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Biophysical Characteristics on Nesting Habitat of Green Turtle *Chelonia Mydas* in the Coastal Zone of Kasiak, Bindalang and Karabak Ketek Island of West Sumatra, Indonesia

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A B S T R A C T

The research was conducted on three small islands of the marine conservation area of West Sumatra, namely Kasiak Island, Bindalang Island, and Karabak Ketek Island from January to December 2016. This research aimed to study the variation of the biophysical character of the nesting habitat of the green turtle (*Chelonia mydas* L, 1758) by survey method, measurement, observation, and analysis. All data were analyzed using Main Component Analysis (PCA), Kruskal Wallis Test Analysis. Based on PCA analysis, the contribution of the main character is 43.28%. These results are supported by biophysical conditions of spawning habitats for green turtles on Karabak Ketek Island as an ideal island of spawning sites favored by green turtles compared to the location of Bindalang Island and Kasiak Island habitats. Kruskal Wallis analysis of Karabak Island rank; 11.90, with a chi-square value; 10.47, sig value 0.005 (5% -10%). This value shows the difference between the spawning habitat's biophysical character on the character of the coastal slope parameter (KP) is 9.60°. It is also the ideal slope value for the sandy beach habitat (PSe) and fine sandy beaches (PHA) as the central spawning location for green turtles in West Sumatra.

INTRODUCTION

Inorganic fertilizers enhance agricultural production and contribute to agricultural productivity growth. Applying the recommended amounts of inorganic fertilizers enables farmers to achieve optimum yield and contributes to soil amendment in areas with fragile soils (Alfsen et al., 1997).

In Indonesia, there are six (6) out of 7 (seven) types of sea turtles, namely Leatherback turtle *Dermochelys coriacea*, Olive ridley turtle *Lepidochelys olivacea*, Hawksbill turtle *Eretmochelys imbricata*, Loggerhead

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turtle *Carreta caretta*, Flatback turtle *Natatordepressus*, and Green turtle *Chelonia mydas* (Halim & Dermawan, 1999).

One of the most common turtles found in the Indian Ocean, Riau, West Kalimantan, and East Kalimantan waters is the green turtle *Chelonia mydas* (Suwelo, 1999). The green turtle is one of the most abundant and most often found sea turtle species in Indonesia. This species is the main target for hunting and fetching meat, so it tends to decline rapidly. At sea, the green turtles face the threat of fishing net traps and the amount of marine debris, while on the mainland, turtle eggs are taken for trading and are also eaten by predators (Karnan, 2008).

At present, green turtle populations are declining due to illegal hunting and illegal harvesting, and turtle habitat degradation (Dharmadi & Wiadnyana, 2008). Green turtle habitat destruction is mostly caused by development activities such as coastal tourism development, so turtles have difficulty rediscovering nesting sites. Eggs buried in sandy nests will be disrupted in embryonic development, disrupted in the hatching process, and the problems of turtle hatchlings out of the nest that can threaten their lives (Marquez, 2004).

According to Nuitja (1992), turtle nesting habitat preferences are characterized by large and sloping coastal areas, with a slope of about 30°, and an egg position above tide between 3.00m - 4.00m. Turtle eggs are not incubated, but the eggs are dumped in the sand on the beach-nesting habitat. Turtle eggs will hatch within 7 to 12 weeks depending on the temperature of the sand, where the eggs are incubated (Limpus, 1979); (Clarine, 2005)

Sand temperature becomes the primary key in the egg hatching process. At a temperature range of 33.40°C - 35.70°C, the movement of the dive provision in the eggshell is uncertain, while in the temperature range above 36.0°C - 37.50°C, it will result in eggs of other turtles not being able to hatch (Drake & Spotila, 2002).

Turtle made adapted to the environment from hatching. The pattern and behavior of hatchling turtle in meeting the feeding needs and breeding activities after adulthood will affect the turtle's instinct to return to its birthplace (Clark, 1976)

The conservation of turtle and spawning habitat is one way to respond to the coastal development issue, which is adult turtle nesting populations (Tripathy et al., 2003).

Changes in turtle nesting habitat conditions in the coastal areas will result in changes in nesting patterns of individual turtles. It is mainly due to the disruption of turtles' ecological habitat nesting (Andriyono & Mubarak, 2011). Therefore, research on the environmental habitat of green turtle *Chelonia mydas* nesting on 3 (three) locations of small islands in the West Sumatera marine conservation area is essential to support national and international turtle conservation programs.

