

## The Sustainability Study of Pangumbahan Beach as Conservation Area of Green sea turtle (*Chelonia mydas*)

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### **Abstract**

Green Turtle (*Chelonia mydas*) has been considered as endangered species both nationally and internationally. Many efforts have been carried out to conserve Green Turtles through the establishment of conservation areas, such as the Pangumbahan Beach, Sukabumi, West Java. There were many factors to be considered in a conservation area, one of it is biophysical of the area. The changes of biophysical factors in Pangumbahan Beach will influence the number of turtles land and nesting. This study aims to determine the biophysical factors that affect the number of Green Turtles that landed on Pangumbahan Beach and to determine the sustainability of Pangumbahan Beach as a Green Turtle conservation area. The research was conducted by analysing secondary data obtained from Balai Pengawasan, Konservasi Sumber Daya Kelautan Perikanan (BPKSDKP) Southern Region of Pangumbahan and literatures with the systematic review method which obtained 29 articles published in 1992-2020 through the database (Google Scholar, International Journal of Science and Research, Microsoft Academic, SciELO, Science Direct, Elsevier, Springer Link, Inter-Research Science Publisher, and JSTOR). The results revealed the biophysical factors which influence turtles to landing and nesting are the type of vegetation, vegetation cover, predators, tides, rainfall, substrate water content, substrate moisture, grain size of sand, sand texture, beach length, beach width, beach slope, light intensity, wave, wind speed, and temperature. Based on biophysical factors, the number of turtles landing and nesting, the number of eggs and the number of hatchlings released into the sea have increased, therefore the sustainability of Pangumbahan Beach for Green Turtle conservation area can still be maintained.

**Keywords:** *Green sea turtle (Chelonia mydas), Pangumbahan Beach, systematic review, biophysical factors, conservation*

### **Abstrak**

Penyu Hijau (*Chelonia mydas*) telah dianggap langka baik secara nasional maupun internasional. Usaha perlindungan terhadap Penyu Hijau banyak dilakukan melalui penetapan kawasan konservasi, salah satunya Pantai Pangumbahan, Sukabumi, Jawa Barat. Perubahan biofisik yang terjadi di Pantai Pangumbahan akan mempengaruhi jumlah penyu yang mendarat dan bertelur. Penelitian ini bertujuan untuk mengetahui faktor biofisik yang mempengaruhi jumlah Penyu Hijau yang mendarat di Pantai Pangumbahan serta mengetahui keberlanjutan Pantai Pangumbahan sebagai daerah konservasi Penyu Hijau. Penelitian dilakukan dengan cara melakukan kajian pada data sekunder yang diperoleh dari Balai Pengawasan dan Konservasi Sumber Daya Kelautan Perikanan Wilayah Selatan Pangumbahan (BPKSDKPWS) dan penelusuran literatur dengan metode *systematic review* yang memperoleh 29 artikel yang diterbitkan tahun 1992-2020 melalui *database*. Hasil penelitian menunjukkan faktor biofisik yang mempengaruhi penyu untuk mendarat dan bertelur adalah jenis vegetasi, tutupan vegetasi, predator, pasang surut, curah hujan, kadar air substrat, kelembapan substrat, ukuran butir pasir,

tekstur pasir, panjang pantai, lebar pantai, kemiringan pantai, intensitas cahaya, gelombang, kecepatan angin, dan suhu. Berdasarkan faktor biofisik, jumlah penyu yang mendarat dan bertelur, jumlah telur yang ditangkarkan dan jumlah tukik yang dilepas ke laut yang mengalami peningkatan, maka keberlanjutan Pantai Pangumbahan sebagai kawasan konservasi Penyu Hijau masih dapat dipertahankan.

**Kata kunci:** *Penyu Hijau (Chelonia mydas), Pantai Pangumbahan, systematic review, faktor biofisik, konservasi*

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## 1. Introduction

Sea turtle are reptiles that live in the sea and are able to migrate long distances across the ocean area (Dermawan et al., 2009). Sea turtle need a special habitat to breed and store their eggs. The Indonesian sea is a habitat and migration route for six of the seven species of sea turtle in the world. However, sea turtle have experienced a significant decline in population numbers. The causes are both natural threats and human behavior (Ario et al., 2016).

Green sea turtle have a greenish yellow or blackish brown carapace with an ovoid shell (when viewed from above), the head is small and blunt. The Green sea turtle is a poikilothermic animal, which means that its body temperature is affected by the ambient temperature. Green sea turtle are animals that are sensitive to light, sound, and vibration (Krismono et al., 2010).

Green sea turtle have been considered as endangered species both nationally and internationally, therefore they are included in the Redlist of the International Union for the Conservation of Nature (IUCN) in the endangered category, Appendix I of the Convention on International Trade in Endangered Species (CITES), Government Regulation number 7 of 1999 concerning Preservation of Plants and Animals, and rule Number 5 of 1990 concerning Conservation of Biological Natural Resources and Their Ecosystems (Krismono et al., 2010).

