Habitat Condition and Its Correlation With Olive Ridley (*Lepidochelys olivacea*) Nesting in Alas Purwo National Park, Banyuwangi District, Indonesia

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ABSTRACT
Alas Purwo National Park is one of the sea turtle conservation areas developing positively in Indonesia. This study aimed to investigate the ecological factors causing the olive ridley to (*Lepidochelys olivacea*) nest in this park. The research was conducted in 2004 at six research stations. The turtle nesting data were updated until the year 2008. The data collected examined coastal elevation and its width, sand percentages, water content of the sand percentages, type of vegetation and type of sea turtle predators. Secondary data was composed of turtle nesting from daily reports of the field officer. The results show that the olive ridley turtle chose its nesting places with specific characteristics as well: not too wide (about 55.3 meters), relatively open topography, an elevation of about 4.7 degrees, composition of sand substrate of 97.3% and a water content of 2.6%. The significant increase of turtle egg laying recorded from 1983 to 2008 indicates that the coastal area of TNAP is well maintained and appropriate for a nesting habitat of the olive ridley. The presence of TNAP could provide a positive impact to the current good condition of the sea turtle nesting area. Therefore, it would be best to continue to maintain the TNAP well to ensure the sustainability of sea turtle conservation in the world.

KEYWORDS: olive ridley, *Lepidochelys olivacea*, nested habitat, Taman Nasional Alas Purwo, Banyuwangi District

INTRODUCTION

In the last few decades, there has been a sharp decline in numbers of sea turtles found in Indonesia. The massive, overexploitation andthe damage to coastal habitat in many places where sea turtle nesting occurs could increasingly threaten their sustainability. Therefore, under both national and international laws, all species of sea turtles have been declared as endangered and protected species. In CITES (Convention on International Trade in Endangered Species of Wild Flora and Fauna) sea turtles are listed in appendix I, where it states that sea turtles are an endangered species and are forbidden to be traded internationally, including any part of the body including the eggs, meat and skin with the exception of purposes of research efforts or cultural importance (Sukresno, 1997).

In order to ensure the safety of the sea turtles and the protection of their environment, the Indonesian Government has implemented conservation programs in some areas. Alas Purwo National Park, also called "**Taman Nasional Alas Purwo**" (TNAP) in Banyuwangi, East Java is one of such sea turtles conservation areas. Four species of sea turtles are found landing and laying eggs in this conservation area. These are the leatherback turtle (*Dermochelys coriacea),* the hawksbill turtle (*Eretmochelys imbricata*), the green turtle *(Chelonia midas)* and the olive ridley turtle (*Lepidochelys olivacea*). The latter is the dominant nesting species.

Each species of sea turtle tends to select specific seasonal and ecological conditions when coming to land and laying eggs (Sitaparasti, 2001). Lopez-Castro *et all*., (2004) found that the olive ridley sea turtle chose a nesting site with some characteristics similar to those in Southern Baja, California. The purpose of this paper is to investigate the ecological factors causing the olive ridley to choose its nesting ground in the TNAP conservation area.

MATERIALS AND METHODS

The research was conducted in January-July, 2004 at the TNAP coastal area and the sea turtle nesting data was updated until 2008. OThe observation station was determined, based on the signage of the World Wild Foundation (WWF) that was available. The WWF signs are on wooden poles complete with the TNAP area code. TNAP nesting beach areas are divided into 6 units of observation stations with a distance of 3 km between each.

Station I is at the far west and borders Grajagan fishing port, while Station VI is located in the east and borders the Plengkung coast which is a rocky beach (Fig. 1). Data were collected by direct observation and interview and were subsequently analyzed descriptively.

The parameters and materials were measured in this research are shown in Table 1.