RESEARCH METHODS

Research on biophysical characteristics of green turtle *Chelonia mydas* nesting habitat is conducted in coastal areas of small islands located in a marine conservation area, West Sumatra. The location selected as the habitat for nesting green turtles is located in Kasiak Island (north of Pariaman City), Bindalang Island (west of Padang City), and Karabak Ketek Island (south of Pesisir Selatan Regency), West Sumatera Province (Figure 1).

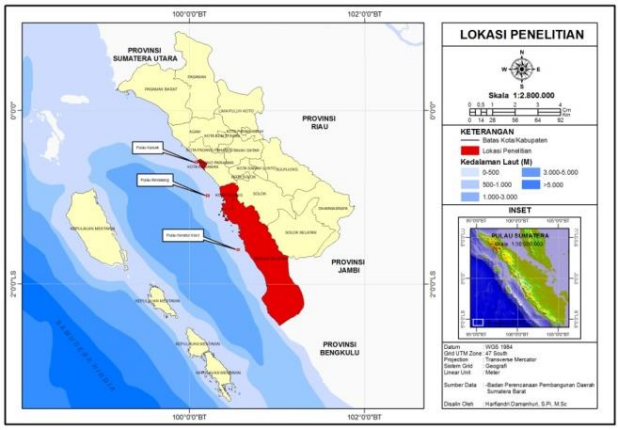

Figure 1. Research Sites in Kasiak Island, Bindalang Island and Karabak Ketek Island, West Sumatera.

The biophysical characteristics of green turtle nesting habitats measured at each research site include; 1) Beach Width (LP), 2) Coastal Slope (KP), 3) Fine Sand Nest (Pha), 4) Medium Nest Sand (Pse), 5) Body Nest Width (LSTb), 6) Egg Nest Width (LSTR), 7) Humidity Nest (KS), 8) Nest Temperature (SS), 9) pH Nest (pHS), 10) Egg Nest Depth (DST), and 10) Nest Vegetation (VS) (Yustina et al., 2004).

RESULTS

Biophysical Hue of Nest Habitat

In order to explain the ecology of the green turtle, *Chelonia mydas* nesting habitat which lay eggs in small islands area in the marine conservation area of West Sumatera, observation of ecological variables of turtle nesting habitat of green turtle consisting of LP, KP, Pha, Pse, LSTb, LSTr, KS, SS, pHS, DST, and VS.

Table 1. The mean biophysical value of green turtle (Chelonia mydas L) nesting habitat on the three small islands

Lokasi Pulau	PSe (mm)	STD (±)	PHa (mm)	STD (±)	VS	STD (±)	LSTb (cm)	STD (±)	KS (%)	STD (±)	KP (°)	STD (±)
Kasiak	69.63	12.92	84.65	6.96	67.50	30.10	137.80	4.82	73.20	7.26	5.10	1.43
Bindalang	84.83	15.87	94.65	5.56	47.50	10.46	141.00	6.89	67.00	4.06	5.55	1.53
Karabak Ketek	72.86	13.48	87.15	6.84	47.50	10.46	136.00	8.46	70.00	6.20	9.60	3.97

Of the 11 ecological character variables of turtle nesting habitat of the green turtle, four of them is the main characteristic of the ecological character of turtle nesting habitat of green that is variable of Pse, Pha, LSTb, and LSTr.

Medium Sand (Pse)

The presence of sand is very important at each nesting location of green turtles. The natural turtle nesting habitat in Kasiak Island, Bindalang Island and Karabak Ketek Island has medium sand fraction size (PSe) 69.63 mm ± 12.92, 84.83 mm ± 15.87, and 72.86 mm ± 13.48 respectively.

Fine Sand (Pha)

In addition to the sand-sized fraction of fine sand also plays an important role in the incubation process of green turtle eggs. The composition of fine sand at the location of green turtle nesting habitat in Kasiak Island, Bindalang Island, and Karabak Ketek Island each have a fine sand fraction size (PHa) 84.65 mm ± 6.96, 94.65 mm ± 5.56, and 87.15 mm ± 6.84.

Vegetation Nest (VS)

Vegetation of plants around the nesting habitat plays an important role in determining the choice of egg placement location by the adult female turtles. The coastal vegetation type is more dominant than grass vegetation type, where nest vegetation in each island, Kasiak Island, Bindang Island, and Karabak Ketek Island, consists of 67.50 ± 30.10, 47 50 ± 10.46 and 47.50 ± 10.46 respectively.