Efforts to protect the Green sea turtle are mostly carried out through the establishment of conservation areas, one of the Green sea turtle conservation areas is the Pangumbahan Coastal Turtle Park, Sukabumi, West Java. Pangumbahan Village is designated as a turtle conservation area with the status of a Coastal Park determined by marine minister decree Number 5/KEPMEN-KP/2016 dated February 5, 2016. Pangumbahan Beach is the most productive nesting beach for Green Sea turtle (*Chelonia mydas*) on the island of Java (Rudiana et al., 2004). One of the reasons why Pangumbahan Beach is favored by Green Sea turtle is that it is directly facing the Indian Ocean, which is an open ocean and has a coastal physical condition that supports Green sea turtle nesting (Panjaitan et al., 2012).

As time goes on, many changes occur in Pangumbahan Beach. One of the changes that need to be studied is the change in biophysical factors. These changes will affect the number of sea turtle land landing and nesting, therefore it is necessary to study the sustainability of Pangumbahan Beach as a Green sea turtle conservation area.

## 2. Material and methods

This research was conducted from September 2020 to December 2020. The tools used in this study are stationery and laptop. The materials used are books, journals, scientific articles, scientific works, and thesis in the form of soft files and secondary data from the BPKSDKPWSP Sukabumi, West Java.

The method used is a systematic review. Systematic review is a research method that summarizes the

results of primary research to present more comprehensive and balanced facts (Siswanto, 2010). Systematic review has criteria where the review of articles is carried out in a structured and planned. Based on Hariyati, 2010 the stages of implementing a systematic review in this research are:

a. Define the purpose of the review.

The purpose of this systematic review is to know the changes in Pangumbahan Beach as a Green sea turtle conservation area and what factors affect the number of Green Sea turtle landing on Pangumbahan Beach.

b. Literature Search.

The strategies used in the literature search are, using only published literature, published years from 1992-2020, using English and Indonesian. Types of literature is journals, proceedings, and thesis in full text. How to search electronically by using the search engine Google Scholar (<https://scholar.google.co.id/>), International Journal of Science and Research (<https://www.ijsr.net/>), Microsoft Academics (<https://academic.microsoft.com/>), Inter-Research Science Publisher (<https://www.int-res.com/>), SciELO (<https://www.scielo.org/>), ScienceDirect (<https://www.sciencedirect.com/>), Elsevier (<https://www.elsevier.com/>), SpringerLink (<https://link.springer.com/>), and JSTOR (<https://www.jstor.org/>).

Literature search using keywords (1) Green sea turtle Conservation Pangumbahan Beach, (2) Pangumbahan Beach vegetation composition, (3) Green sea turtle landing characteristics, (4) Factors affecting Green sea turtle landing, (5) Pangumbahan Beach changes, (6) Habitat Characteristics of Pangumbahan Beach, (7) Pangumbahan turtle beach, (8) Pangumbahan sea turtle conservation. The literature search turned up 6,627 articles and after the same articles were eliminated 436 articles were left. The complete list of identified publications is maintained with Zotero reference management software (<https://www.zotero.org/>).

c. Study assessment.

The determination of the inclusion criteria included only a quantitative methodology. Selection of articles with the main selection criteria, namely articles that discuss Pangumbahan Beach and the factors that affect sea turtle landing on Pangumbahan Beach. Of the 436 articles, 407 articles were eliminated according to the exclusion criteria (Table 1), so the remaining 29 articles were included in the final data collection and analysis.

d. Combine results.

The results of the review after being carried out must be grouped to get meaning. The biophysical factors that affect the Green Sea turtle landing and nesting on Pangumbahan Beach are combined from the existing literatures, so that changes and habitat suitability can be known in a given year.

e. Setting results

Findings from the groupings need to be discussed to conclude the results of the review. The review results obtained from the literature search are presented in paragraphs on biological parameters and in tabular form on physical parameters.

Data collected from BPKSDKP Pangumbahan is presented in graphical form, data processing is carried out using the Microsoft excel application.

### **3. Results and Discussion**

#### **Biological factors**

##### **Types of beach vegetation**

Based on the literature search, there are 58 different types of vegetation on Pangumbahan Beach, but according to research by Roemantyo et al., (2012) there are 66 types of vegetation. The types of vegetation that are commonly found are : Nyamplung (*Callophyllum inophyllum*), Ketapang (*Terminalia cattapa*), Waru Laut (*Hibiscus tiliaceus*), Babaungan (*Crinum asiaticum*), Wind grass (*Spinifex littoralis*), Katang-katang (*Ipomea pescaprae*), Babakoan (*Scaevola taccada*) and so on. Dominating Vegetation around Pangumbahan Beach is Pandan Laut (*Pandanus tectorius*).

