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Characteristics of Olive Ridley Sea Turtle (*Lepidochelys olivacea*) Nesting Habitat along the Coast of Jembrana Regency, Bali

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Abstract. This study aims to identify the characteristics of the spawning habitat of the loggerhead turtle (*Lepidochelys olivacea)* and the ecological obstacles that affect the spawning process in the turtle conservation area on the coast of Jembrana Regency, Bali. The research was carried out through field observation by collecting data on environmental parameters including the type of coastal vegetation, the slope of the beach, and the characteristics of sediment at the spawning location of loggerhead turtles. The results of observations show that loggerhead turtles tend to choose open sand areas with sparse coastal vegetation, sloping beach slopes, and fine-textured black sand sediments. The study also found that some turtle spawning processes are hampered by changes in coastal conditions, especially due to abrasion and the presence of artificial structures such as breakwaters that block turtles' access to the sampling zone. These findings indicate the importance of maintaining the physical condition of natural spawning habitats to support the reproductive sustainability of loggerhead turtles. The results of this study are expected to be a reference in conservation efforts and sustainable management of turtle spawning habitats, especially in coastal areas that are under pressure due to human activities and environmental changes.

Keywords: Characteristics, Jembrana, nesting habitat, olive ridley sea turtle

INTRODUCTION

Indonesia is an archipelagic country located between the Indian Ocean and the Pacific Ocean, making it an important region in the migration route of various marine species, including sea turtles. These geographical conditions are supported by the richness of diverse marine ecosystems, such as coral reefs, seagrass beds, and coastal areas that are important habitats for turtle life (Bahri et al., 2022). Turtles are included in a group of marine reptiles that have the ability to migrate long distances, both for foraging and for reproductive processes (Harnino et al., 2021). Turtle migration is greatly influenced by oceanographic factors, especially ocean currents which are the main component in the movement of turtles in waters (Ario et al., 2016).

Indonesia is a strategic archipelagic country because it is located between the Indian Ocean and the Pacific Ocean. This geographical position makes Indonesian waters an important migratory route and natural habitat for various species of marine life, including six of the world's seven species of sea turtles, one of which is the loggerhead turtle *Lepidochelys olivacea*. Turtles are known to be marine animals that migrate long distances to breed and forage (Harnino et al., 2021). This migratory movement is greatly influenced by oceanographic factors, especially ocean currents, which help determine the direction and destination of turtle movements (Ario et al., 2016). Although each species has different biological and ecological characteristics, most turtles have a life cycle that involves long journeys in the open ocean and back to land to lay eggs (Musick & Limpus, 2017).

Turtle habitats include pelagic marine ecosystems to coastal ecosystems such as seagrass beds, coral reefs, and brackish waters (Isdianto et al., 2022; Atjo et al., 2023). Its role in ecosystems includes maintaining the balance of biological communities as well as the distribution of nutrients between marine and coastal habitats (Kurniarum et al., 2015). However, turtle

populations in Indonesia are currently facing various pressures, both from human activities such as egg exploitation, habitat destruction, and fishing activities, as well as from natural predators. This condition has caused a significant decline in the turtle population so that turtles are designated as protected animals based on Government Regulation No. 7 of 1999 by (Directorate of Conservation and Marine National Parks, 2009; Selmen et al., 2025). Other factors such as climate change, coastal development, and suboptimal conservation practices also contribute to the survival of turtles in the wild.

Bali Province is one of the regions that has a tradition of using turtles, both for traditional ceremonies and consumption, which has been going on since the 1970s Jensen, 2009. Turtles are one of the offerings at traditional events such as celebrations when children reach the age of 3 months, tooth cutting, marriage and cremation (Firliansyah et al., 2017). However, Bali is also one of the important locations for turtle landing and spawning in Indonesia, including in the turtle conservation area of Jembrana Regency. This is the basis for the importance of conservation efforts that are integrated between animal protection and cultural preservation of local communities. One of the conservation efforts that can be carried out is to study problems such as disturbances experienced by turtles during spawning landings through the identification of the characteristics of the spawning habitat of loggerhead turtles. Therefore, research on the characteristics of turtle spawning habitat in the turtle conservation area of Jembrana Regency is important as a scientific basis in supporting turtle management and conservation programs in a sustainable manner. This study aims to identify the characteristics of the spawning habitat of the loggerhead turtle (*Lepidochelys olivacea)* and the ecological obstacles that affect the spawning process in the turtle conservation area on the coast of Jembrana Regency, Bali Province.

