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GREEN TURTLE (CHELONIA MYDAS) NESTING BASED ON CHANGES IN THE CHARACTERISTICS OF THE BIOPHYSICAL ENVIRONTMENT AT PANGUMBAHAN TURTLE CONSERVATION BEACH, SUKABUMI

Raka A. Perdana[1], Indah Riyantini[2], Eri Bachtiar[2], Moch. Rudyansyah[2]

[1]Student of Fisheries, Faculty of Fisheries and Marine Sciene, Universitas Padjadjaran, Indonesia
[2]Lecture of Fisheries, Faculty of Fisheries and Marine Sciene, Universitas Padjadjaran, Indonesia

ABSTRACT

Green Turtle (Chelonia mydas) is a marine reptile that has nesting habitat in coastal areas. The bio-physical environmental characteristics of a coastal area greatly influence turtles to land and carry out the nesting process. The purpose of this research is to analyze changes in the character of the bio-physical environment of Pangumbahan Beach and to correlate these changes with the arrival of Green Turtles (Chelonia mydas) to lay eggs. This research was conducted in the Pangumbahan Beach Turtle Conservation Area, Kab. Sukabumi, West Java, which was held in November 2020. The methods used in this research are survey and observation methods for taking coastal characteristics and literature review methods for secondary data collection. After that, changes in the characteristics of the coast were analyzed descriptively and comparatively. Then the correlation between changes in coastal characteristics and the number of turtles laying eggs were analyzed using linear regression and polynomials. The data used in this research include the number of turtle nesting data from January 2008 to October 2020 and the bio-physical characteristics of Pangumbahan Beach in 2008, 2015 and 2020. The research results show that changes in characteristics do not affect the arrival of turtles to lay eggs if changes are still within the optimum limit for turtles to lay eggs. The decline in the number of turtles laying eggs in 2015 was due to the large beach width of 88.01 m and the 3 year cycle of turtles to reproduce.

Keywords: Characteristic Change, Green Turtle, Laying Habitat, Pangumbahan

1. INTRODUCTION

The Green Turtle (*Chelonia mydas*) is a reptile that has lived on earth for millions of years. Based on the provisions of CITES (Convention on International Trade in Endangered Species of Wild Flora and Fauna), all types of sea turtles have been included in Appendix I, which means that international trade in sea turtles for commercial purposes is prohibited. The world conservation agency IUCN (International Union for Conservation of Nature and Natural Resources) includes the Hawksbill Turtle (*Eretmochelys imbricate*) as a species with a critical ecological status (critically endangered). Meanwhile, Green Turtle (*Chelonia mydas*), Olive Ridley Sea Turtle (*Lepidochelys olivacea*), and Loggerhead Sea Turtle (*Caretta caretta*) are classified as endangered species.

Green turtles (*Chelonia mydas*) are able to migrate regularly every year with a distance of thousands of kilometers between feeding ground and nesting ground. Green turtles that will lay eggs usually choose a specific location to lay their eggs. This is related to several factors of egg safety. Turtles will choose a beach for laying eggs based on the type of vegetation, type of sand, the width of the beach, and the slope of the beach (Rukmi, 2011). The bio-physical characteristics of the beach will be very influential for turtles to nest, due to the limited accessibility of turtles to roam the area, the suitability of physical and biological parameters and also to avoid natural predators from turtle eggs.

Green turtle landings at Pangumbahan Beach have fluctuated with a downward inclination every year. According to the turtle landing data issued by the Pangumbahan Turtle Conservation Center, in 2018 there were 668 turtles that landed on Pangumbahan Beach and of that number only 348 did the laying process. This number is much different from the previous year, namely in 2017 where the number of turtles landing was 2596 and the turtle laying eggs was 1664.

This research was conducted by analyzing the number of turtles laying eggs on Pangumbahan Beach based on changes in the characteristics of the coastal bio-physical environment. This research was previously conducted by Segara (2008), in his research explaining the bio-physical characteristics of the coast and the conservation area management strategy.

