



Study of temperature, humidity, and semi-natural nest depth parameters on the hatching rate of hawksbill turtle (*Eretmochelys imbricata*) Eggs at Lowita Beach, Pinrang regency

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Abstract

Lisdayanti, conducted a study under the guidance of Asbar and Danial on the parameters of temperature, humidity, and semi-natural nest depth, and their impact on the hatching rate of Hawksbill turtles (*Eretmochelys imbricata*) at Lowita Beach, Pinrang Regency. The Hawksbill turtle (*E. imbricata*, L.) is a small-sized turtle species, smaller in size compared to the Green turtle. Adult Hawksbill turtles have a length of 70-90 cm and weigh between 40-90 kg, with straight shells ranging from 66 to 86 cm in length. The aim of this research was to examine the parameters of temperature, humidity, and semi-natural nest depth in relation to the hatching rate of Hawksbill turtle eggs at Lowita Beach, Pinrang Regency. The study was conducted between February and May 2023, at Lowita Beach. A descriptive survey method was used to study the semi-natural nests by measuring the temperature, humidity, and nest depth. Data collection focused on studying the physical parameters of the semi-natural nests, including nest depth, nest temperature, and nest humidity. Based on the research findings, the hatching success rate of Hawksbill turtle eggs at the research site reached 90.38%, with an average nest temperature ranging from 28°C to 39°C, stable humidity levels, and an ideal nest depth of approximately 40 cm. This research provides important information about the environmental parameters that influence the hatching rate of Hawksbill turtle eggs, which can be utilized for conservation and protection efforts for this species in the future.

Keywords: Physical Parameters, semi-natural Nests, Egg Hatching, Hawksbill Turtle

Introduction

Hawksbill turtles (*Eretmochelys imbricata*) draw attention as a rare and endangered species. Among the existing turtle species, the Hawksbill turtle is classified as critically endangered and listed on the IUCN Red List. However, the challenges never cease for the population of Hawksbill turtles. Habitat destruction, hunting, and climate change are looming threats to their survival.

One significant moment in the life of Hawksbill turtles is when their eggs hatch. The hatching period becomes a critical stage where the environmental conditions surrounding the nest greatly influence the hatching success rate. When discussing important nesting sites for Hawksbill turtles, we cannot overlook Lowita Beach. Located in Pinrang Regency, this beach serves as a special place chosen by Hawksbill turtles to lay their eggs. The female turtles meticulously create semi-natural nests in the sandy beach, providing an environment that supports the development of Hawksbill turtle embryos before they hatch and embark on their journey to the ocean. (Ermysuari, 2022) ^[4].

In such a context, it is crucial for us to study the environmental parameters that play a vital role in the hatching rate of Hawksbill turtle eggs at Lowita Beach. This research focuses on three main parameters: temperature, humidity, and semi-natural nest depth.

The temperature inside the nest affects the embryo's development, while humidity ensures environmental stability around the eggs. The nest depth also plays a role in maintaining stability and protecting the eggs from external disturbances. Previous studies have shown that changes in environmental parameters can significantly impact the hatching success rate of Hawksbill turtle eggs. However, there has been no comprehensive research on the influence of temperature, humidity, and semi-natural nest depth on the hatching rate of Hawksbill turtle eggs at Lowita Beach. Therefore, this study aims to fill this knowledge gap by examining how temperature, humidity, and semi-natural nest depth affect the hatching rate of Hawksbill turtle eggs at Lowita Beach, Pinrang Regency. (Winarto & Azahra, 2022) ^[11] The hope is that the findings of this research can

provide new insights into the environmental factors contributing to the hatching success of Hawksbill turtle eggs. Thus, this information can serve as a strong foundation for more effective management and conservation efforts to protect the Hawksbill turtle population in this area. (Prihanta *et al.*, 2016) ^[9].

Materials and Methods

This research was conducted from February to May 2023, at Lowita Beach, Wiringtasi Village, Suppa District, Pinrang Regency, South Sulawesi Province. A descriptive survey method was employed to study the semi-natural nests by measuring the temperature, humidity, and nest depth. The location map of the study can be seen in Figure 1.