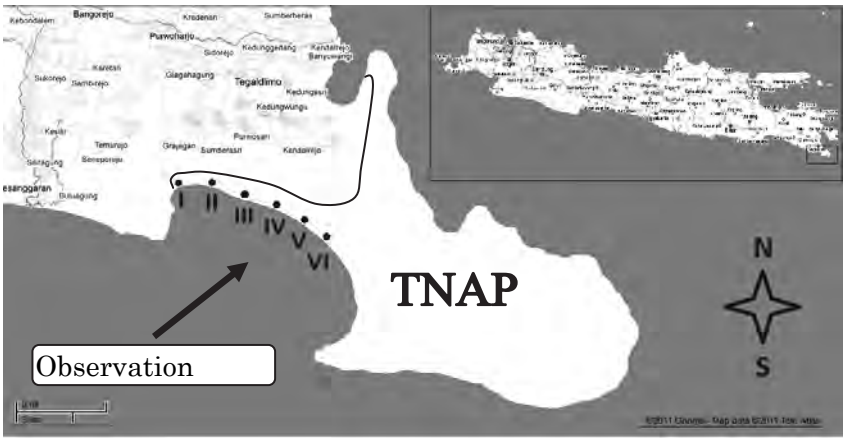


Fig. 1. Location map of observation stations

Table1. Parameters and materials/ methods were measured and used

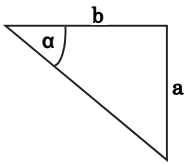
No	Measured/observed Parameter	Unit	Materials / Methods used
1.	Coastal elevation	degree	Roll meter, inside measurement
2.	Coastal width	m	Roll meter, insidemeasurement
3.	Sand substrate percentage	%	Plastic bag, pipette methods (laboratories)
4.	Water content percentage	%	Plastic bag, backer glass, oven, analytic counterweight
			Visual identification,interview
5.	Coastal vegetations	qualitative	Visual identification, interview
6.	Fauna predator	qualitative	Visual, data quotations that has been exist, inside
7.	Amount of olive ridleys those nested	numeric	

All of the parameters and data which were observed are analyzed as follows.

Coastal Elevation

Measurement results of coastal elevation were counted using the following formula:

$$Tg\,\alpha = \frac{a}{b}$$



Explanation:

α	=	coastal elevation angle
a	=	stick's height marked by rope
b	=	rope's length tied on the closest vegetation border

Water Content Percentage (WC)

Sand's wet weight (initial weight) noted and than heated using an oven at 105 º C in temperature for 24 hours before the dry weight (final weight) is recorded.

Water content percentage was counted using the following formula:

$$\%\ WC = \frac{\text{initial weight} - \text{final weight}}{\text{final weight}}$$

RESULTS AND DISCUSSION

Characteristics of Nesting Habitat's Selection

Coastal elevation and its width

Biotic and non-biotic factors gave influence to the number of sea turtles nesting on each of the observation station. Biotic factors include vegetation and predator organisms (including human). One non-biotic factor is coastal elevation and its width. Measurement results of coastal elevation and its width are shown in Fig. 2.

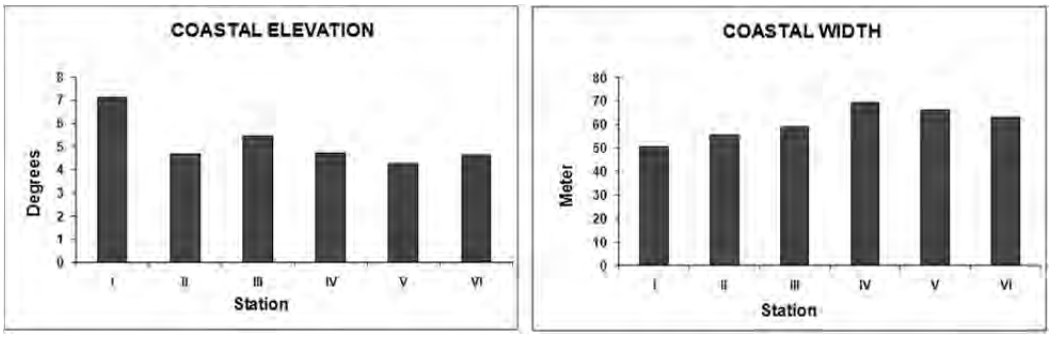


Fig. 2**.** Coastal elevation and coastal width on each observation station.

