incubators is around 24-33ºC.

Beach Slope

The slope of the coast is one of the factors that play an important role for turtles in choosing a place to lay their eggs, because it is reproductively beneficial. Based on the results of measurements of the coastal slope of Popaya Island at each station location, it can be seen in Figure 3.

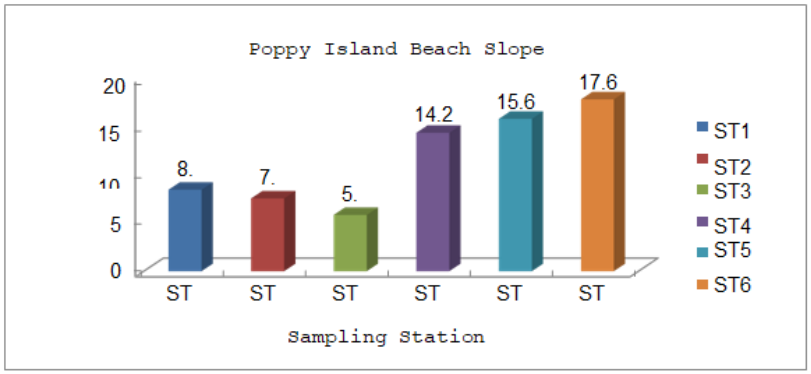


Figure 3.
The slope of the Popay Island beach

From the measurement results, it is determined that the slope of the coast of Popaya Island is suitable for turtle nesting habitats. Turtle species that often appear on this island are loggerhead turtle, Hawksbill turtle (Eretmochelys imbricate) and Green turtle (Chelonia mydas).

Beach Vegetation

Coastal vegetation is one of the factors that support the characteristics of the beach and plays an important role for turtles to determine nesting locations. Observations showed that vegetation was found at every station on the coast of Popaya Island which was dominated by sea pine (Casvarina equisetifolia), coconut (Cocos nucifera), sea pandanus (Pandannus tectorius), ketapang (Terminalia cattapa), Butun (Baringtonia asiatica) and katang-katang. (Ipomoea pes-caprae). This is in accordance with the opinion of Rusila et al. (1999), plants that usually grow around the beach where turtles land are sea waru (Hibiscus tiliaceus), Sentigi (Phemphis acidula), Rumbiga (Calatropis gigantea), Noni (Morind citifolia), and Cactus (Opuntia spp).

Natural Predator

Turtle nesting habitats include habitats for other animals such as natural predators that coexist in a coastal ecosystem. Predators such as monitor lizards, burrowing crabs, and insects pose a threat to the nesting habitat when the eggs are nested. The presence of natural predators becomes dangerous for turtles and their eggs in the coastal area of the island of Popaya as well as threats to turtles that are still in the hatchling phase or have just hatched resulting in decreased hatchling growth due to predation (Butcher & Elson, 2017).

Water quality

The characteristics of a beach are strongly influenced by water quality conditions. The results of water quality measurements are shown in Table 2 below.

Table 2. Waters Quality Parameter

No.	Waters Quality Parameter	Value
1	Temperature	27 – 32 ^{o}C
2	pH (Acidity)	7 – 8
3	DO (Dissolved Oxygen)	12,4 – 15,3 mg/L

Source: Primary Data, 2019

The results of the measurement of the water temperature in the island of Popaya reached 27 - 32 oC. The temperature measured during observations was still in optimal conditions for the life of marine ecosystems in the waters of the island of Popaya, especially turtle species. According to Gonçalves & Erzini (2000), the optimal temperature of seawater is below 0°C-33°C. According to Campbell and Busack (1979), it is recommended that the water temperature for turtles is above

21oC because turtles have a minimum limit for carrying out normal activities. pH measurement data in the waters of the island of Popaya is still in a stable condition, namely 7-8. Marine life has a pH quality standard of seawater which is in the range of 7-8.5. When the pH is high, ammonia formation will occur, the higher the toxic ammonia will pose a risk to aquatic organisms and will endanger survival, including turtles.

Dissolved oxygen is needed by marine biota as a process of exchanging substances (metabolism) which becomes energy for growth and survival, especially turtles. In observations of DO measurements in Popaya Island, which ranged from 12.4 – 15.3 mg/L, the DO value during the study was still considered optimal for marine organisms and in accordance with the Decree of the Ministry of Environment No. 51 of 2004 concerning the life of marine biota for dissolved oxygen values > 5 mg/l.

4. Conclusion

Finally, from the theoretical presentation, and the discussion presented above, it is concluded several essential points as follows.

1) The results of the research in the Popaya Island Nature Reserve have biophysical characteristics that support the turtle spawning process and water quality parameters that meet quality standards for the sustainability of marine organisms including turtle species.
2) The biophysical characteristics of the beach include the width of the beach which is divided into 2 types, namely the intertidal zone and subratidal zone, beach slope, sand temperature, vegetation and natural predators.

Next, it is also recommended that further research is needed to be conducted, especially related to other reproductive aspects as well as research on the condition of hatchlings that have successfully hatched and the effect of natural temperature on the sex of the newly hatched hatchlings and research on the hatchlings that have successfully hatched and headed for the beach.

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