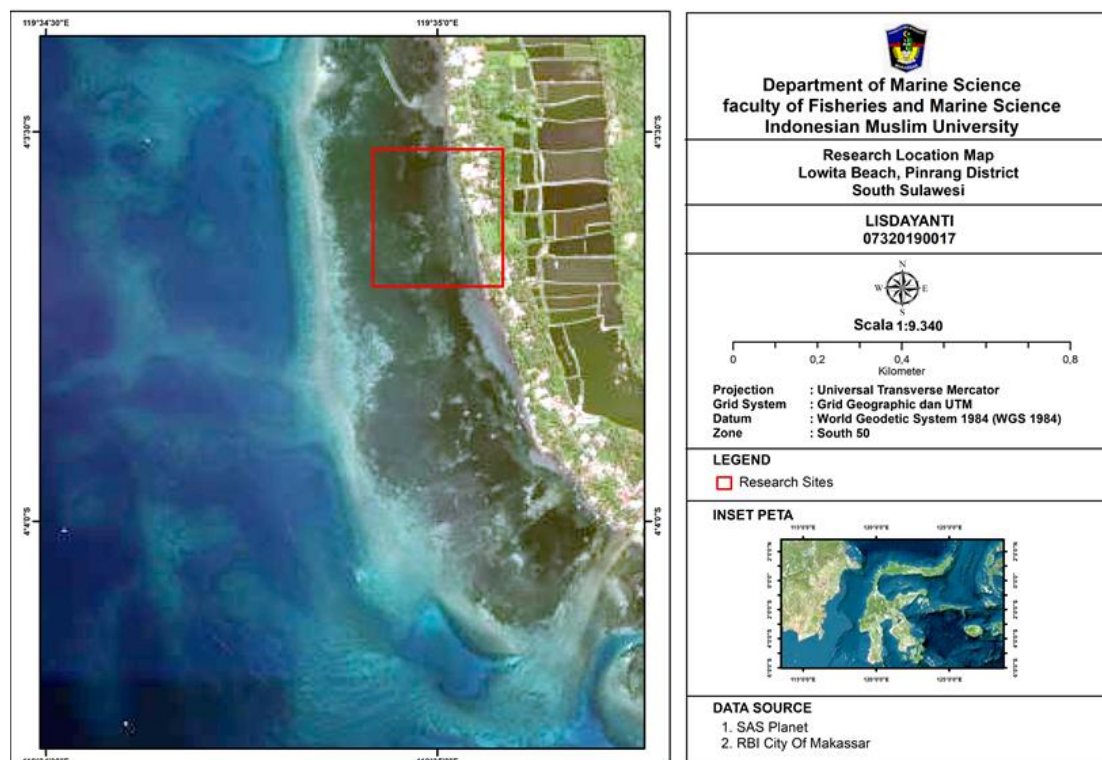


Fig 1: Research Location Map at Lowita Beach, Pinrang Regency

Tools and Materials

The tools used for data collection in the field are presented in the following table:

Table 1: Tools used for data collection in the field are presented

Tools		
No	Name	Utility
1.	Soil tester	To measure temperature and humidity
2.	Measuring tape	For nest depth measurement
3.	Safety net	Used to protect the nest from predators
4.	Wooden stakes	Used as support for the net
5.	Camera	For documentation purposes
6.	Writing utensils	Used for note-taking
Materials		
7.	Turtle eggs	Samples

Research Methodology

The research methodology employed in this study includes the measurement of semi-natural nest depth, semi-natural nest temperature, and semi-natural nest humidity. To

measure the nest depth, a measuring tape is used before the eggs are placed inside the semi-natural nest. The treatment of incubation nest depth has a significant influence on the incubation period of the eggs and the hatching success rate of Hawksbill turtle eggs. The measurement of semi-natural nest temperature is conducted using a soil tester after the device is inserted into the semi-natural nest for 7-10 minutes.