Coastal elevation. Fig. 2 shows that the highest elevation occurred at Station I at 7.1 degrees and the lowest elevation at station V at 4.3 degrees. The average coastal elevation from all observation stations is 5.2 degrees, which shows the land is relatively flat and homogenous. According to Wicaksono (1999), the coastal elevation influenced the selection of olive ridley landing and nesting. The flat coast is appropriate for the olive ridley nest-site but is inappropriate for another species, the leatherback turtle. Leatherback turtles tend to choose steeper coast elevated between 6.69-6.98 degrees (Sulaiman, 2004). According to the study of Sitaparasti (2001), olive ridley and green turtles tend to choose flat nest-sites with an elevation between 2-10 degrees or without high elevation; however, the elevation is not the only factor that influences sea turtle landing and nesting.

Coastal width. Coastal width influences the separation of the highest tidal range from the vegetation. Measurement results of coastal width at the observation stations were shown in Fig.2. This coastal width would not have an affect on the highest tidal range to the nest, however it would affect the vegetation that exists on it. Sukristianto (2004) found that coastal width does not affect the nesting range of olive ridley turtles from highest tidal border, however it has and affect on the range of the nesting place from the vegetation. With a coastal width that is relatively big, the range between nests and vegetation will be farther. Olive ridley may prefer to locate the nest-site under the vegetation.

Fig.2 shows that Station IV has the longest and Station I has the shortest coastal width compared to the other observation stations. CThe coastal width on Station IV is 69.3 m and on Station I, 50.58m. The average of combined coastal widths is 60.5 meters. The different coastal width at each station is influenced by the different coastal topography of TNAP Coastal areas. According to Sukristianto (2004), the number of sea turtles landing in this area did not have any connection with coastal width. The unrelated relationship of coastal width to the number of sea turtle landings at observation locations is assumed to be affected more by other factors such as those concerning sea turtle nesting in this area. According to Mortimer (1982), the elevation is the most influential factor on nest selection location. Yong (2001), explained that sea turtle choose a nesting beach based on their instincts.

Sand substrate and its water content percentage

Sand substrate. Sea turtles tend to select a nest-site with certain sand conditions or a soil texture containing a subtract grain size of 2 mm-50 µm, 50-2 µm called dust and or of a smaller size 2 µm called clay. Grain composition of subtract or soil texture is shown in Fig. 3.

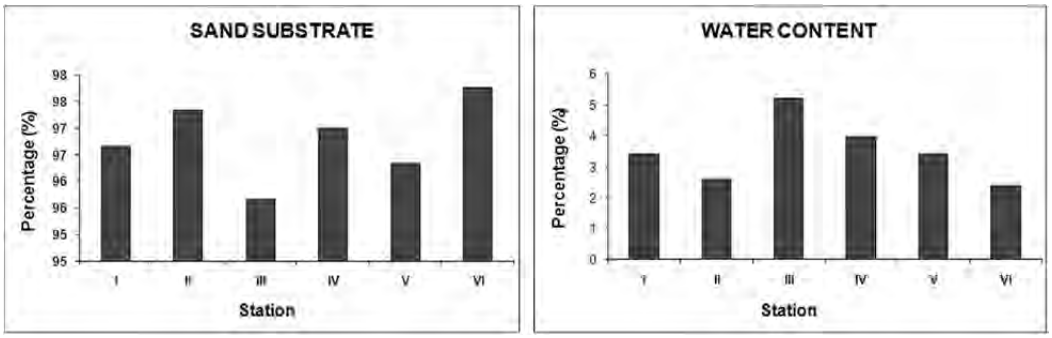


Fig. 3. Sand substrate and its water content percentage at each observation station.

Olive ridleys prefer to choose coasts with a high sand composition. High sand content allows us to assume that the digging process of the nest would be easier and enables the nest temperature to remain more stable and allows oxygen diffuions to become more fluent. According to Mortimer (1990), each species of sea turtle will prefer nest-sites with a certain structure and sand composition.The quality of coastal sand has a significant role to their hatching success, therefore sea turtles use the texture as a criteria for their nest-site selection. Hirt & Ogren (1987) found that sand particle size and its relationship to the moistness of sea turtle nests could affect the growth of embryos.