Sea turtle have an affinity for different vegetation. Green sea turtle nesting beaches are generally composed of pandanus vegetation (Nuitja, 1992). This is evident in Pangumbahan Beach, many nests of turtle eggs are found under the auspices of pandanus, so it can be seen that Pangumbahan Beach is suitable and worthy as a place to landing and nesting Green sea turtle.

### **Coastal vegetation cover**

Based on the literature search, the vegetation cover on Pangumbahan Beach ranges from 28.52 to 46.67% (Segara, 2008). According to Harteti et al., (2014) of 36.12% .Based on Afandy et al., (2016) of 60.81%. Nurbaeti (2016) stated the cover range of 39 - 47%. Beach vegetation is very influential on the turtle's instinct to land caused by vegetation roots that can bind grains of sand and avoid sand collapse so that it can make it easier for sea turtle to dig and nesting. Vegetation cover on Pangumbahan Beach is suitable as a landing and nesting habitat for Green Sea turtle, because the existing vegetation is not too open and not too dense.

### **Predator**

Predators are a threat to female sea turtle, hatchlings, and sea turtle eggs. The types of predators found on Pangumbahan Beach are burrowing crabs, monitor lizards (*Varanus salvator*), wild boars, several species of bird, wild dogs (*Canis lupus*), red ants (*Oecophylla smaragdina*), lizards and snakes.

Ants become predators by covering the entire surface of the egg, so the egg will rot. For other predators (lizards, snakes, and wild boars) will prey on the eggs in the nest. The presence of several predators on Pangumbahan Beach makes the beach is not suitable as a green sea turtle conservation habitat. Efforts to reduce the impact of predators, then captive activities are carried out in semi-natural nests which are always ensured that the eggs are still in the nest and are not eaten by predators. This effort is effective as a Green sea turtle conservation measure because it can increase the number of hatchlings that survive.

### **Physical factor**

#### **Tide**

Based on the results of a literature search, it can be seen that the tidal type on Pangumbahan Beach is semi-diurnal tidal type, where in one day there are two high tides and two low tides. Based on Segara's research (2008), the water level at high tide can increase up to 2.3 m and at low tide it can reach 0.6 m. The tidal height of the water on Pangumbahan Beach is still suitable to make it easier for sea turtle to land, because the water depth at Pangumbahan Beach is more than 1.5 m according to the statement of Nurhayati et al., (2020) a depth of 1-1.5 m at high tide can make it easier for sea turtle to landing.

#### **Rainfall**

The Pangumbahan area has rainfall ranging from 3,750–4,250 mm/year with an average rainy day of 110–170 days/year (Kucera, 2004). The average is 5.5 mm/day (Segara, 2008). Hatasura (2004) states that the highest

daily rainfall is 101 mm/day while the lowest rainfall is 0 mm (days without rain).

The different of rainfall affect the number of sea turtle nesting on Pangumbahan Beach. In the rainy season the tide is higher so it is easier for sea turtle to get to the beach and landing. High rainfall affects the temperature, salinity of the sea, and humidity of the substrate cause the nesting area will be harder and difficult to dig, so the Green sea turtle delays the nesting process. Bad weather such as storms accompanied by lightning will decrease turtle landing and nesting because sea turtle are very sensitive to light (Wicaksono et al., 2013).

#### **Substrate moisture and water content**

Moisture content can affect the humidity of the sand required that the embryo in the egg can develop normally. Based on the literature search, the water content of Pangumbahan Beach ranges from 0.05 to 17.34 %. This value is still suitable for embryonic development in eggs, it is in accordance with the opinion of Limpus (1995) in (Rupilu et al., 2019) eggs that are incubated with a water content value of 3-12% have normally embryonic development.

Based on literature search, the value of substrate moisture ranged from 2 - 98.07%. Akbar et al., (2020) stated that the optimum humidity is around 60%, so the humidity on Pangumbahan Beach is not suitable as a turtle egg incubation place, because it is too high or even too low.

#### **Substrate size and texture**

Sea turtle really need sand as a place to lay eggs. Sand grains come from weathering of dead coral and weathering of shells, causing variations in the size of the sand grains (Rupilu et al., 2019). These varying grain sizes make it easier for sea turtle to landing and digging nest.

Nybakken (1992) in Leni (2017) states that the grain size of the sand affects the nature of the sand as a good buffer for temperature changes. According to Chen et al., (2010) sand grain size can affect important factors determining successful incubation, such as porosity, humidity and density of sand. Bustard (1972) in Fadhilah and Sunarto (2018) states that the sand grain size suitable for turtle nests is in the medium sand category (0.21-0.50 mm) and quite suitable for the fine sand category (0.10-0.21 mm).