RESEARCH METHODS

The research locations were carried out in three turtle spawning beach locations in Jembrana Regency. The first location is along the coast of Perancak, Jembrana District, then the second location is on Pengambengan beach (Figure 1). The selection of the three research locations was based on the location that has indeed become a landing beach for turtles to lay eggs from year to year.

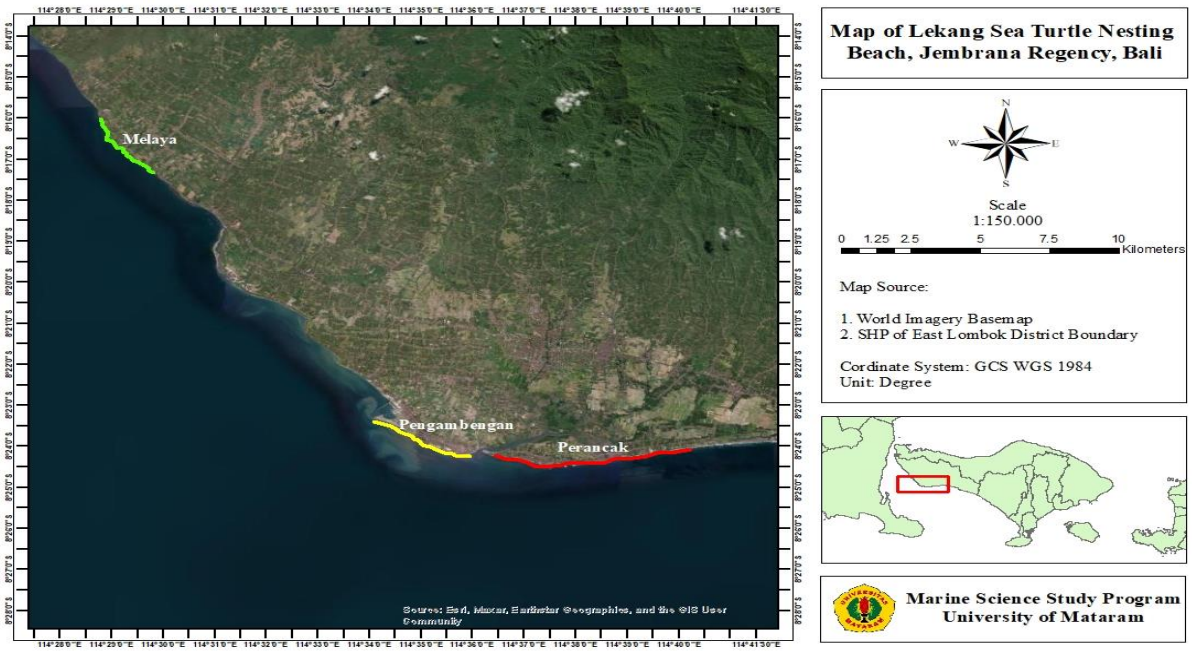

Figure 1. Map of the Research Location of the Lekang Turtle Spawning Beach, Jembrana Regency

Tools and Materials

In conducting field data collection, it is very important to use the right tools and materials to ensure accuracy, efficiency, and reliability, as shown in Tables 1 and 2 as follows:

Table 1. Tools needed in this study

No.	Tools	Function
1	Microsoft Excel	*Software* or application of tools in data analysis
2	GPS	Determining the landing point of the turtle's nest
3	Camera/ Smartphone	Documentation of activities during research
4	Kobotoolbox	*Software* or applications that can be used for surveys or data collection
5	Roll meter (100m)	Calculating the width of the beach as preliminary data to calculate the slope of the beach.
6	Flashlight	Lighting aids during monitoring activities and monitoring during the spawning process
7	Scale pole (2m)	Shore height measurement aids

Table 2. Materials needed during the ongoing research.

No.	Material	Function
1	Turtle	Objects in this study
2	Sediment	Additional parameter data on the relationship of turtles with spawning site characteristics

Research Procedures

The data collection method employed in this study involved a turtle habitat survey using in-depth interviews with local volunteers or turtle egg collectors. These interviews were complemented by direct field observations to identify the locations of turtle nests and assess their physical conditions. This approach allowed for the integration of local ecological knowledge with empirical field data to enhance the accuracy and depth of the findings.