Body Nest Width (LSTb)

Before making a nest egg, the turtle will make the body nest first. The nesting habitat of a green turtle on Kasiak Island, Bindalang Island, and Karabak Ketek Island each have a size of body nest (LSTB) about 137.80 cm ± 4.82, 141.00 cm ± 6.89, and 136.00 cm ± 8.46 respectively.

Nest Humidity (KS)

Humidity is essential at each turtle nest egg location; this is related to the length of egg incubation time. Humidity nest egg (KS) conditions in each nesting habitat of a green turtle on Kasiak Island, Bindalang Island, and Karabak Ketek Island are each with a humidity level of 73.20% ± 7.26, 67.00% ± 4.06, and 70% ± 6.20, respectively.

Beach Tilt (KP)

The gentle beach is one of the critical factors for turtles in selecting and determining egg placement for the turtle egg incubation process. The coastal slope profile (KP) on Kaisak Island, Bindalang Island, and Karabak Ketek Island is by coastal slope 5.10 ° ± 1.43, 5.55 ° ± 1.53 and 9.60 ° ± 3.97 as in table 3 below.

Variation of Biophysical Characteristics of Nesting Habitat

Variation of the biophysical characteristics of green turtle Chelonia mydas nesting habitat in each island was centered on Axis1 and Axis2, as shown in Figure 2.

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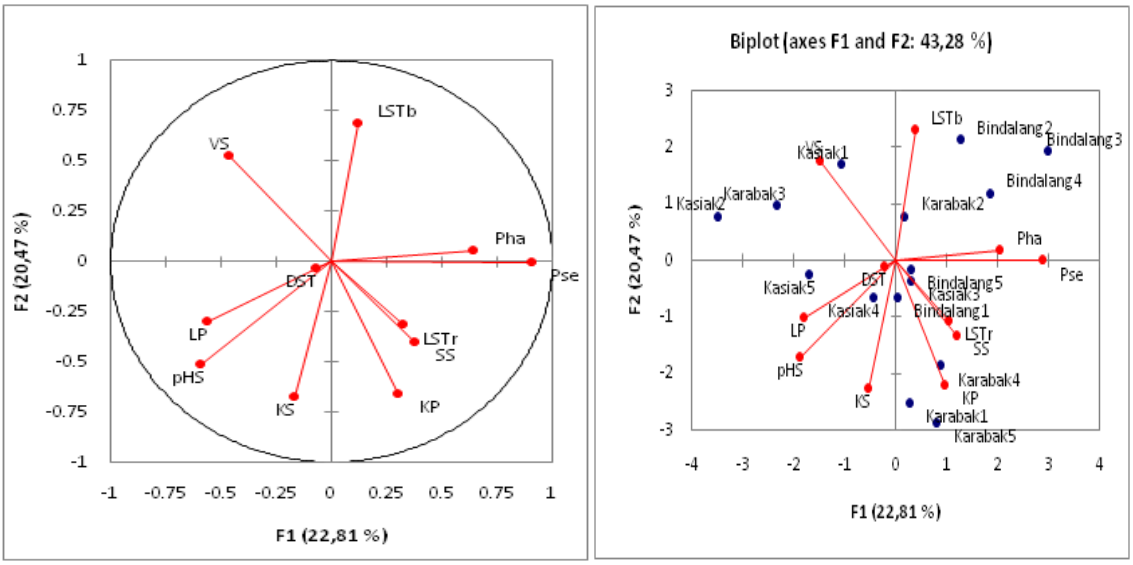

Figure 2. PCA results of variation in habitat characteristics in each island on the Axes 1 (F1) and Axis 2 (F2)

DISCUSSIONS

The medium sand fraction (Pse), the size of the fine sand fraction (Pha), body nest width (LSTb), and egg nest width (LSTr) are the main characteristics of *Chelonia mydas* spawning habitat in all three locations of the islands. Turtles favored fine sandy beaches as their spawn habitats (Panjaitan, 2012), suitable grains of sand which turtle favor make nests are medium to fine sands (Yustina et al., 2004).

In a suitable sandy coastal area, the turtle will build a nest in the location chosen and desired, and this is supported by Ackerman's (1997) research, which states that the turtles will build their nest and lay their eggs on a sandy beach.

The location of green turtle Chelonia mydas nesting habitat on the sandy beach is a limiting factor from the extent of the distribution of nest sites that can indicate and estimate the magnitude and number of nesting and nesting turtle populations.