According to Nuijta (1992) the substrate texture preferred by turtles for nesting is not less than 90% sand. The ease with which turtles dig their nests is determined by the characteristic properties of fine and coarse sand. Because according to Nuijta (1992) sand that is too fine will make it difficult for sea turtle to make nests and nests will easily slide. The size of the large and coarse sand will make it difficult for sea turtle to dig, because the larger the surface size of particles, the greater the friction force caused. The grain size of the sand at Pangumbahan Beach is suitable for sea turtle nesting and storing eggs, because there are variations in size and the substrate is dominated by the medium-sized sand category.

#### **Beach length**

According to Booth et al., (2004) sea turtle will find it easier to determine nesting locations on long coastlines, so that there is a large area for observation and assure themselves that the nesting location is safe enough and far from predators. Pangumbahan Beach has a total length of 3000 m. Based on the literature search, the length of Pangumbahan Beach as a turtle nesting habitat has a length ranging from 1,017-2,739 m. The length of Pangumbahan Beach is suitable as a landing and nesting habitat for Green Sea turtle, this is in accordance with the statement of Khaisu (2014) that the length of a good coastline for turtle nesting habitat is more than 867m.

### **Beach width**

The smallest area of Pangumbahan Beach is in the south and continues to increase towards the north (Nurhayati et al., 2020). Based on the literature, Pangumbahan Beach has a width ranging from 6-129.1 m. From 1989-2010 Pangumbahan Beach experienced 80.91% abrasion while 19.01% accretion (Panjaitan et al., 2012).

The width of the beach greatly affects the accessibility of sea turtle in reaching areas suitable for making nests. Sea turtle prefer to lay their eggs above the tides between 30-80m. Based on the results of a literature search, Pangumbahan Beach has a suitable width for sea turtle to land and nest.

### **Beach slope**

A fairly large slope will require more turtle energy to reach the nesting site (Ismane, 2017). Based on the literature search, Pangumbahan Beach has a slope of 0-86.1°. According to Nuijta (1992) sea turtle will choose a beach that has a low slope (3-16°).

In general, the slope of Pangumbahan Beach is included in the sloping to slightly steep category. However, there is a slope angle of more than 76°, this can be caused by extreme weather that causes high waves so that it can cause coastal abrasion and the formation of cliffs (Saputra et al., 2019). Pangumbahan Beach is still suitable as a landing and nesting habitat for Green Sea turtle, because it has a low slope category.

### **Light intensity**

Lighting around the beach affects the Green sea turtle's instincts in landing and tracking when it wants to lay eggs, and can affect the success of the hatchling's journey to the sea. Lighting value from literature search ranged from 0-3 lux. Santos et al. (2006) stated that the appropriate lighting range for sea turtle nesting habitats is 0-3 lux so Pangumbahan Beach is still suitable for sea turtle to land and nest.

### **Wave**

The type of wave at Pangumbahan Beach is surging. This type describes the condition of the steep slope of the coast. Based on the literature search, the wave height at Pangumbahan Beach is 0.5 – 4.72 m. The number of sea turtle nesting in an area is influenced by the oceanographic conditions of the area, such as strong winds, currents and ocean waves. If it is too strong, it will become an obstacle for sea turtle to nest and migrate (Bara et al., 2013). The waves at Pangumbahan Beach are still suitable as a landing place and nesting habitat for Green Sea turtle because they are not too high.

### **Wind speed**

According to Hidayat et al (2017) the blowing wind belongs to the medium category from south to north. During the full moon and dead moon, the wind usually blows hard and is accompanied by storms, especially during the west monsoon. Wind speed based on literature search is 0.51-9.8 m/s.

On the Beaufort scale, category of wind in light air (0.3-1.5 m/s) and light breeze (1.6-3.3 m/s). Winds with a speed of more than 3 m/s, make the sea conditions choppy and make the wind blow hard, which can make it difficult for sea turtle to land. The appropriate wind speed for sea turtle is small or medium wind speed (Fadhilah and Sunarto, 2018). In general, the wind speed at Pangumbahan Beach is suitable for sea turtle landing and nesting.

### **Temperature**

Based on the literature search, the air temperature on Pangumbahan Beach ranges from 15-33°C, the

water temperature ranges from 22-32°C, the substrate surface temperature ranges from 20.7-54.0°C and the temperature in the substrate ranges from 21.40-31.35°C. According to Leni (2017), differences in depth, measurement time, and the presence of shade will cause differences in temperature measurement results. At night the temperature outside the nest will be lower than inside the nest. Temperature change sand are caused by heat propagation from sunlight, media types, wind, rain, and other environmental factors.

Temperature will determine the sex ratio of young sea turtle, sea turtle born from nests with incubation temperature greater than 28°C are more likely to produce female sea turtle. According to Miller (1997) temperature has an inverse effect on the incubation period. A change of 1°C in the temperature range of 26-32°C can reduce or increase the incubation period of 5 days. In general, the substrate temperature range at Pangumbahan Beach is in the ideal temperature range and is suitable for Green sea turtle nests. This is in accordance with Nuitja's (1992) statement that the normal range of tsea urtle hatching nest temperatures is 24-34 °C.

