

Sea turtle landing and distribution in aceh jaya district

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Abstract. The research in Aceh Jaya District identified nine turtle nesting beaches: Babah Kuala, Patek, Babah Ngom, Kuala Doe, Rigaih, Alue Piet, Nisero, Aroen Meubanja, and Seunebok Padang. Olive Ridley (*Lepidochelys olivacea*) and Leatherback (*Dermochelys coriacea*) turtles inhabit these coastal areas. Nisero beach, Kuta Tuha Village, Panga Sub-District, recorded the highest nest count (12 nests) with both Leatherback and Olive Ridley turtles. Seunebok Padang beach, Seunebok Padang Village, Teunom Sub-District, had the lowest count (2 Olive Ridley turtle nests). Aroen Meubanja beach is the only one with protected status, while the remaining eight face the threat of egg poaching. Unprotected beaches are at high risk, emphasizing the importance of conservation for sea turtle survival and the local economy, particularly through tourism development. Beyond Aceh Jaya, Indonesia features other significant sea turtle nesting sites, like Pangumbahan beach in West Java and Wairundi Island and Venu Island in West Papua Province. The study evaluates various beach characteristics, including width and slope, influencing sea turtle nesting activities. Sediment analysis reveals predominant medium sand textures in Aceh Jaya District, contributing to suitable nesting conditions and emphasizing the need for targeted conservation efforts.

1 Introduction

Sea turtles belong to a group of vertebrates in the class of reptiles that live in the sea. The existence of sea turtles has long been threatened, both from their natural habitat and from human activities. Internationally, sea turtles are included in the IUCN "red list" and appendix I of CITES (Convention on International Trade in Endangered Species), which means that their existence in nature is threatened with extinction [1].

Indonesia's coastal areas are the nesting habitat for five of the world's seven sea turtles, including the Olive Ridley turtle (*Lepidochelys olivacea*), Green turtle (*Chelonia mydas*),

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Leatherback turtle (*Dermochelys coriacea*), Loggerhead turtle (*Caretta caretta*), and Hawksbill turtle (*Eretmochelys imbricata*) [2]. Aceh Province is a sea turtle nesting habitat such as Lhoknga beach, Lampuuk beach, Lange beach, Gugop beach and Alue Raya beach in Aceh Besar District, Bengkaru beach in Aceh Singkil District [3] and Rantau Sialang beach in South Aceh District [4]. Some beaches in Indonesia are turtle nesting habitats such as the beach of Paloh District, West Kalimantan Province [5–8]. and Jamursba Medi beach in West Papua Province [9,10].

The population of sea turtles in Aceh is currently experiencing an increasingly troubling decline, due to several causes, one of which is the illegal hunting of eggs and capture of mothers by coastal residents who do not understand the importance of preserving this animal [11]. Activities carried out by residents around coastal areas, such as settlements and pond businesses, accelerate the process of damage and change in coastal ecosystems. Changes in the ecosystem environment in coastal areas, both direct and indirect, have resulted in damage to the habitats of biota living in these ecosystems [12].

This study aims to analyse the distribution of sea turtles and their habitat types in the coastal areas of Aceh Jaya District. The information obtained can be a reference for students for further research and the central and local governments in making decisions related to the management of these beaches, especially the Turtle Conservation Area.

2 Research Methods

2.1 Location and Time

This research was conducted from 23 December 2022 to 19 March 2023 along the coast of Aceh Jaya District. This research consists of two stages, namely field data collection and laboratory analysis. Field data collection was carried out along the coast of Aceh Jaya District, Aceh Province with information on beaches that are turtle nesting habitat obtained from residents around the coast, using random sampling techniques. Laboratory analysis was carried out at the Soil and Plant Research Laboratory, Faculty of Agriculture, Syiah Kuala University.