Temperature measurements are taken daily, with data collection conducted three times a day at 06:00-07:00 AM (morning), 12:00-13:00 PM (noon), and 18:00-19:00 PM (evening). Semi-natural nest humidity is measured using a soil tester. Previous research published in the Journal of Zoology has shown that moist substrates tend to produce more male turtle hatchlings, while dry substrates tend to produce more female turtle hatchlings. Researchers at FAU have successfully explained in detail why and how nest humidity affects the development and sex ratio of turtle embryos (Tarigan *et al.*, 2020) ^[10].

Data Analysis

Hatching Success Percentage

The hatching success of turtle eggs is calculated by excavating the semi-natural nests of hatched turtle eggs (Fristikawati, 2009) ^[5].

- Number of hatchlings emerged from the sand (E)
- Number of live hatchlings that have emerged from the eggshell but are still within the nest (LIN)
- Number of dead hatchlings that have emerged from the eggshell and are still within the nest (DIN)
- Number of live hatchlings still inside the eggshell, ready to hatch/break out (LPE)
- Number of dead hatchlings still inside the eggshell, ready to hatch/break out (DPE)
- Number of remaining eggs or dead hatchlings with completely opened eggshells (indicating the presence of predators, denoted by the letter P)
- Number of undeveloped eggs with no signs of embryos (UD)
- Number of eggs that did not hatch but showed signs of small or underdeveloped embryos (UH)
- The number of eggs did not hatch but showed signs of fully developed embryos (UHT).

Based on observations of the turtle's nest, the number of eggs per nest (CS) can be calculated using the formula (Konservasi & Laut, 2009) ^[3]:

$$CS = (E + LIN + DIN) + (UD + UH + UHT + LPE + DPE) + P$$

If the number of emerged hatchlings (E) is unknown, it can be calculated using the formula:

$$E = S - (LIN + DIN)$$

The calculation of the percentage (%) of hatchlings capable of emerging to the sand surface is done using the formula:

$$\% = (E/CS) \times 100$$

The calculation of the percentage (%) of hatching success is determined using the formula:

$$\% = \{(E + LIN + DIN)/CS\} \times 100$$

The percentage of hatching success rate is analyzed using the following formula:

$$\% \text{ hatching} = \frac{\text{Number of hatches}}{\text{Total number of eggs}} \times 100\%$$

Temperature, Humidity, and Nest Depth in Semi-Natural Nests

To test the hatching success of turtle eggs, this study focuses on three main parameters: temperature, humidity, and nest depth in semi-natural nests. The approach used is a quantitative descriptive method, which allows for a systematic, factual, and accurate description of the relationship between environmental factors and the observed phenomena. The method employed in this research is direct observation, with a particular focus on measuring the temperature in semi-natural nests. Humidity and nest depth also play crucial roles in determining the hatching success of Hawksbill turtle eggs. Through this quantitative approach, the study aims to identify the relationships between temperature, humidity, nest depth, and the hatching success of turtle eggs. With a better understanding of these parameters, it is hoped that more effective conservation strategies can be developed to preserve the population of Hawksbill turtles in their natural habitat.

Results and Discussion

Physical Parameters

Semi-Natural Nest Temperature

The data collected by the researchers aimed to investigate the temperature parameter in semi-natural nests and its impact on the hatching success of Hawksbill turtle eggs. The temperature in the semi-natural nests was examined as a key aspect of the research objective. The following are the findings related to the temperature, including temperature fluctuations, averages, and standard deviations during the incubation period.

Table 2: Highest, Lowest, Mean, and Standard Deviation of Temperature Fluctuations during Incubation

No	Fluctuation	nest 1			nest 2		
		Morning	Afternoon	Evening	Morning	Afternoon	Evening
1.	Highest	32	39	37	32	39	37
2.	Lowest	28	30	29	28	30	31
3.	Average	29,6	34,8	33,6	29,7	35,0	33,9
4.	Sdv	1,19	2,15	1,77	1,09	1,89	1,39

Based on Table 2, it can be observed that the highest temperature fluctuation in the semi-natural nests is 39°C during the afternoon, while the lowest temperature is 28°C in the morning. Temperature measurements were conducted by the researchers using a Soil Moisture Tester. In this study, temperature measurements of the semi-natural nests were taken from two samples in the morning, afternoon, and evening throughout the incubation period of the hawksbill turtle eggs.

