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Physiological Value of Heart Rate, Respiration and Rectal Temperature of Wild-Captive Dugong (*Dugong dugon*)–A Case Study in Lingayan Island

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ABSTRACT

This study aims to obtain the physiological value of dugongs that live in natural habitats (*in-situ*) as protected wildlife, namely on the coast of Lingayan Island, Toli-Toli Regency. Wild dugongs caught on the beach were put into a net cage. After 14 days of living in a beach cage, measurements of heart rate, respiration, and body temperature were measured using non-invasive methods. This study showed that the value of heart rate, respiration, and body temperature were measured (80.00±17.32) beats/minutes, (17.33±6.80) inspiration/minute, and (32.75±0.07)°C. This physiological value is higher when compared to dugongs that live in captivity, this is likely due to the process of homeostasis through physiological adaptation mechanisms. The physiological value of the dugong is very important for the advancement of dugong animal health science and technology. Besides this finding can be a medical reference that is very useful for veterinarians in the diagnostic and therapeutic process.

1. Introduction

The diversity of wild animals is one of the forms of biodiversity of natural resources in a region or a country, therefore efforts on wild animal protection are required. One of the protected wild animal is dugong, a mammal that is also known as sea cow (Nair and Mohan 1997). The existence of dugong in the wild should get special attention, considering the dugong world population to date has plummeted drastically. The number of dugong population is decreasing daily due to hunting and habitat damage (Anderson 1981). Biological data on dugong and the causes of its population decline could be caused by several factors. Most of dugong death incidence are known caused by human activities and some because of the dugong diseases itself (Campbell and Ladds 1979). To this date there have not been many reports on the presence of infectious or non-infectious diseases in this marine mammal. Most of the disease incidence reports were reports from pathological, histopathological, or microbiological examination in which the subject was already dead and reports on living dugong examination is still rare. This is likely because there are still no normal physiological data of dugong, in addition to the difficulty of understanding the existence and the wild nature of dugong in its habitat.

The scarcity of dugong physiological values become the complication factor for veterinarian to make diagnosis and therapy. In fact, the physiological values for general clinical diagnosis such as heart frequency, respiration rate, and body temperature values are still not yet well known. These physiological values are important to know the health status of healthy or sick dugong. In view of this, study of the physiological value of dugong is urgently needed as an effort to save dugong. This study was conducted to study and obtain the physiological value of dugong, especially the value of heart frequency, respiration and body temperature, that live in natural habitats as wild animals, namely on the coast of Lingayan Island, Toli-Toli Regency. This location was chosen because Lingayan Island is on the migration route and stopover place for dugong, so the probability of catching this wild animal is higher.

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2. Materials and Methods

2.1. Dugong Habitat and Feed Condition

The location of this study was in Lingayan Island beach, Toli-Toli regency, Central Sulawesi, Indonesia, the most outer island of Indonesia. This location was hard to reach, in order to get to the location it took 45 minutes by small wooden boat with high risk of massive wave. The geographical picture of Lingayan Island and the location of the study can be seen in Figure 1.

The dugong habitat in Lingayan Island is a shallow beach with a lot of coral reefs and varieties of seagrass found. Based on observation, there were 3 types of the most palatable seagrass for dugong namely *Halophila ovalis, Halodule uninervis*, and *Cymodocea rotundata*. The nutrition analysis value of palatable seagrass for dugong was reported in the results of this study.

2.2. Measurement Technique of Physiological Value Parameters

Dugong physiological value was measured with patient monitor, Welch Allyn, 621E. This method is non-invasive which was very appropriate with the dugong condition as very protected wild animal. The recording was done on mornings from 9.30 to 10.30 Central Indonesia Time. The wild dugong caught on the beach were put into a circular net cage with diameter of + 50 m. After 14 days living in the net cage the measurement was conducted. The measurement was done on boat under the shade after dugong is taken from a net cage located 1 km from the beach. Once the dugong was on boat the measurement was done with the position of the dugong was arranged in such a way that it was in supine position with its back lined with foam mattresses. In this position the body surface of dugong was dried with tissue papers and afterwards ECG electrode leads were placed on left and right chest, and the left side of sternum. At the same time, the body temperature indicator was placed on right axillary region (Figure 2). The recordings of heart rate frequency (beat/minute), respiration rate (inspiration/minute), and body temperature (°C) were observed through monitor screen. Meanwhile the water and air environment temperature were measured at the time of measuring the physiological value of the dugong.