In addition, further surveys and observations were conducted to examine the environmental characteristics of turtle nesting habitats along the coastal areas where turtles come ashore. The observational method focused on several key environmental parameters, including sediment type and texture, natural beach vegetation, and the slope of the shoreline. These factors were assessed to understand the suitability and preferences of nesting sites for sea turtles.

Determination of Spawning Habitat Location

The research was conducted at three sea turtle nesting beach locations along the coastline of Jembrana Regency. The selection of these nesting sites was based on prior survey results and recent observational data regarding turtle landing activity in the area over the past several years. According to Benni et al., (2017), the identification of potential nesting habitats can be carried out by examining specific coastal characteristics, such as turtle tracks, the presence of nearby vegetation, and visible signs of previous nest excavation sites. These criteria were used to guide the determination of suitable research locations for this study.

Data Collection Techniques

a. Number of nests found

Data collection of the number of nests found and the traces of turtles that landed at the research site, after finding turtle nests, observation was carried out and identification of the type of eggs found in each nest found.

b. Measurement of the depth and diameter of each nest

The depth and diameter of the nest hole are measured using a sewing meter. Measurements are taken after the egg excavation is carried out. The depth of the nest is measured from the point of the sand plain to the point when the eggs are first found.

c. Types and textures of sediment

Analysis of sediment type and texture was carried out by visual observation and assessment methods, by observing the texture, color, and wet or dry conditions along the turtle spawning coast.

d. Coastal vegetation

Observation and observation of vegetation types are carried out by recording and identifying the types of plants that exist in the surrounding area (Zarkasi et al., 2011).

e. Slope of the beach location

Picking up slope points was carried out at 9 location points along the exploration coast. With the estimated distance per point is (Distance of beach length / number of measurement points). Measurements of distances per point and length of the beach were carried out using the help of the google earth application. Then, the height and width of the beach data were processed to determine the level of slope slope using the slope slope formula: Beach Height/ Beach Width x 100% (Siregar et al., 2014).

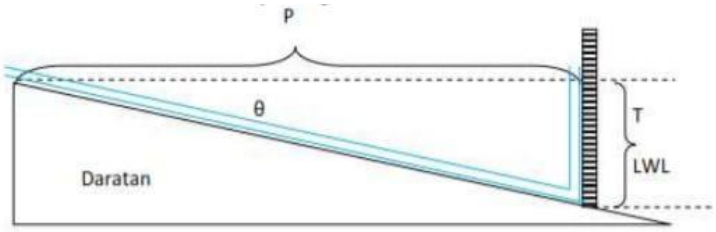

Figure 2. Coastal Slope Measurement (Siregar et al., 2014)

Figure Description:
P: Horizontal distance
T: Vertical height
LWL: Lowest water level (blue line): water-filled hose (striped pole): scaled bamboo stick

Data Analysis

The data obtained is in the form of quantitative and qualitative data. Quantitative data is obtained from direct measurements taken in the field by measuring environmental parameters. Meanwhile, qualitative data was obtained from surveys and direct observations as well as information from the surrounding community (interview results). These two data will then be analyzed descriptively which are presented in the form of tables, graphs and images using *Microsoft excel*.

RESULTS AND DISCUSSION

Overview of the Appearance Conditions of Peneluran Beach

The research location is located in three different locations along the spawning beach of loggerhead turtles in Jembrana Regency, namely Perancak beach with a total length of spawning beach (10,020.9 m), Pengambengan Beach (3,834 m), and Melaya Beach (3,285 m). The three research beach locations are the location of the coastal habitat for the spawning of Lekang Turtles throughout the year which are geographically located on the same coastline. The three spawning beach locations have the characteristics of black sand beaches with various types of plants that make up coastal vegetation such as ketapang trees, waru, cypress and sea pandanus. This is in accordance with the statement (Akbar et al., 2020) in their research, the Lekang Turtle has the characteristics of a spawning beach area in the form of a black sandy beach.