Humidity of Semi-Natural Nests

In the measurement of humidity, it was found that a dry humidity level is more suitable for hatching hawksbill turtle

eggs compared to wet or moist humidity levels.

Table 3: Humidity of semi-natural nests during the incubation period of hawksbill turtle eggs

Nest 1			Nest 2		
Morning	Afternoon	Evening	Morning	Afternoon	Evening
Dry	Dry	Dry	Dry	Dry	Dry

Based on Table 3, it shows the average data comparison of humidity measurements taken three times in the morning, afternoon, and evening. The dry average data is associated with each incubation period. Turtle eggs undergo absorption

and exchange of water during the incubation period, causing an increase in volume. Conversely, high humidity in the nest can lead to the growth of fungi on the eggshell and the entry of bacteria, which can hinder gas exchange within the nest (Abidin, 2013) ^[1].

Based on the measurement

Results of the nest depth in 2 semi-natural nests, the highest nest depth (deepest) was found in nest 2, measuring 40 cm, while the lowest nest depth was in nest 1, measuring 30 cm. The depth of the nest hole was measured using a meter. The measurement results of the nest depth can be seen in Figure 2.

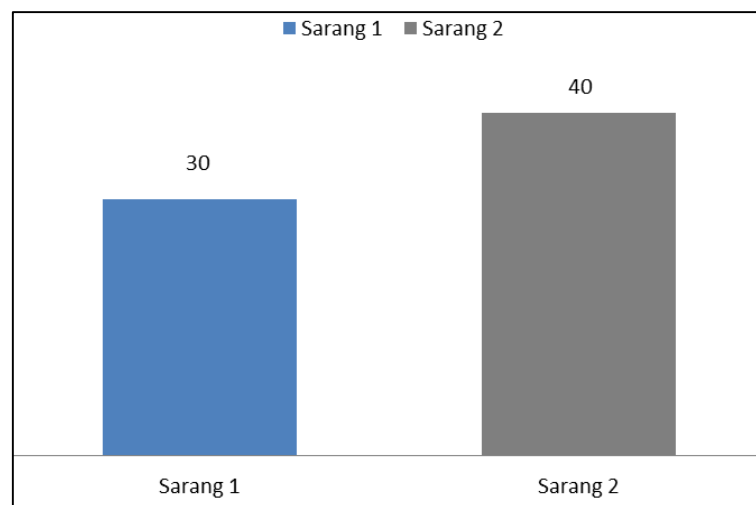


Fig 2: Depth of Semi-Natural Nests

The Incubation Period of Hawksbill Turtle Eggs

The length of the incubation period of hawksbill turtle eggs is influenced by the location of the nest, whether it is situated beneath vegetation or trees that provide sufficient shade. This limited sunlight reaching the ground surface affects the duration of the incubation period. In contrast, nests located in areas with less vegetation or shade receive direct sunlight, allowing the sunlight to directly reach the

ground surface. The incubation period refers to the period of embryo development from the time the eggs are laid in the sand until the hatchlings emerge from the nest (Abidin, 2013) ^[1].

The duration of the incubation period of hawksbill turtle eggs in natural nests at Lowita Beach can be seen in Figure 3.