Laboratory analysis results show that the condition of substrate in the nest-site consisted of almost 100% sand (size 2 mm-50 µm) at 96.8% and the rest was dust that made up about 3.2%. This condition is normal because generally, sea turtle nesting occurs in coastal areas with various colors of sand (white colored sand at Station I changing to black colored sand at the most westerly station at Station VI). StationVI is the station with the highest sand substrate composition (97.8%) while the lowest sand substrate composition was found at Station III (95.7%).

According to Sitaparasti's (2001) study, the olive ridley selected sands with a diameter of 0.1-0.3 mm. In this study, the analyses of soil texture was limited to the classification level of the soil texture class (sand, dust, clay). Sand class was not analyzed in more detail to determine the grain's classification (hard sand, medium and soft), therefore it is difficult to conclude which type of sand may become the preference of olive ridleys nesting at TNAP coastal area.

Water content. Water content affected temperature and sand moistness. Fig.3 shows the percentage of water content of sand at each observation station. The highest water content is at Station III (5.2%), while the lowest water content is at Station VI (2.4%). The level of water content is influenced by the sea tides; moreover soil texture is also affected by the amount of water content that exists within it. According to Sitaparasti (2001), sea turtles tend to choose nest-sites in the moist substrate. Hard and dry conditions will make itdifficult for sea turtles to dig up a place for nesting, therefore sea turtles tend to choose moist sand substrate sands for their nest-site (Mortimer, 1990).

The certain, specific water content will directly affect the sand temperature as hatching condition, therefore it will also affect the time of eggs hatching. Even in extreme conditions where the sea tides reach the nest affecting levels of moisture, the egg inside will decay. Mortimer (1990) also found that hard and dry particles create obstacles for sea turtles to dig the nest which would cause the death of eggs due to their desiccation.

Measurement results of water content at observation stations show that olive ridleys tended to choose coastal nesting areas with a water content between 2.60% - 5.21% with average an average of 3.50%. According to Wicaksono's (1999) study at the same location, the average water content that was selected by olive ridleys when chosing their nest location was 5.54% with the lowest value at 3.36%. According to Parkinson and Brantly (2000), sand quality of the nest location was the most important factor for the sea turtles when selecting their nest. The color, type, sand particle size and water content also had an influence over the selection of a nest location.

Vegetations and Fauna at Coastal Nesting Sites

Generally, the type of vegetation found at each observation station at TNAP coastal area was relatively homogenous. Through visual observation, different types of vegetation was found around the nest-sites. The observation results of vegetation and predator fauna show in Table 2. According to Hadisusanto *et al.*(1996), sea turtles tend to choose a nest-site under the shelter of sea pandanus(*Pandanus tectorius*) and do not prefer this to shelter of keben (*Barringtonia asiatica*).

Table 2. Dominant vegetations and predators organism around the location of nesting beaches

No.	Vegetation	Species	No.	Fauna	Species
1.	Sea Pandanus	*Pandanus tectorius*	1.	Lizards	*Saranus salvator*
2.	Keben	*Barringtonia asiatica*	2.	Wild boar	*Sus scrofa*
3.	Hibiscus	*Hibriscus tilliaceus*	3.	Albatross	*Heliaetus leucogaster*
4.	Nyampung	*Calophyllum mophyllum*	4.	Sea crab	*Cerra ceratus*
5.	Ketapang	*Terminalia catappa*			
6.	Queen sago	*Cycas rumphii*			
7.	Sun grass	*Spinifex littoralis*			
8.	Sea peanut	*Virginia marina*			

Other organisms are often seen around the coastal area. In some cases sea turtle nests are often destroyed by predator organisms. Mortimer (1982) also found a similar situation; that habitat selection for every species of sea turtle was influenced by biotic factors such as predator and inter specific competition among female turtles. Common predator organisms determined to influence nest choice are lizards *(Saranus salvator)*, wild boar (*Sus scrofa*), albatross (*Heliaetus leucogaster*) and sea crabs (*Cerra ceratus*).

Nesting Frequency and Its Correlation to Habitat Condition

The number of olive ridley turtles landing and laying eggs at TNAP coastal area during January-July, 2004 are shown in Fig.4, while the years spanning 1983-2008 are shown in Fig.5.