According to the Sukabumi Regency Maritime Affairs and Fisheries Service in 2018, turtles that come to lay their eggs on Pangumbahan Beach have decreased in the last three years. In the Focus Group Discussion of Data Series Provision Activities in the Pangumbahan Turtle Beach Area which was held in October 2019, many factors could be a threat to the Pangumbahan Conservation Area, one of which is the reduction in sea pandanus vegetation as habitat for turtles to lay eggs. By changing the turtle nesting habitat, it will impact the arrival of the turtles to lay their eggs. Based on this, the bio-physical characteristics of the beach and the number of turtles laying eggs are related to one another. So that research is needed to determine changes in the characteristics of the coastal bio-physical environment and also its correlation with the number of turtles laying eggs. The results of this research are expected to be used as material for future consideration and anticipation regarding ecological problems and a reduction in the number of turtles landing or laying eggs for the Pangumbahan Beach Turtle Conservation Center.

2. MATERIALS AND METHODS

Time and Location of Research

This research was conducted in November 2020 along Pangumbahan Beach, Ujung Genteng, Ciracap District, Sukabumi. The study was conducted for 1 week including analysis of initial conditions, in situ data collection, and secondary data collection. The research station is divided into 6 based on the existing turtle monitoring posts there.

Research methods

This research uses two methods, the literature review method with secondary data collection through literature studies and also a survey method by taking data directly from the field. After that, the data processing on the characteristics of the beach is carried out and then analyzes the changes on the arrival of the turtles to lay their eggs. Data on the bio-physical characteristics of the beach such as beach slope, beach width, beach light intensity, coastal vegetation, and the substrate are obtained directly from the field and from previous research and journals. The data processing of changes in the bio-physical characteristics of the coast is carried out to determine the differences in the characteristics of the coast over a period of several years by correlating the primary data and secondary data then analyzed descriptively and comparatively.

Beach slope data is measured using a rollmeter and vertical stick then calculated using the formula, the beach width is measured using a roll meter drawn perpendicularly from the outermost vegetation to the shoreline, the grains of sand are measured by means of a sand sample taken and dried then processed using a shieve shaker, light intensity data were taken using a light meter at night, temperature and humidity data were taken using an envirometer, and coastal vegetation data were recorded the name of the species from each station. Meanwhile, the data on the bio-physical characteristics of Pangumbahan Beach in 2008 and 2015 were taken from related research journals.

3. RESULT

Bio-physical Characteristics of Pangumbahan Beach

The bio-physical characteristics of a beach are an aspect that determines turtles to nest in the area. Some of the physical and biological parameters taken in this study are the slope of the beach, the width of the beach, the intensity of light, the temperature and humidity of the sand, the size of the grains of sand and the beach vegetation. The results of data collection on physical characteristics in the field are presented in Table 1.

Table 1. Physical Parameters of Pangumbahan Beach 2020

Parameters	Station						Overall Average
	1	2	3	4	5	6	
Beach Slope (°)	4,44	5,77	2,11	4,57	1,54	1,77	3,4
Beach Width (m)	50	28,33	30	58,67	72,67	98,67	56,3
Light Intensity (lux)	0,17	0,12	0,17	0,25	0,19	0,24	0,19
Percentage of Sand (%)	90,29	97,15	90,71	94,93	96,95	90,7	93,46
Sand Temperature (℃)	29,5	30,50	30,8	31,43	30,73	30,80	30,63
Sand Humidity (%)	24,33	26,33	27	28	22,33	27,33	25,89

Slope is an important factor for turtle landing and selection of nesting sites. The slope of Pangumbahan Beach ranges from 1.54 ° - 5.77 ° with an average of 3.4 °. Station 2 has the steepest slope among the other 6 stations with a slope of 5.77 ° while the softest slope is located at station 4 with a slope of 1.54 °. According to the criteria of Zuidam (1985), Pangumbahan Beach is classified as a beach that has a very gentle slope, which is between 1 ° - 3 ° and also a gentle slope at a slope of 3 ° - 6 °. Based on the measurement results, the slope of Pangumbahan Beach has an average slope with an angle of 3.4 ° which is included in the gentle category. Turtles tend to prefer wide and sloping beaches with a slope of less than 30 ° (Nuitja, 1992). Therefore, Pangumbahan Beach is still suitable as a turtle nesting area because it is still under the optimum slope for turtles to lay eggs.