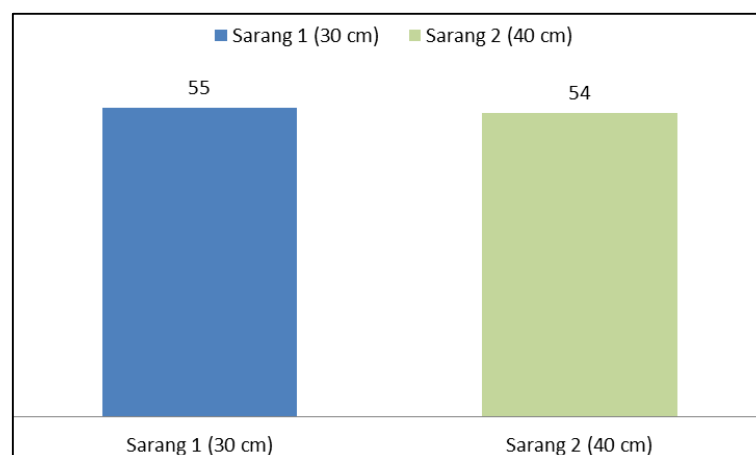


Fig 3: Incubation Period of Hawksbill Turtle Eggs

The duration of the incubation period is influenced by environmental factors such as rainfall and sunlight exposure. Higher rainfall can result in a longer incubation period as the eggs receive less heat, leading to slower metabolic processes. This, in turn, affects the success rate of hatching. The longer the incubation period, the lower the percentage of successful hatching. (Maulana, 2017) ^[8].

The percentage of hatching success for hawksbill turtle eggs

The data presented is based on interviews and discussions with relevant parties, as well as observations and

calculations by the researchers. Some information and data obtained through interviews and direct observations include:

a. Making and transferring eggs to semi-natural nests.

During the stage of making and transferring eggs to semi-natural nests, the search for natural nests is conducted at night around the Lowita beach using flashlight illumination. Subsequently, semi-natural nests are created by digging holes with a depth of 30-40 cm and maintaining a temperature between 29-35 degrees Celsius. The positioning of the eggs in the semi-natural nests follows the order of the egg positions in the natural nests, starting from the top to the

bottom.

Egg Transfer

1. The transfer process takes place around midnight, between 1:00-3:00 AM local time, depending on the time the natural nest is found. At this time, the relocation of the natural nest to the semi-natural nest is carried out to avoid predators such as dogs, monitor lizards, and crabs.
2. The egg transfer process is done carefully by digging the nest until reaching the top part of the eggs. The equipment prepared for nest transfer includes a bucket filled with approximately 2.5 cm layer of sand at the bottom. The eggs are transferred one by one into the bucket. During the transfer, the eggs should not be turned upside down and should be placed in an upright position. It is important to count the number of eggs. When carrying the bucket, hold it firmly to avoid damage and disturbance. When constructing a new nest, the shape should resemble a natural nest; otherwise, the mortality rate will be high. The new nest is dug in the shape of a bottle with a depth of 30-40 cm, similar to the actual nest.
3. Carefully place the eggs from the bucket into the new nest. Make sure not to turn the position of the eggs upside down. The eggs should be in contact with each other, and the topmost egg in the natural nest should be placed at the bottom in the bucket. When transferred to the semi-natural nest, it will return to the top position. Sprinkle a minimal amount of sand between the eggs.
4. Count the number of eggs when they are placed in the new nest and record it in a notebook. Once the eggs are transferred, cover them with a layer of sand. The nest transfer process takes approximately 10-15 minutes.
5. Surround the nest with a wire fence for protection and label it with the nest number and the date it was found.

Table 4: Average Percentage of Hawksbill Turtle Egg Success Rate

Nest	Egg Quantity (%) (%)			Percentage (%)	Incubation period
	Total	Hatching	Failure		
Nest 1	172	151	21	87,79%	55 hari
Nest 2	140	131	9	93,57%	54 hari
Total	312	282	30		
Average Hatching Success Percentage of Hawksbill Turtle Eggs				90,38%	

Conclusion

Based on the findings of the conducted research, the following conclusions can be drawn:

1. The hatching success rate of hawksbill turtle eggs in semi-natural nests was found to be 90.38%.
2. The parameters that influence the hatching success rate are: nest temperature with an average range of 28°C - 39°C, stable humidity levels, and an ideal nest depth of 40 cm for hawksbill turtle egg incubation.

Recommendations

Based on the research findings, the following recommendations are suggested:

1. Further research is needed to investigate the influence of seasonal variations and changes in environmental quality on the biological conditions of the eggs.
2. Future researchers should consider expanding the scope of the study, as the current research may not fully capture the detailed analysis of the parameters that can affect the hatching success rate of turtle eggs.

Thank You

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