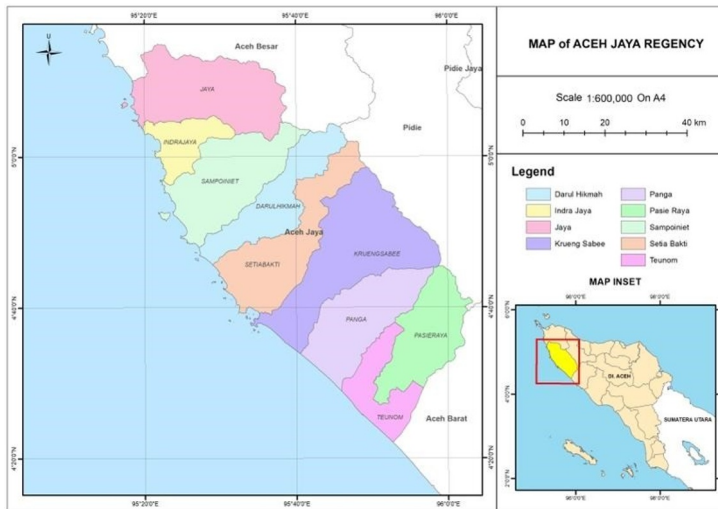


Fig.1. Map of Aceh Jaya District

2.2 Tools and Materials

The equipment used in this study were Global Positioning System (GPS), roll metre, 2 metre scale board, plastic, and stationery. The materials used in this study were data on the location of nests, beach slope, and beach sediment samples.

2.3 How It Works

2.3.1 Nesting Beach Designation

The determination of nesting beaches was carried out by looking for information circulating in the community around the coastal area, after which a sweep of the coastal area is suspected to be a sea turtle nesting habitat in the afternoon until morning. The determination of nests is not easy to do because it is very rare to find sea turtle hatchlings making nests, the determination of nests is done by looking at the flipper traces of sea turtle hatchlings left on the sand. Nests that were found were marked with GPS coordinates and entered into the Google Earth Pro application so that the data could be processed into a map using the ArcMap 10.3 application.

2.3.2 Measurement of Beach Width and Slope

Beach slope was measured using a Roll metre and a 2 metre high scale board. The slope was measured from the highest tide to the outer vegetation boundary. Measurements were made by pulling the roll metre from the outermost vegetation and placing it on the sand until it reached the highest tide limit. After that, a scale board is placed at the highest tide limit to get the height of the beach, so that the slope of the beach can be known by calculating the angle formed between the horizontal line and the vertical line [7].

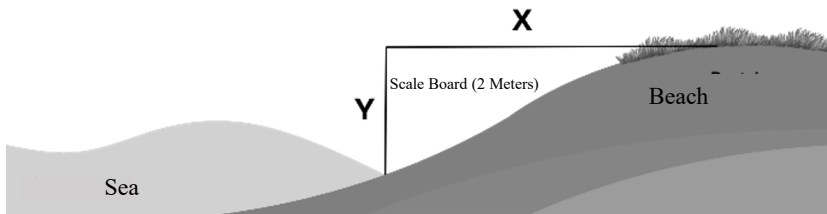


Fig.2. Illustration of beach slope measurement

2.3.3 Beach Sediment Sampling

The first step was to collect 200 grams of sediment from the beach that is the habitat of sea turtle nesting. Sediment has an impact on the ability of sea turtles to dig nests. Sediment measurement was carried out through a sieve process. The method of filtering the sediment substrate was carried out using a sieve shaker [13]. The volume measurement process utilised the soil texture classification [14].