Pangumbahan Beach has a length of about 2.3 kilometers stretching from post 1 to post 6 and an average beach width of 56.3 meters. Based on field measurements, Pangumbahan Beach has a beach width of 28 - 98 meters. The ideal beach width for nesting turtles ranges from 30-80 meters (Nuitja, 1992). Even though at station 2 the beach width is below 30, in reality the turtles still land at the station. According to Segara (2008) the size of the nesting beach width greatly affects the accessibility of turtles to reach areas suitable for nesting.

The results of observations of light intensity at Pangumbahan Beach, the value of light intensity ranged from 0.12 to 0.24 lux with an average of 0.19 lux for all stations. The greatest light intensity is at station 6 with a value of 0.24 lux, while the lowest intensity value is at station 2 with 0.12 lux.

Visually Pangumbahan Beach has white sand. The substrate composition of Pangumbahan Beach is dominated by fine-medium sand (0.125mm - 0.25mm) of more than 90% with a range of 90.29% - 97.15%, the rest is dust and clay in small amounts. The largest percentage of sand is at station 2 with 97.15% and the lowest is at station 1 with 90.29%.

The sand temperature that is too high will make it difficult for the turtles to make nests, but if the temperature is too low it will affect the incubation period and the success rate of hatching turtles (Dharmadi and Wiadnyana, 2008). As for the results of observations in the field, the sand temperature at a depth of 70 cm obtained an average temperature of 30.63 ℃, with a range of 29.5 ℃ - 31.43 ℃. The lowest sand temperature is at station 1 at 29.5 ℃ and the highest temperature is at station 4 which is 31.42 ℃.

The humidity of the sand on Pangumbahan Beach tends to be evenly distributed at each station with a range of 22.33% - 28% with an average humidity of 25.89%. The smallest humidity is at station 5 with 22.33% humidity and the highest is at station 4, which is 28%.

The existence of vegetation on the beach is an important thing for turtles to lay their eggs. The presence of vegetation will make the turtle feel calm to carry out the laying process (Putra, 2014). As for the results of vegetation observations on Pangumbahan Beach, there are 11 types of vegetation scattered at each station. The types available include *Calophylum inophylum, Terminalia cattapa, Ipomoea pescaprae, Pandanus tectorius, Scaevola raccada, Crinum asiaticum, Hibiscus tiliaceus, Callotropis gigantean, Cyperus padunculatus, Spinifex littoralis, Canavalia maritime* (Table 2.).

Table 2. Vegetation at Pangumbahan Beach 2020

Vegetation	Station					
	1	2	3	4	5	6
Calophylum inophylum	✓	✓	✓	✓	✓	✓
Terminalia cattapa	✓	✓	✓	✓	✓	✓
Ipomoea pescaprae	✓	✓	✓	✓	✓	✓
Pandanus tectorius	✓	✓	✓	✓	✓	✓
Scaevola raccada	✓	✓	✓	✓	✓	✓
Crinum asiaticum	✓	✓	✓	✓	✓	✓
Hibiscus tiliaceus	✓	✓	✓	✓	✓	✓
Callotropis gigantean	✓	✓				
Cyperus padunculatus			✓	✓	✓	✓
Spinifex littoralis				✓	✓	✓
Canavalia maritima			✓	✓	✓	✓

Vegetations that are often used as shade for nesting turtles include Nyamplung (*Calophylum inophylum*) and Sea Pandanus (*Pandanus tectorius*) for tree types as well as Katang-katang (*Ipomoea pescaprae*) and Sea Nuts (*Canavalia maritima*) for shrub types (Hidayat, 2017). Pangumbahan Beach has evenly distributed vegetation at each station. And the vegetation that dominates is Nyamplung (*Calophylum inophylum*), Pandan Laut (*Pandanus tectorius*), Ketapang (*Terminalia cattapa*) and Katang-katang (*Ipomoea pescaprae*).