### **The Sustainability of Pangumbahan Beach as a Green sea turtle Conservation Area**

The management of sea turtle on Pangumbahan beach from 1973 – 2008 was held by the private sector, namely CV. Daya Bakti Sukabumi. After the concession permit for the use of turtle eggs expired in 2008, and realizing that Green Sea turtle were increasingly rare, August 2008 Sukabumi district government issued a policy on the reserve of turtle conservation areas by establishing a Regional Technical Implementation Unit (UPTD). This conservation area was inaugurated and designated on December 22, 2009 with the name Pangumbahan Turtle Beach Coastal Park.

Then In 2017 until now, the management of the Pangumbahan Turtle Conservation Area has been carried out by the Province of West Java by establishing a Center for Supervision and Conservation of Marine Fisheries Resources for the Southern Region of Pangumbahan (BPKSDKPWSP) under the authority of marine and fishery department (DKP) West Java Province (KKP, 2019).The turtle conservation area of Pangumbahan Beach is a captive area that focuses on the Green sea turtle species. Conservation activities include the process of nesting, hatching eggs and releasing hatchlings.

### **Number of sea turtle landing and nesting**

The frequency of the Green sea turtle nesting changes every year. Based on literature searches, the highest frequency occurred in 1965 with 12,045 individuals, while the lowest frequency in 2018 was 348 individuals. The number of sea turtle nesting decreased drastically from 1965 to 1973, only 2,356 individuals and tended to decrease in the following years. The total number of sea turtle landing in 1989 reached 6,277 individuals, while in 2008 it was only 3,160 individuals. Based on these data, it is known that there is a decrease of ± 50% of female sea turtle landing.

From the graph (Figure 1.), it can be seen that in 2012 and 2018 there was a decrease in the number of sea turtle landing and nesting, this could be due to an increase in the number of visitors to Pangumbahan Beach in 2012 and 2018. Turtle ecotourism activities were carried out to see sea turtle nesting at night. will affect the number of sea turtle landing, because more visitors who come at night will cause noise and light pollution that can affect the turtle's instinct to make a landing. Female sea turtle that do not succeed in nesting will return to the sea.

This is in accordance with the research of Bara et al., (2013) which states that the decline in turtle nesting can be caused by an increase in human activities around the conservation area, so that it can affect the turtle's

instinct to cancel nesting. According to Panjaitan et al., (2012) the decrease in the number of sea turtle that landed can also be caused by changes in shoreline, reduction in vegetation cover, changes in width and slope. Pangumbahan Beach experienced a reduction in coastal vegetation cover as far as  $\pm 50$  meters and a reduction in coastline of 1053.3 m.

In 2013 there was an increase in the number of sea turtle landing and nesting, because intensive monitoring has been applied to the nesting beach area (Harahap et al., 2015). Coastal surveillance activities involve community groups who care about sea turtle, so that they are more effective and can reduce disturbances caused by humans. This supports and increases the comfort of sea turtle to nesting on Pangumbahan Beach.

In one year, the peak of the turtle landing and the turtle nesting can occur in different months. This difference is due to the difference in the spawning season for each individual turtle. According to Nuitja (1992) all types of sea turtle lay eggs more than once in a spawning season, including the Green sea turtle. Green Sea turtle have a certain time interval between the time of the last spawn and the time of the previous spawn.

The arrival of sea turtle landing to lay eggs does not recognize a certain season or month, because every month there are always sea turtle that land to lay eggs. According to Panjaitan et al., (2012) the peak of turtle landings every year occurs in a different month. In 2009 January, 2010 in October, 2011 in November. Generally, sea turtle lay their eggs throughout the year, but in the rainy season at Pangumbahan Beach, more sea turtle land.

From the graph (Figure 2.), In 2018 the peak of turtle landing occurred in October as many as 93 individuals, and the peak of turtle nesting occurred in October and November as many as 48 individuals. In 2019, the peak of sea turtle landing and nesting occurred in October. The rise of female sea turtle to the beach is influenced by beach conditions that are suitable as nesting habitats.

There was a sharp increase in sea turtle landing and nesting in September 2019, this can be caused by a series of earthquakes that occur. One of the earthquakes occurred on August 2, 2019 with a magnitude of 7.4 with the potential for a tsunami in the Banten South Coast, Pelabuhan Ratu, Pangumbahan and Ujung Genteng areas. An earthquake also occurred on September 20, 2019 with a magnitude of 4.2 and on October 25, 2019 with a magnitude of 3.7 (BMKG, 2019). Earthquakes will affect the physiological condition of sea turtle because sea turtle are very sensitive to vibrations, so earthquakes can stress sea turtle and speed up spawning intervals.