Figure 3. Break Water Building (Perancak) and Examples of Coastal Erosion and Abrasion (Pengambengan)

In the coastal areas of Perancak and Pengambengan there are several location points where there are *break water* buildings. This shows that in both locations the spawning beach has the potential for abrasion or erosion of the beach so that at some points of the beach break water is made. According to Faza et al., (2016) break water buildings function as mitigation efforts to prevent abrasion and coastal erosion due to waves and coastal currents.

Beach Vegetation

Based on the results of observation and identification of plant species that make up coastal natural vegetation in three locations, there are around 13 types of plants that live along the turtle spawning beaches in the three research locations, namely 5 of them were found spread across the three research locations, namely the types of katang-katang, waru, roll-roll, ketapang and weeds (weeds). According to Mansula et al., (2020) types of coastal vegetation are generally found in areas along the location of the spawning area which are pioneer plants or pioneer plants that fill vacant land. The following is a table of plant types that make up the natural vegetation of the beach on the beaches of Perancak, Pengambengan, and Melaya.

Table 3. Types of Vegetation Plants in Perancak Beach

Vegetation Type	Perancak Beach			
	Scaffolding	Yellow Water	Yeh Yellow	Delod Brawah
Squirrel (*Ipomoea pescaprae*)	*	*	*	*
Spinifex	*	*	*	*
Pandan (*Pandanus odorifer*)	*	*	*	*
Eights (*Hibiscus tiliaceus*)	*	*	*	*
Squirrel (*Terminalia cetappa*)	*	*	*	*
Sea fir (*Casuarina equisetiofolia*)	-	-	-	-
Button (*Barringtonia asiatica*)	-	-	-	-
Gagabusan (*Scaevola taccada*)	-	-	*	*
Weed	*	*	*	*
Cactus (*Opuntia cochenillifera*)	*	-	-	-
Virgin Tapak (*Catharanthus roseus*)	*	-	-	-
Biduri (*Calostropis gigantea*)	*	*	*	*
Sea purslane (*Sesuvium portulacastrum*)	*	-	-	-

Information:

* : Found
\- : Not found

Table 4. Types of Vegetation Plants in Pengambengan Beach

Vegetation Type	Pengambengan Beach		
	Munduk	Ketapang	Ketapang Estuary
Squirrel (*Ipomoea pescaprae*)	*	*	*
Spinifex	*	*	*
Pandan (*Pandanus odorifer*)	-	-	-
Eights (*Hibiscus tiliaceus*)	*	*	*
Squirrel (*Terminalia cetappa*)	*	*	*
Sea fir (*Casuarina equisetiofolia*)	*	*	-
Button (*Barringtonia asiatica*)	-	-	-
Gagabusan (*Scaevola taccada*)	-	-	*
Weed	*	*	*
Cactus (*Opuntia cochenillifera*)	-	-	-
Virgin Tapak (*Catharanthus roseus*)	-	-	-
Biduri (*Calostropis gigantea*)	*	*	*
Sea purslane (*Sesuvium portulacastrum*)	-	-	-

Information:
* : Found
\- : Not found

Table 5. Types of Vegetation Plants in Melaya Beach

Vegetation Type	Melaya Beach		
	Holiday rentals in Bali	Pangkung Dedari	Source of Sand
Squirrel (*Ipomoea pescaprae*)	*	*	*
Spinifex	*	*	*
Pandan (*Pandanus odorifer*)	*	*	*
Eights (*Hibiscus tiliaceus*)	*	*	*
Squirrel (*Terminalia cetappa*)	*	*	*
Sea fir (*Casuarina equisetiofolia*)	-	-	-
Button (*Barringtonia asiatica*)	*	*	
Gagabusan (*Scaevola taccada*)	*	*	*
Weed	*	*	*
Cactus (*Opuntia cochenillifera*)	-	-	-
Virgin Tapak (*Catharanthus roseus*)	-	-	-
Biduri (*Calostropis gigantea*)	-	-	-
Sea purslane (*Sesuvium portulacastrum*)	*	*	*

Information:
* : Found
\- : Not found

Based on the results of monitoring and data collection activities of turtles that landed, around 124 turtle broods landed in the three locations of the exploration beach. 101 nests were in open sand areas and were not affected by tides, 15 turtle nests were found in vegetation areas and 8 nests were found in areas affected by tides (Figure 4). This shows that loggerhead turtles do not pay much attention to the condition of the location of their spawning area. Lekang turtles are turtles that are not easily distracted by the conditions around their spawning environment. Rosalina et al., (2022) added that Lekang turtles have relatively low sensitivity to disturbances around them when searching.