2.4 Data Analysis

2.4.1 Beach Slope

The beach slope angle value is determined by the formula of Kalay et al. [15] as follows:

$$\text{Beach Slope}(\text{°}) = \text{arc tan tan} \left(\frac{y}{x} \right) \quad (1)$$

Description:

x = Horizontal plane distance measured using a roll metre

y = Distance of the vertical plane of the beach placed at the highest tide limit using a scale board

2.4.2 Identification of Sediment Grain Size

According to Agus et al. [14] the calculation of sediment grain size uses the following calculation:

$$\text{- Sand} = (\text{cup weight} + \text{sandy soil}) - \text{weight of empty cup} = X \quad (1)$$

$$\text{- } A = X * 10 \quad (2)$$

- $Clay\ dust = (cup\ weight + clay\ dust) - weight\ of\ empty\ cup = Y \quad (3)$
- $Clay = (cup\ weight + clay) - weight\ of\ empty\ cup = Z \quad (4)$
- $C = Z * 500 \quad (5)$
- $Dust = clay\ dust - clay \quad (6)$
- $= (Y - Z) * 500 = B \quad (7)$
- $A + B + C = W \quad (8)$
- $\%Sand = \frac{A}{W} 100\% \quad (9)$
- $\%Sand = \frac{B}{W} 100\% \quad (10)$
- $\%Sand = \frac{C}{W} 100\% \quad (11)$

After obtaining the sediment weight percentage for each particle size, the next step was to use the data to graph the soil texture diagram to classify the samples into the appropriate soil type.

3 Results And Discussion

3.1 Distribution of sea turtle nesting beaches in Aceh Jaya District

The results of the research survey showed 9 beaches that are turtle nesting habitat in Aceh Jaya District, including Babah Kuala beach, Patek beach, Babah Ngom beach, Kuala Doe beach, Rigaih beach, Alue Piet beach, Nisero beach, Aroen Meubanja beach, and Seunebok Padang beach. Sea turtle species that can be found in the coastal area of Aceh Jaya District are Olive Ridley turtle (*Lepidochelys olivacea*) and Leatherback turtle (*Dermochelys coriacea*). The beach with the largest number of nests was found in the Nisero beach area, Kuta Tuha Village, Panga Sub-District, the results showed 12 nests found with different types of turtles, 2 leatherback turtle nests and 10 olive ridley turtle nests, and the beach with the smallest number of nests found in the Seunebok Padang beach area, Seunebok Padang Village, Teunom Sub-District, 2 olive ridley turtle nests were found. From the research results, almost all beaches have 2 different species, there are only 2 beaches that have 1 species, namely Rigaih beach and Seunebok Padang beach. The following table shows the location of sea turtle nesting beaches in Aceh Jaya District.

Table 1. Location of sea turtle nesting beaches in Aceh Jaya District

No.	Sub-District	Village	Beach Name	Protection Status	Coordinate Points	Number of Nests Found	
						Olive Ridley turtle (<i>Lepidochelys olivacea</i>)	Leatherback turtle (<i>Dermochelys coriacea</i>)
1	Indrajaya	Kuala	Babah Kuala	Not protected	5°2'38.43"U 95°21'13.39"T	7	2
2	Darul Hikmah	Patek	Patek	Not protected	4°45'52.02"U 95°28'46.03"T	3	2
3	Setia Bakti	Sawang	Babah Ngom	Not protected	4°44'54.41"U 95°29'40.84"T	5	1
4	Setia Bakti	Lhok Geulumpang	Kuala Doe	Not protected	4°41'45.31"U 95°31'23.89"T	4	1
5	Setia Bakti	Lhok Buya	Rigaih	Not protected	4°39'57.54"U 95°34'3.22"T	3	0
6	Panga	Alue Piet	Alue Piet	Not protected	4°34'10.67"U 95°40'3.26"T	4	2
7	Panga	Kuta Tuha	Nisero	Not protected	4°32'8.38"U 95°42'29.42"T	10	2
8	Panga	Keude Panga	Aroen Meubanja	RMCA*	4°31'27.02"U 95°43'17.22"T	5	2
9	Teunom	Seunebok Padang	Seunebok Padang	Not protected	4°29'0.70"U 95°45'49.63"T	2	0

*Information: Regional Marine Conservation Area

There are a total of 9 sea turtle nesting beaches in Aceh Jaya District, only 1 of which has a protected status, namely Aroen Meubanja beach in Keude Panga Village, Panga Sub-District, the protection status of the area is written in the Decree of the Minister of Marine Affairs and Fisheries Number 76 of 2020, while the other 8 beaches have an unprotected status (Figure 3). Unprotected beaches are at great risk of high egg poaching [3]. While protected beaches can save sea turtles from extinction and benefit the economy of communities around the area, one of the benefits of conservation areas is tourism development [16].