### **Number of eggs produced and hatchlings released**

Based on literature searches, in 1950 egg production could reach 2,500,000 eggs, then decreased drastically until 1973 and continued to decline until 2007 because eggs were traded. Yudha (2004) stated that turtle eggs are sold at a price of IDR 3000 - IDR 3500 per egg. In 2008 there was an increase (Figure 3), due to the change of management. Management is carried out by the Marine and fishery department (DKP) of Sukabumi Regency with the aim of conservation, so that turtle eggs are not traded.

From the graph (Figure 3.) explain that there was a sharp increase in the number of hatchlings released in 2007 as many as 30,361 and in 2008 as many as 192,729. This increase occurred because the turtle eggs management has changed. Turtle egg management by CV. Daya Bakti in 1973-2001 carried out 100% egg for sale. 2001–2005 based on Regional Regulation No. 2 of 2001 concerning the tax on swallow nests, turtle eggs and seaweed, 30% of eggs are bred and 70% for sale. 2005-2008 issuance of Regional Regulation No. 16 of 2005 concerning the conservation of sea turtle in Sukabumi Regency, 50% of eggs are bred and 50% for sale (National

Geographic, 2013). Since August 2008 eggs are 100% bred (Nastiti and Wiadyana, 2013).

In addition to management changes, the increase is also due to changes in the captive system. Previously, captivity was carried out with two systems, its open captivity and closed captivity, but now the hatchery and hatching of turtle eggs is carried out in an open area because it is more efficient so that the success of hatching turtle eggs is increasing and more hatchlings are released into the sea. This is in accordance with the statement of Nastiti et al., (2015) with an outdoor hatching system, the hatching rate is almost 100%, while the indoor hatchery is only around 6.64-47.72%.

Eggs in captivity cannot hatch 100%, so the number of hatchlings released into the sea is less than the number of eggs produced. This is due to the presence of predators in the nest such as microbes, monitor lizards, ants, lizards, snakes and wild boars as well as hunting by humans. In 2001-2008 the percentage of successful hatching of eggs was very low, this was because the eggs produced were not bred, but sold and then consumed. In 2008-2019 the percentage of successful hatching of eggs increased to 73.21% - 91.03% because the eggs produced were bred 100% both naturally and semi-naturally.

The hatching of turtle eggs currently being carried out is semi-natural hatching which is done by moving eggs from their original nest to an artificial nest that has been prepared. The shape and depth of this artificial nest is made like the original nest. According to Pane et al., (2019) semi-natural hatching of eggs is carried out to avoid coastal abrasion and tides and to make it easier to control and monitor from predators and human hunting. If there are no obstacles, turtle eggs will hatch in 7-12 weeks or 40-80 days.

Based on the data obtained (Figure 4.), it can be seen that the peak of egg production occurs around August to November, as well as the peak time of nesting for the female turtle. From 2001-2019, in 2019 there was the highest and lowest point in the number of egg production in one month, the highest point was in October with 42,400 eggs, while the lowest occurred in February with 713 eggs. Egg production from 2001-2008 was still low because of the egg hunting carried out at night by the surrounding community, so that the Pangumbahan Beach condition became crowded and uncomfortable for sea turtle to search for nests.

#### **4. Conclusion**

1. Based on the research, it can be concluded that the biophysical factors that influence sea turtle to land on Pangumbahan Beach are the type of vegetation, vegetation cover, predators, tides, rainfall, substrate water content, substrate humidity, sand grain size, sand texture, beach length, beach width, beach slope, light intensity, waves, wind speed, and temperature. In general, these factors have conditions that are still suitable as nesting turtle habitats, except for predators and substrate humidity.
2. Based on biophysical factors, the number of sea turtle landing and nesting, the number of eggs in captivity and the number of hatchlings released into the sea have increased, the existence of Pangumbahan Beach as a Green sea turtle Conservation Area can still be maintained.