Green turtle landing at Pangumbahan Beach

Green turtle landings on Pangumbahan Beach in 2020 from January to October totaled 1962, with 1471 turtles laying eggs or nearly 75% successfully laying eggs (Figure 1.). The significant increase occurred from June to its peak in September, this was due to the start of the eastern season. Meanwhile, the drastic decrease in October was due to La Nina which caused a decrease in sea temperatures.

The nesting turtles from 2008 to 2019 fluctuated with a downward trend every year. The highest number of turtles that came laying eggs occurred in 2008 as many as 2952, and the lowest was in 2018 with 348 tails (Figure 2.).

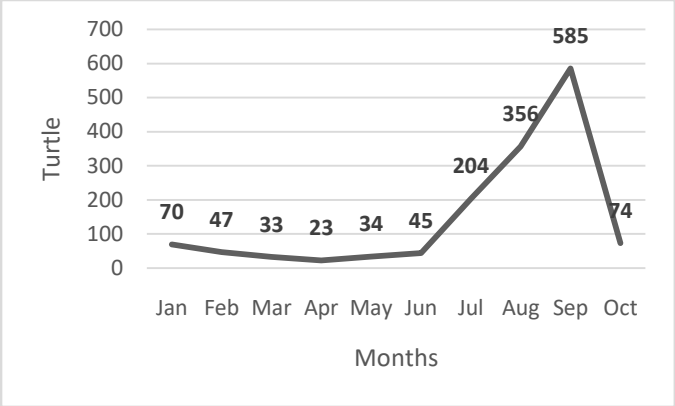

Figure 1. Green Turtle Nesting January – October 2020

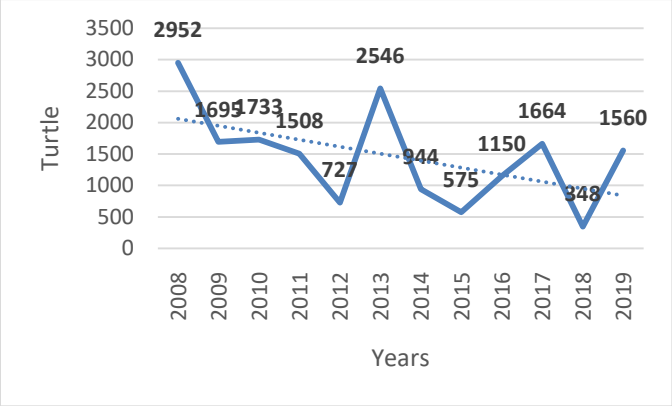

Figure 2. Green Turtle Nesting 2008 – 2019

Changes in the Bio-physical Characteristics of Pangumbahan Beach

Pangumbahan Beach has changed its biological and physical characteristics within a certain period of time. This is caused by many factors, one of which is the weather. Weather plays an important role in the bio-physical changes of a beach. Because several parameters such as vegetation, slope, beach width and sand conditions greatly affect the weather. Table 5. presents changes in physical parameters at Pangumbahan Beach.

Table 3. Changes in Physical Parameters of Pangumbahan Beach

No	Parameters	Units	Years			Optimum
			2008	2015	2020	
1.	Beach Slope	˚	18.42	10.74	3.37	< 30˚ (Nuitja, 1992)
2.	Beach Width	M	56	88.01	56.39	30-80 m (Nuitja, 1992)
3.	Percentage of Sand	%	96.53	87.90	93.46	> 90% (Putra, 2014)
4.	Sand Temperature	℃	28.96	29.83	30.63	25℃ – 32℃ (Afandy, 2016)

On the table above, the environmental characteristics of Pangumbahan Beach in 2008 and 2020 have been optimal for nesting turtles. However, in 2015, the width of the beach and the percentage of sand grains were not suitable for turtle nesting habitat. So from 2015 the number of turtles laying eggs has decreased.