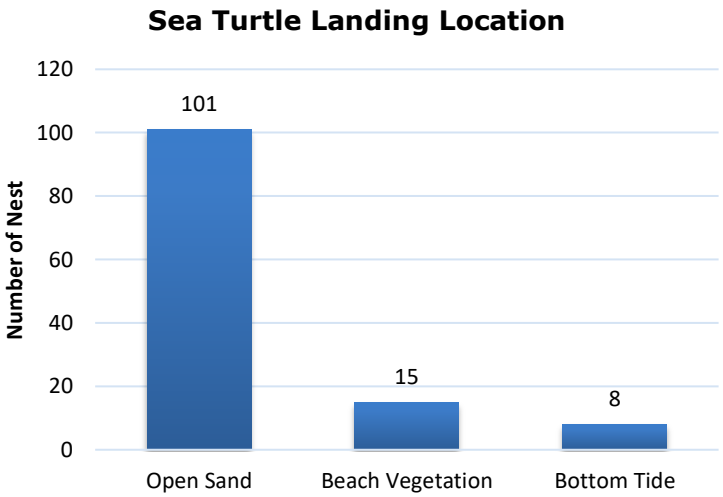

Figure 4. Chart of the location of the turtle landing

The chart depicting turtle landing locations (Figure 4) indicates that natural beach vegetation does not appear to directly influence the initial search behavior of the Lekang turtle. However, coastal vegetation plays a significant role in the overall suitability of nesting sites. According to Swadarma (2018), vegetation surrounding turtle nests serves important ecological functions, such as regulating nest temperature and humidity, stabilizing beach sand, and offering protection against predators.

Furthermore, the type of vegetation found along the coastline can serve as an indicator of the ecological condition of turtle spawning habitats. Setiawan et al., (2018) observed that the substrate and sand composition of turtle nesting beaches commonly share characteristics with areas where dominant vegetation such as Hibiscus tiliaceus (waru), beach morning glory (Ipomoea pes-caprae or katang-katang), and creeping plants are found—findings that align with the observations made in this study.

Types and Textures of Sediments

From the results of observation of sediment shape, color, and texture, the three locations along the coast of the research area of the Lekang turtle (*Lephidochelys olivacea*) spawning area have types of sediment on the spawning beach, including black sand beach areas with a smooth texture and slightly muddy. Black sand sediment types with a fine texture and slightly muddy are characteristic of alluvial sand types (Setiady et al., 2016). In his research (Akbar et al.,2020), loggerhead turtles have the characteristics of spawning beach areas in the form of black sandy beaches.

Based on direct observation and observation, loggerhead turtles that land spawn in beach sand locations with conditions that are not too dry, this is because the condition of the sand substrate that is run dry causes difficulties for turtle brooders who dig nest holes due to too loose, in addition to that the sand conditions that are too wet also make it difficult for turtles to dig nests so that this is one of the indications of the cause of turtles returning to the sea and not So spawn at the location. In line with the opinion of Siahaan et al.,(2020) which states that the texture conditions of the substrate and the type of sediment affect the distribution and location of the egg nest.

Slope of the Beach

Based on the collection and measurement of beach slope data, the three research locations have conditions of slope and beach height that are not too different. On Perancak beach (Figure 6) the highest point of the beach is at point 9 which is 1.8 m and the lowest at point 1 with a height of 1.3 m.