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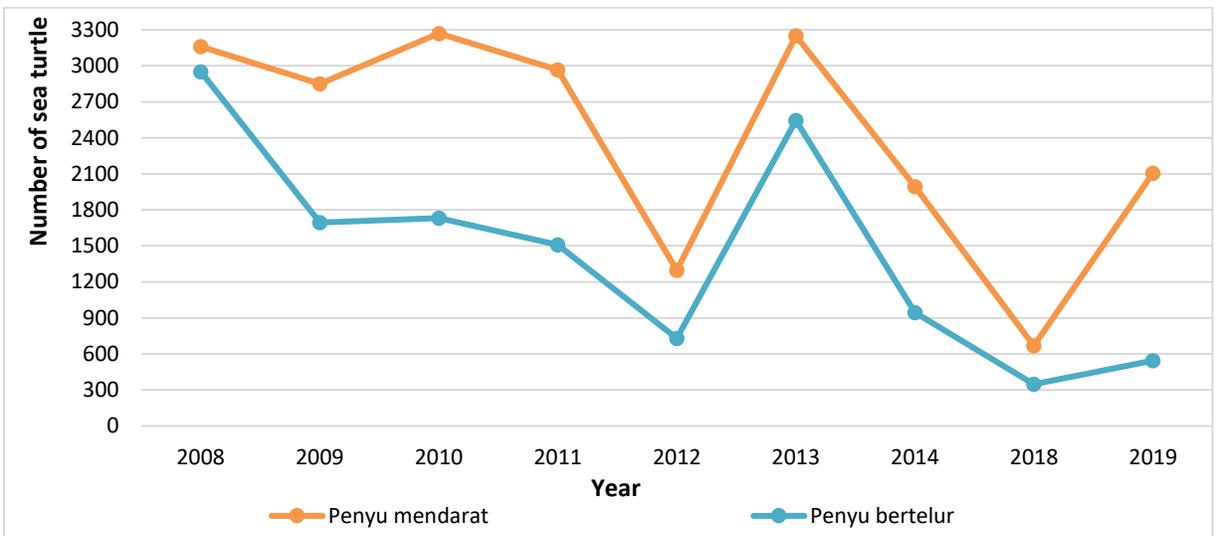
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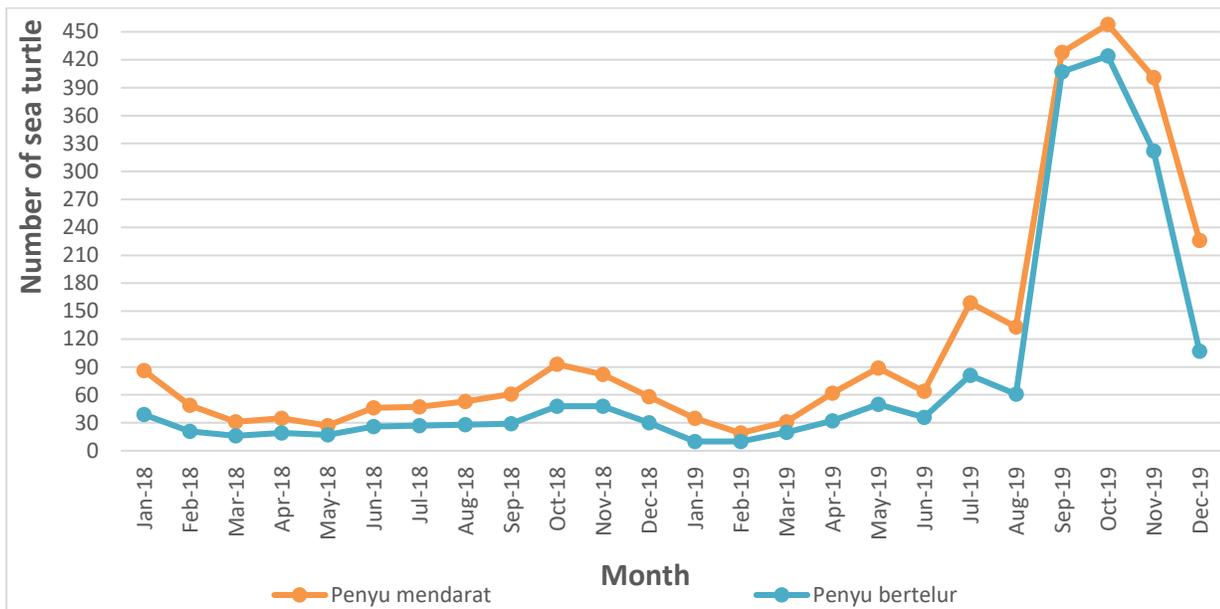
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**Table 1.** Article Exclusion Criteria