In 2008 the vegetation on Pangumbahan Beach was very diverse, found 17 types of vegetation that were scattered along the coast. Meanwhile, in 2015 and 2020 only 12 types of vegetation were found. In the 2015 study, new vegetation was found that were not found in 2008, namely Canavalia maritime, Cyperus padunculatus, Callotropis gigantean, Ischaemum muticum and Voacanga foetida. In 2020 the existing vegetation was rediscovered in 2008, namely Crinum asiaticum (Table 4.).

Table 4. Comparison of Vegetation Amount and Type on pangumbahan beach

No.	Vegetasi		
	2008	2015	2020
1	*Calophylum inophylum*	*Calophylum inophylum*	*Calophylum inophylum*
2	*Terminalia cattapa*	*Terminalia cattapa*	*Terminalia cattapa*
3	*Ipomoea pescaprae*	*Ipomoea pescaprae*	*Ipomoea pescaprae*
4	*Scaevola raccada*	*Scaevola raccada*	*Pandanus tectorius*
5	*Pandanus tectorius*	*Pandanus tectorius*	*Scaevola raccada*
6	*Crinum asiaticum*	*Hibiscus tiliaceus*	*Crinum asiaticum*
7	*Diopyros froscens*	*Spinifex littoralis*	*Hibiscus tiliaceus*
8	*Diopyros maritima*	*Canavalia maritima*	*Callotropis gigantean*
9	*Cycas rumphii*	*Cyperus padunculatus*	*Cyperus padunculatus*
10	*Hibiscus tiliaceus*	*Callotropis gigantean*	*Hibiscus tiliaceus*
11	*Gonocarium marcophyllum*	*Ischaemum muticum*	*Spinifex littoralis*
12	*Avicennia sp*	*Voacanga foetida*	*Canavalia maritima*
13	*Spinifex littoralis*		
14	*Gluta renghas*		
15	*Harpulia cupunadea*		
16	*Ardisia numiliis*		
17	*Leucaena leucocephala*		

Green Turtle Laying (Chelonia mydas) Based on Changes in the Bio-Physical Environmental Characteristics of Pangumbahan Beach

Data on the arrival of turtles to lay their eggs on Pangumbahan Beach shows that the fluctuating number tends to decrease every year. In 2008, there were 2952 turtles laying eggs on Pangumbahan Beach, while in 2015 it decreased to 575 and increased in 2019 to 1560 (Table 5.). Some of the factors that influence turtles to land in an area are the physical and biological characteristics of the beach including the slope of the beach, the width of the beach, the percentage of sand, the temperature of the sand, the vegetation, the light intensity and the availability of food (Hardijanti 2013).

Table 5. Comparison of The Landing Turtles Number and the Characteristics of their Laying Habitats

Years	Nesting Turtles	Beach Slope(°)	Beach Width (m)	Sand Percentage(%)	Sand Temperature (℃)
2008	2952	18.42	56	96.53	28.96
2015	575	10.74	88.01	87.90	29.83
2019	1560	3.37	56.39	93.46	30.63