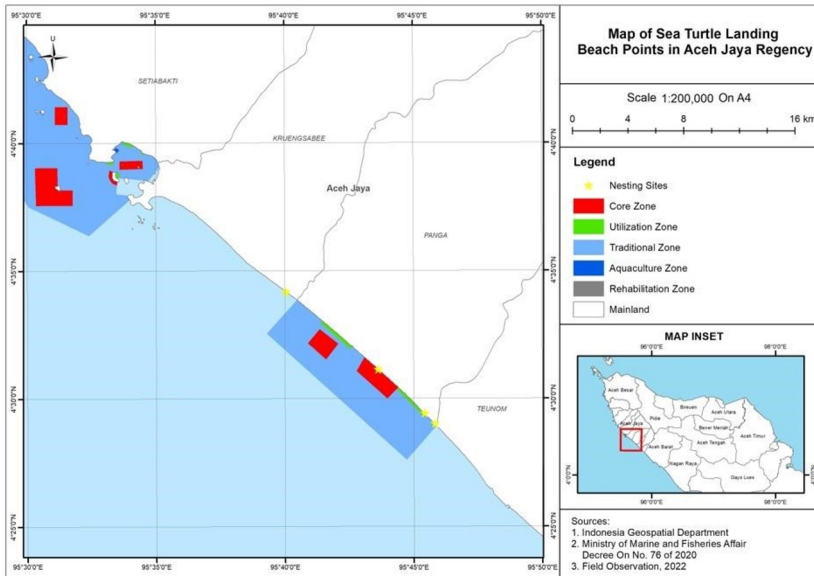


Fig.3. Map of turtle landing sites in Aceh Jaya District

Some beaches in Indonesia are sea turtle nesting beaches, such as Pangumbahan beach in Sukabumi District, West Java, which is a nesting habitat for green turtles (*Chelonia mydas*). In 2017, 26 green turtles were found landing, 25 nesting and 1 that did not nest [17]. Some islands in West Papua Province are also sea turtle nesting habitats, such as Wairundi Island and Venu Island. In 2016, 214 sea turtle nests were recorded on Venu Island, mostly from green and hawksbill sea turtles [18].

3.2 Beach Width and Slope

The results of measuring the width of the beach in Aceh Jaya District at each observation point from the outer vegetation boundary to the highest tide limit show that the width of the beach ranges from 16.35 metres to 53.77 metres. The shortest beach width is at the observation point on Rigaih beach which is 16.35 metres, while the longest width is at the observation point on Aroen Meubanja beach which is 53.77 metres. The results of coastal slope measurements at each observation point in Aceh Jaya District ranged from 1.19° to 6.15°. The lowest beach slope is on Aroen Meubanja beach, which is 1.19°, while the highest beach slope is on Patek beach with a value of 6.15°. The beach area of sea turtle nesting habitat in Aceh Jaya District mostly has a gentle slope category. The results of beach width measurements are shown in Table 2.