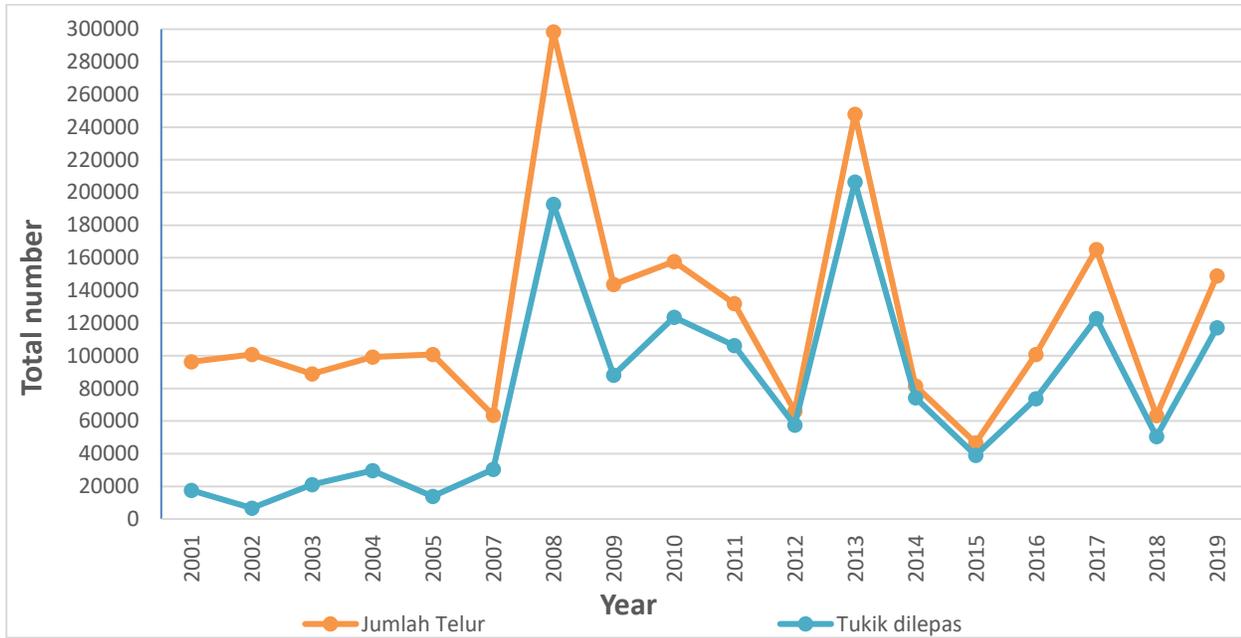
<b>Exclusion Criteria</b>	<b>Amount Article</b>
Article does not cover:	
- Pangumbahan Beach	374
-Green sea turtle	18
-Green sea turtle landing factor	12
-Green sea turtle Conservation	3
<b>Amount</b>	<b>407</b>



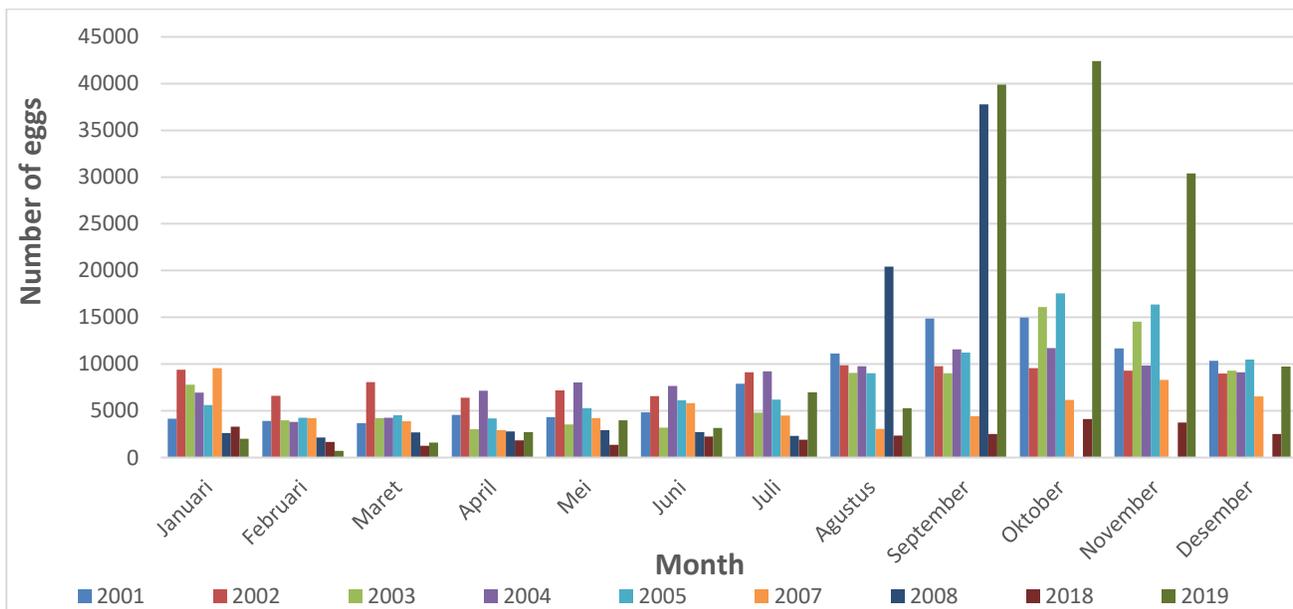
**Figure 1.** Annual graph of the number of sea turtle landing and nesting on Pangumbahan Beach in 2008-2019



**Figure 2.** Monthly graph of the number of sea turtle landing and nesting on Pangumbahan Beach in 2018-2019



**Figure 3.** Annual chart of egg production and hatchling release at Pangumbahan Beach 2001-2019



**Figure 4.** Monthly egg production chart at Pangumbahan Beach 2001-2019