Based on the data that has been collected and analyzed, the biological and physical characteristics of Pangumbahan Beach have changed. Among them is the slope of the beach that has become more gentle, in 2015 the degree of slope in Pangumbahan was 10.74 ° and became more gentle in 2020 with a slope of 3.37 °. This was caused by a large wave that triggered abrasion in 2018. The slope of the beach greatly affects the arrival of turtles to lay eggs, the sloping beach increases the risk of submerging the eggs by sea water. But this does not apply to Pangumbahan Beach because even though it is sloping, Pangumbahan Beach has a wide shoreline and also a slightly steep vegetation path. Therefore, turtles can still lay their eggs in the area. As well as the central area on Pangumbahan Beach, which is station 2, has a not too significant change in elevation which makes it easier for the turtles to reach vegetation and lay eggs, therefore station 2 is the place most turtles choose to lay their eggs. Meanwhile for the northern part, namely stations 4 to 6, the change in slope is uneven where there is a significant change in the slope of the supratidal area which tends to be very steep when approaching the outer vegetation boundary, so there are not many turtles laying their eggs there.

The width of Pangumbahan Beach has increased in 2015 compared to 2008. Where in 2008 the average width of the beach was 56 m, while in 2015 the width of the beach was 88.01 m. And in 2020, the width of the beach will be 56.39 m or reduced by 31.62 m. One of the factors affecting the width of the coast is the season, in the results of research conducted by Segara (2008), the width of the coast in the west monsoon and the east monsoon is different, width of the beach during the east monsoon is greater than the west monsoon. The width of the beach has an effect on the arrival of turtles, when in 2015 Pangumbahan Beach has a beach width of 88.01 m, which can be said to be less suitable to be a turtle nesting area so that the arrival of turtles in 2015 has decreased greatly. According to Afandy (2016) the selection of turtle nesting sites is more related to changes in the tides and tides of an area where the height of the tides and tides is different and also correlates with changes in the width of the coast in an area. Turtles that keep coming to lay eggs may be due to their remigration behavior which makes them return to their birthplace to lay their eggs in that place.

The percentage of sand has an influence on the arrival of the turtles to lay eggs, the percentage of sand above 90% makes it easier for the turtles to dig nests because the large size of the sand and the coarse texture make it difficult for the turtles to dig sand to a suitable depth to place their eggs. And the temperature of the sand has a role that is almost the same as the humidity of the sand,

which affects the selection of nests indirectly, the temperature has an effect when digging the nests, causing some turtles to move around to lay their eggs (Afandy, 2016).

Changes in vegetation structure also have less impact on the arrival of turtles to lay eggs, as long as the vegetation that turtles prefer to shelter and build nests (*Calophyllum inophlum, Pandanus tectorius, Terminalia cattapa, Canavalia maritime,* and *Ipomea pescaprae*) still exists.

According to Musonif, the manager of the Pangumbahan Beach Conservation Center, turtles also have a three-year laying cycle. Green turtles usually go up to the coast 5 to 6 times in one year to lay their eggs after which they return to the home and return again several years later.

Conclusion

The characteristics of the bio-physical environment of Pangumbahan Beach change over several years. In 2008 the slope of the beach reached 18.42 °, the width of the beach was 56 m, the percentage of sand was 96.53%, the sand temperature was 28.96 ℃, and the humidity of the sand was 12.78%. Then in 2015 there was a change in environmental characteristics, namely the slope of the beach to 10.74 °, the width of the beach was 88.01 m, the grain size was 87.90%, the sand temperature was 29.83 ℃ and the sand humidity was 24.5%. In 2020 the slope of the beach is 3.37 °, the width of the beach is 56.39 m, the grain size is 93.46%, the sand temperature is 30.63 ℃, and the humidity of the sand is 25.89%. Vegetation on Pangumbahan Beach has decreased from 2008 to 2020, but important vegetation that turtles prefer to use as shade, such as *Calophyllum inophlum, Pandanus tectorius, Terminalia cattapa, Canavalia maritime,* and *Ipomea pescaprae* remain and not lost.

Changes in characteristics at Pangumbahan Beach do not have a direct effect on the arrival number of landing turtles if the characteristic changes are still within the optimum limit for turtles to lay eggs. In 2015 the arrival of turtles decreased drastically due to several reasons, namely the average beach width of 88.01 m and also because of the 3 year cycle of turtles to reproduce.

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