Table 2. Slope and width of the coast in Aceh Jaya District

No	Beach Name	Coordinate Point	Beach Width (M)	Beach Slope (°)	Category*
1	Babah Kuala	5°2'38.43"U 95°21'13.39"T	19,35	3,87	Sloping slope
No.	Beach Name	Coordinate Point	Beach Width (M)	Beach Slope (°)	Category*
2	Patek	4°45'52.02"U 95°28'46.03"T	17,82	6,15	Sloping slope
3	Babah Ngom	4°44'54.41"U 95°29'40.84"T	30,1	3,1	Gentle slope
4	Kuala Doe	4°41'45.31"U 95°31'23.89"T	18,5	3,34	Gentle slope
5	Rigaih	4°39'57.54"U 95°34'3.22"T	16,35	2,45	Gentle slope
6	Alue Piet	4°34'10.67"U 95°40'3.26"T	18,15	4,22	Sloping slope
7	Nisero	4°32'8.38"U 95°42'29.42"T	29,34	1,58	Gentle slope
8	Aroen Meubanja	4°31'27.02"U 95°43'17.22"T	53,77	1,19	Gentle slope
9	Seunebok Padang	4°29'0.70"U 95°45'49.63"T	39,35	2,33	Gentle slope

*Source: Kalay et al. [15]

Sea turtles have unique characteristics in choosing their nesting sites [6]. The slope of the beach and the width of the beach have an influence on turtle nests, the slope that is suitable for turtles to make nests is 10° to 30° and the width of the beach that is suitable for turtles to make nests is 20 metres to above 30 metres [19,4]. The slope of the beach has a great influence on sea turtles when landing on the beach to carry out nesting activities. The steeper the beach, the more difficult it will be for the turtle hatchlings to see the object in front of them, so that the greater the energy needed by the turtle hatchlings to climb to the beach [6,20].

Naturally, sea turtles choose beaches that meet criteria such as being wide and sloping, with an average slope below 30° , the beach is also located about 30 metres to 80 metres above the high tide mark [21]. Although some beaches are less than 30 metres wide, in reality, ocean waves at high tide do not reach the area where turtle nests are located, thus keeping the eggs safe. This is consistent with research by Fitriani et al. [4] conducted on Rantau Sialang beach, Pasie Lembang Village, South Aceh, which has an average beach width of 18 metres. The width of Rantau Sialang beach is not included in the ideal category for the characteristics of sea turtle nesting habitat, even so, in fact, sea turtle nests in Rantau Sialang are not submerged during high tide. This is also supported by the opinion of Nuitja [22] which states that a sufficient distance between the nest and sea water will prevent sea water from submerging the turtle nest. If seawater seeps into the nest, it can result in the failure of turtle egg hatching.

3.3 Nesting Beach Sand Texture

Textural composition of sediments according to grain size scale Wentworth [23] showed differences in sediment texture, namely from 9 beaches on the coast of Aceh Jaya District, there are 6 beaches dominated by medium sand texture, 1 beach is dominated by coarse sand texture, and 2 beaches are dominated by fine sand. According to Balaira et al. [24] there is a correlation between the medium sand component found in sea turtle egg nesting sites, among others, by reducing the possibility of sand collapse when sea turtle mothers dig holes and lay eggs, oxygen circulation and water absorption, ease for hatchlings to move out of the hatching hole. Research results Dima et al. [19] conducted on Sosadale beach, Rote-Ndao, that no sea turtle nests were found on beaches with rocky and coarse sand conditions, while on beaches with fine sand textures a number of sea turtle nests were found on the beach, this is because sand that has a fine texture and lighter colour creates an ideal nesting habitat for sea turtles to carry out the process of laying and hatching their eggs. If the nest is dominated by fine sand, it can make it difficult for turtles to dig the nest hole and make it difficult for hatchlings to get out because of the dense texture, whereas if coarse or gravelly sand dominates, the hole can easily collapse [24]. Pradana et al. [5] also stated that the composition of sediments with medium-sized sand tends to dominate around the holes where turtles lay eggs.