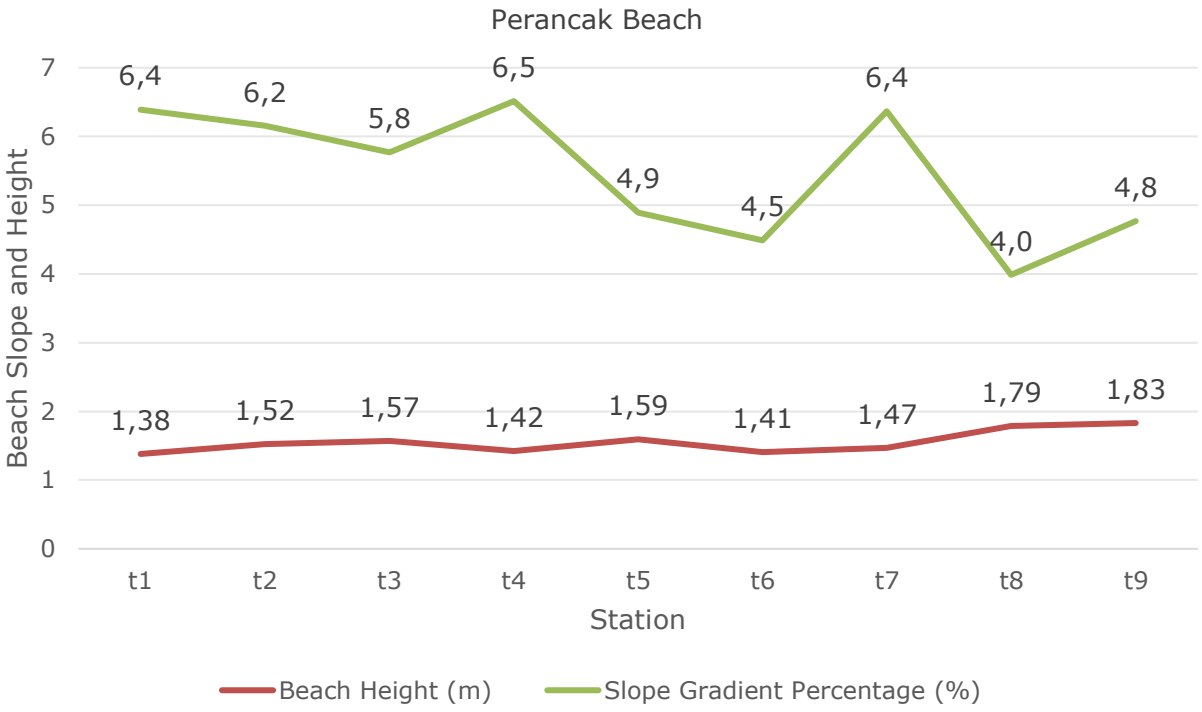

Figure 6. Graph of the slope and height of Perancak Beach

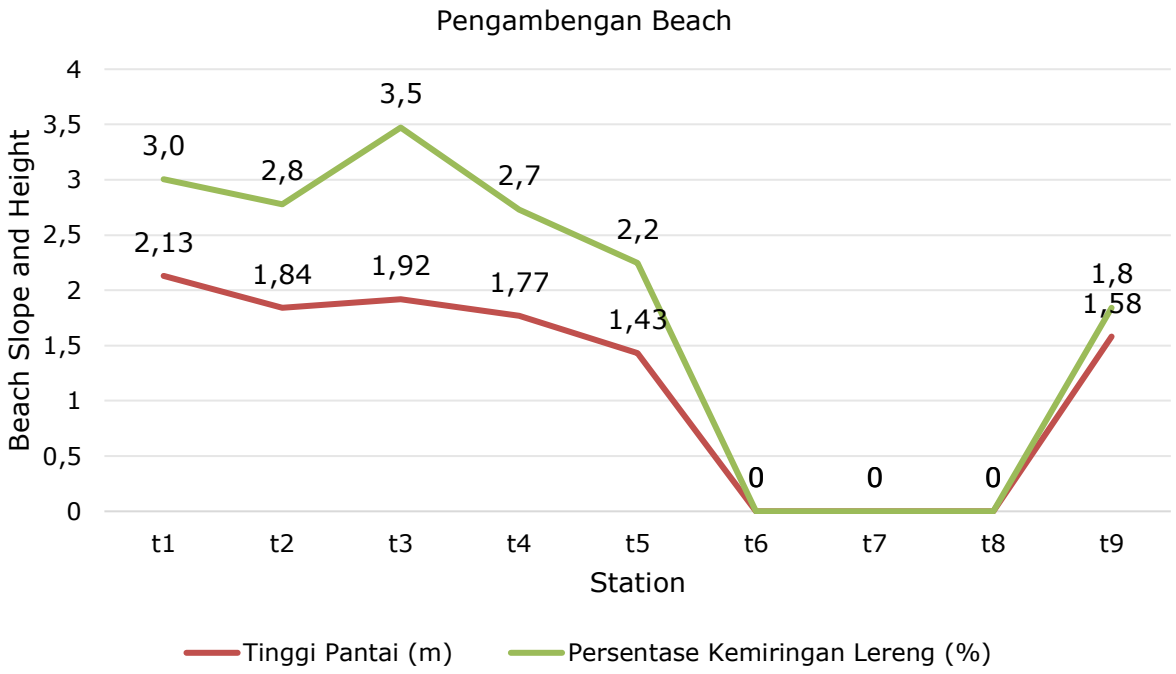

Figure 7. Graph of the Slope and Height of Pengambengan Beach

Based on this height, the average slope of the beach is 5%, this shows that Perancak beach is included in the category of slightly landless slope according to the classification of slope of the slope of Van zui dam and Versteppen, 1985. Meanwhile, on the coast of Pengambengan, the highest point of the beach is at point 1 with a beach height of 2.1 m with an average slope of 2% (Figure 7) and is included in the category of flat slopes. At points 6, 7 and 8, it is not possible to measure the height of the beach due to the presence of break water buildings, so that the graph does not show the percentage of slope slope at these three points

Table 6. The Slope and Height of Melaya Beach

Station	Beach Elevation (m)	Slope Percentage (%)
t1	1.36	3.9
t2	1.39	4.3
t3	1.34	3.9
t4	1.45	4.9
t5	1.27	4.6
t6	1.63	4.1
t7	1.65	3.9
t8	1.59	3.2
t9	1.69	2.3

Table 7. Slope Classification Table (Van Zui Dam and Versteppen, 1985)

Classification	Slope (%)	Slope (Degrees °)	Elevation Difference (m)
Flat	0 – 2	0 – 2	< 5 m
Slightly Gentle	2 – 7	2 – 4	5 – 25 m
Gentle	7 – 15	4 – 8	25 – 75 m
Moderately Steep	15 – 30	8 – 16	75 – 200 m
Steep	30 – 70	16 – 35	200 – 500 m
Very Steep	70 – 140	35 – 55	500 – 1000 m
Extremely Steep	> 140	> 55	> 1000 m

Along the coast of Malaya, the highest elevation recorded was at Point 9, with a height of 1.7 meters and an average slope of 4%, which falls into the category of slightly sloping land. According to the slope classification by Van Zuidam and Versteeg (1985), land with a slope of 0–2% is considered flat, while a slope of 2–7% is classified as slightly sloping (Table 7). The gradient of the beach plays a significant role in turtle landing behavior during nesting searches. Similar to the influence of vegetation and sediment texture, beach slope affects the spatial distribution of nest locations.