The green turtle *Chelonia mydas* nesting habitat can be estimated from the rising turtle population growth on an island.

Green turtle Chelonia mydas adult females in one breeding season vary between 3 and 7 times of spawn's ascending and descending processes. This is supported by Anshary et al. (2014), which states that the green turtle *Chelonia mydas* landing frequency at the nesting beach is closely related to coastal conditions.

Pse, Pha, LSTb, and LSTr are dominant factors to measure other ecological parameters of nesting habitats. Pse and Pha giving an enormous contribution to Axis 1 and are positively correlated with LP and VS. Whereas the higher number of Pse and Pha, the higher the LP. As one of the decisive factors, this factor will allow VS opportunities to grow along the turtle nesting habitats' coast.

The width of the beach (LP) has a positive impact on the presence of turtles nesting habitat location, according to Zamani (1996) suggesting that exploitation by developing and constructing coastal areas will harm turtles. Kasendra et al. (2013) state that many of the vast beaches have been abandoned by turtles because of the location's deteriorating environmental conditions.

Four of eleven variables of the ecological character of green turtle *Chelonia mydas* were the main characteristics of the ecological characters of turtle nesting habitat on small islands of the marine conservation area of West Sumatra.

Medium Sand Characters (Pse) are mostly found on Bindalang3, Bindalang4. While the little Pse is found on Kasiak1 and Karabak Ketek3. The greater character of body nest width (LSTb) was found on Bindalang Island4,

while the small character of LSTb was found on Karabak Ketek5, Karabak Ketek1 and Karabak Ketek4. While the large LSTr found on Bindalang5, and Kasiak4, the smallest size LSTr found on Kasiak3.

The greater amount of sand on the coast, whether it is the Pha fraction-sized or Pse fractions, will give the green turtle *Chelonia mydas* free options *to* select and build the nest according to the activity of the nesting habitat.

The biplot shows that the variables of medium sand fraction size (Pse), fine sand fraction size (Pha), body nest width (LSTb) are more in Karabak Ketek3, Karabak Ketek5, Karabak Ketek1, Karabak Ketek4. While the coastal slope (KP) is also a determining factor in the turtle process to rises to the nesting habitat location with an ideal angle smaller than 30°, found at the site of Karabak Ketek4, Karabak Ketek5, and Karabak Ketek1. This finding is in line with Nuijta (1992) opinion, which states that the turtle prefers the coastal slope with an angle formed below 30°.

Similarly, according to Yustina et al. (2004), the green turtle *Chelonia mydas* prefers the beach with a slope ranging from 24° - 31°, Which is not too sloping and not too steep. A medium-sized fraction of sand (Pse), which few in a number found on Kasiak1 and Karabak Ketek3 Island. Sand is an essential factor in the turtle regeneration process because sand serves as a medium to placing the eggs for incubation on the three small islands of marine conservation areas of West Sumatra. A medium-sized sand beach fraction (Pse) was found on Bindalang3 and Bindalang4. Turtles dig its nest and lay their eggs on a sandy beach (Ackerman, 1997).

The more significant the contribution of the biophysical character of green turtle nesting habitat by medium (PSe) and fine (Pha) sands, means the greater contribution of Axis1 in explaining the variation of green turtle nesting habitat at the three locations of small islands of marine conservation areas in West Sumatra. Where more fractions of fine (Pha) and medium (Pse) sands will be followed by a bigger value of beach width (LP), so the greater contributions to body nest width (LSTb) and egg nest width (LSTr).

Suitable spawning habitats have higher coefficient scores in some variables, especially in medium sand fraction (Pse) and fine sand (Pse) fractions on Karabak Ketek Island. This is similar to what we found on Bindalang Island but in a different value, where Karabak Ketek Island's contribution is bigger on the 1st axis.

CONCLUSIONS

There are various characteristics of green turtle nesting habitat on each island. The nesting habitat is the main characteristic of the green turtle Chelonia mydas. There are four important variables of green turtle nesting habitats; the variable of the medium sand fraction (Pse), the fraction of fine sand (Pse) width of the body hive (LSTb), and egg nest width (LSTr). The best value of the green turtle nesting habitats was on Karabak Ketek Island.

From the three islands, Karabak island has the highest contribution of the correlation coefficient scale of Pse (variation of medium sand), Pha (fine sand), LSTb (width of nest body), and LSTr (egg nest width), with the variation of 43.28%.

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