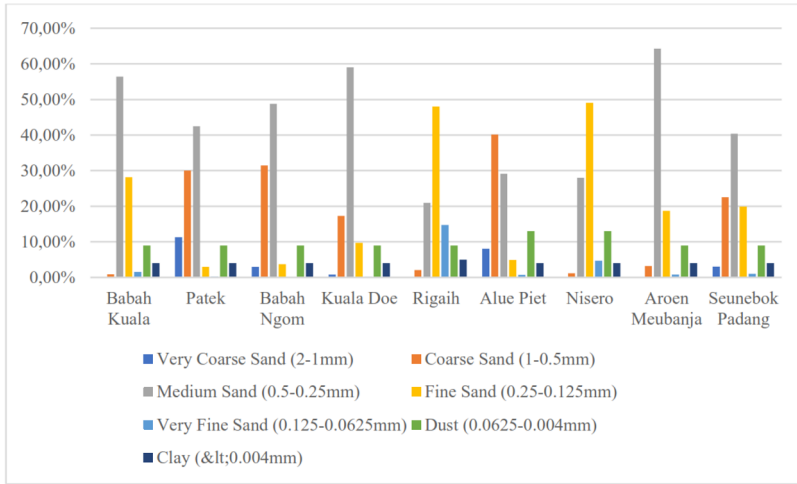


Fig.4. Sediment texture composition at 9 beach points

The composition of sediment texture in the coastal area of Aceh Jaya District is dominated by medium sand with a value of 43% followed by fine sand 21%, coarse sand 16%, dust 10%, clay 4%, and the lowest texture of very coarse sand and very fine sand which is 3%. These results show similarities as in Paloh beach, West Kalimantan, where medium sand texture dominates the beach with a value of 53.11% followed by fine sand 26.91%, coarse sand 12.18%, very fine sand 7.7% and the lowest texture is very coarse sand 0.08% [25].

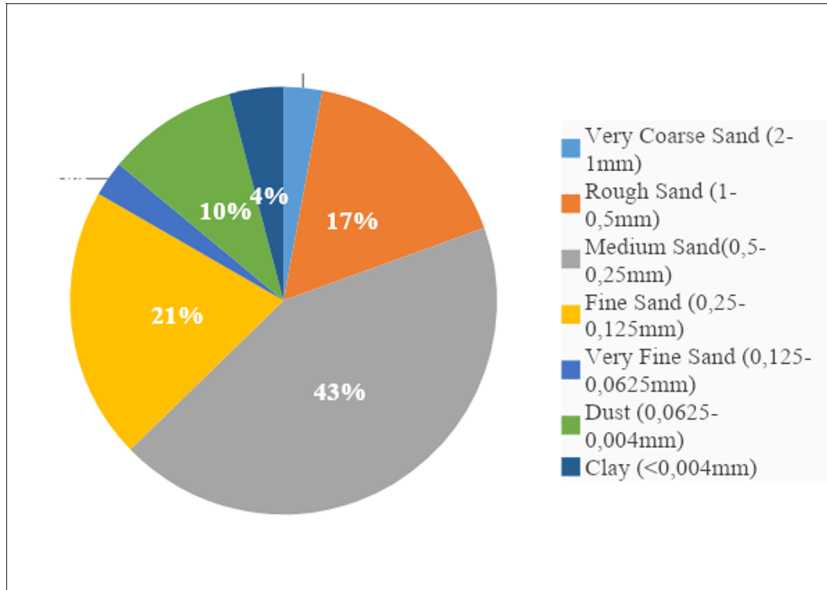


Fig.5. Percentage of beach sediment texture in Aceh Jaya District

4 Conclusion

Aceh Jaya district has 9 turtle nesting beaches, namely Babah Kuala beach, Patek beach, Babah Ngom beach, Kuala Doe beach, Rigaih beach, Alue Piet beach, Nisero beach, Aroen

Meubanja beach, and Seunebok Padang beach. However, of the 9 nesting beaches, only 1 beach is officially protected. The value of physical characteristics of the beach such as beach width ranging from 16.35 metres to 53.77 metres, beach slope ranging from 1.19° to 6.15° and sand sediment texture dominated by medium sand texture (0.5-0.25 mm) with a value of 43%.

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