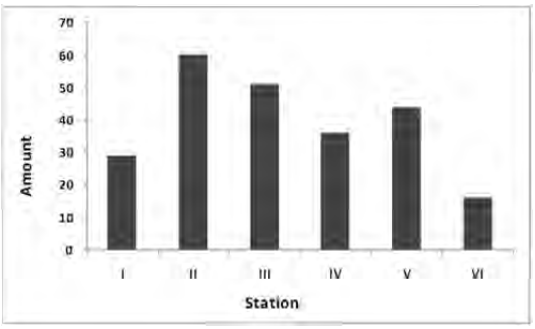


Fig.4. Nesting of the olive ridley turtle (*Lepidocelys olivacea*) at TNAP coastal area (January-July, 2004.)

Based on Fig.4, it can be seen that the highest nesting number of olive ridleys occurred at Station II (60 turtles) and the lowest number occurred at Station VI (16 turtles). The high nesting number at Station II could be attributed to the coastal topography of that station which is relatively open and flat. There were no coral stones found that would disturb olive ridleys walk to the nesting coast, it has a coastal elevation angle of about 4.70 degrees, a coastal width that is not too large at 55.32 meters, water content that is relatively low at about 2.60% and soil texture dominated by sand substrate which makes up 97.33%. According to Wibowo (1990), the olive ridley nesting coastline is usually bordered with deep sea, non-coral stones, big waves and has a slightly flat elevation. This is supported by the Sitaparasti (2001) study at a similar site, which shows that olive ridleys prefer to the flat beach to lay eggs with elevation of 5.8 degrees. The frequency of low olive ridley numbers landing at station VI may be caused by the existence of fishery port activity at Grajagan Village that directly borders Station VI, because the other parameter which includes beach elevation, beach width, soil texture and sand's water content show a relatively similar value to the other stations. Sea turtles tend to choose natural coastal which are not interrupted by human activity. According to Whitten *et al.*,(1999), where the coast remains a place for sea turtles which is not interrupted and is in an isolated part of the world, a lot of female sea turtles will chose to go up the coasts and lay their eggs in the natural conditions.

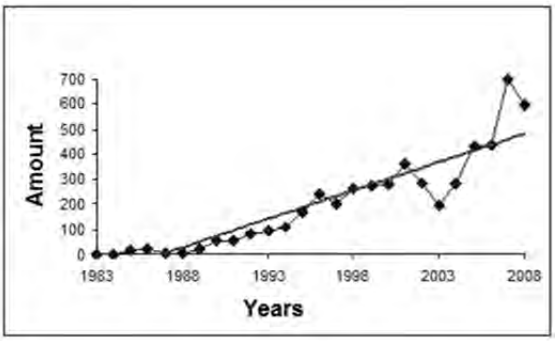


Fig.5. Nesting of the olive ridley (*Lepidocelys olivacea*) at TNAP coastal area recorded from 1983 to 2008.

During 1983-2008, the trend of olive ridley numbers that landed and nested in TNAP shows a significant increase (Fig.5). This trend indicates that the topography and ecological conditions of TNAP are very appropriate for a nest-site. Furthermore, the increasing nesting numbers also indicates there were no significant changes to nesting habitats in these areas between 1983-2008. This condition seems be well maintained by the positive impact of the presence of TNAP. The condition of the TNAP coastal area are still appropriate as the preference of olive ridley nesting on the south coast of East Java. Sea turtles need various habitats that are suited to their needs, which include habitats to find food (feeding area), habitats for mating (mating area), habitat for resting (resting area) and habitat for egging (nesting area) (Hamdan,2001).

CONCLUSION

The coastal area of TNAP is well maintainned and an appropriate nesting habitat for olive ridley turtles. Olive ridleys tend to choose nest-sites along coasts which are not too wide (about 55.3 meters), the topography is relatively open with an elevation of about 4.7 degrees, composition of sand substrate at about 97.3% and with a water content of around 2.6% for laying their eggs. These results suggest that TNAP would enhance the population of the olive ridley. Therefore, this national park, the TNAP should continue to be well maintained to enable sustainable conservation of sea turtles to continue.

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