Coastal areas that are disrupted by breakwater structures or affected by erosion, as illustrated in Figure 3, present physical barriers that hinder turtles from reaching open sandy areas. These conditions can prevent turtles from successfully coming ashore to nest and may cause them to abandon nesting attempts entirely. Thus, slope and coastal infrastructure are critical factors in determining the suitability of nesting habitats for sea turtles.

CONCLUSION

Based on the results of observations and analysis of environmental parameters, the Lekang turtle (Lepidochelys olivacea) exhibits specific preferences for nesting habitats characterized by black sandy beaches, with an average beach slope ranging from 3% to 7%, classified as sloping terrain. The natural vegetation commonly found in these areas includes Ketapang (Terminalia catappa), Waru (Hibiscus tiliaceus), and various shrubs such as beach morning glory (Ipomoea pes-caprae), rolls, and weeds. Although these environmental parameters were recorded and analyzed, they did not show a statistically significant effect on turtle landing behavior. This can be attributed to the species' strong homing instinct, often referred to as "natal homing," wherein turtles return to the vicinity of their birthplace to nest (Christmas homing behavior).

However, certain environmental factors such as substrate conditions and beach slope were found to influence the spatial distribution of nesting and landing sites. In several observed cases, Lekang turtles that landed on the shore did not proceed to lay eggs and instead returned to the sea. This behavior was often linked to unfavorable sand conditions—either too dry or too wet—making it difficult for turtles to dig appropriate nest chambers. Additionally, steep slopes or coastal abrasion led to physical barriers that prevented turtles from accessing suitable nesting

zones. Anthropogenic disturbances also played a critical role in disrupting turtle landing behavior. Activities such as coastal fishing, artificial lighting from nearby residences, the presence of breakwater structures, debris, and large driftwood along the shore posed significant obstacles to nesting attempts and may contribute to habitat avoidance by turtles.

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