3. Results

The parameter measurement of wild dugong in Lingayan Island beach resulted the values of heart rate frequency, respiration rate, body temperature, and environmental temperature as seen in Table 1.

4. Discussion

The habitat condition plays a big role in determining the health status and animal productivity, this matter are related to the presence of feed, environmental temperature, and humidity. Animals that live in their comfort zone are able to express their biological conditions as well as optimal health (Randall *et al.* 2002). In the sea habitat, this marine animal lives in the feeding (seagrass) environment, sea and air environment temperature that greatly determine the level of health and physiological status of the animal's

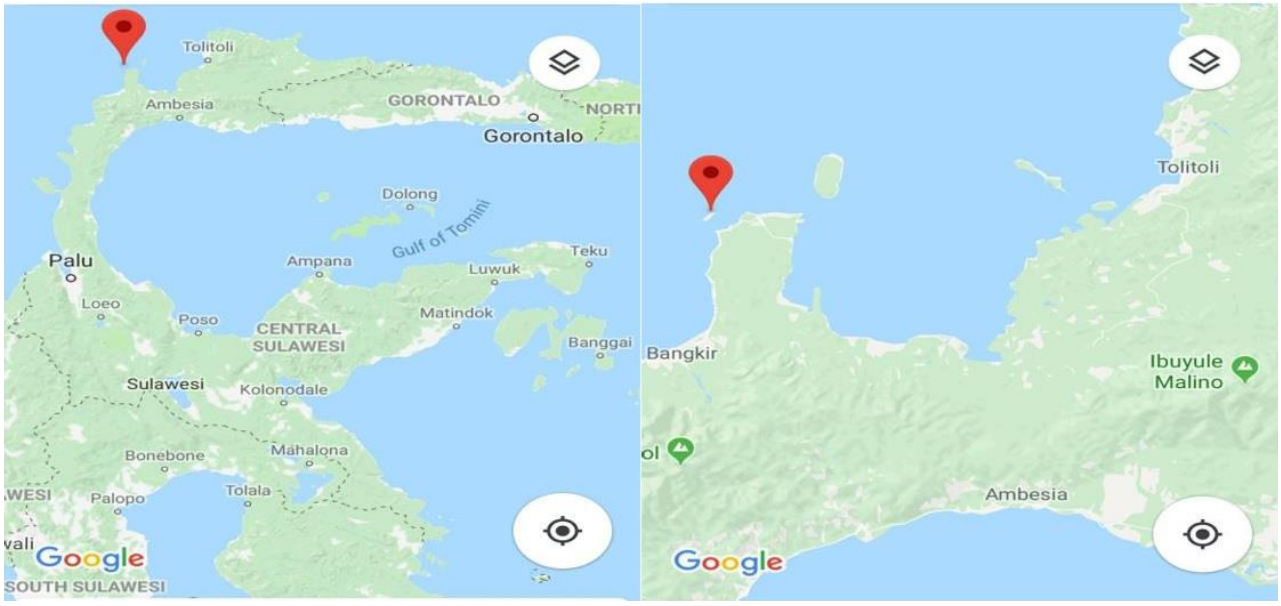

Figure 1. Geographical picture of Lingayan Island, Toli-Toli Regency, Central Sulawesi, Indonesia

Figure 2. The process of dugong physiological values measurements: (a) picking up dugong from the net cage, (b) ECG electrodes placement, and (c) physiological value recording

Table 1. Physiological values (heart rate frequency, respiration rate, body temperature) and environmental temperature of wild dugong in Lingayan beach compared to captive dugong

Physiological and environmental parameters	Dugong in captivity			Wild dugong in Lingayan Island
	ACD1	ACD2	BCD	WAD
Age estimation	9 years old	9 years old	(5-9) months old	(3-5) years old
Body weight	100 kg	96 kg	41 kg	60 kg
Heart rate frequency (beat/minute)	45.73±4.10	45.61±4.10[a]	87.11±8.70[b]	80.00±17.32
Respiration rate (inspiration/minute)	10.11±3.44	11.00±3.76[a]	12.89±3.08[a]	17.33±6.80
Body temperature (°C)	31.42±0.41	31.42±0.41[a]	29.26±0.77[b]	32.75±0.07
Air environment temperature (°C)	28.73±0.69	28.52±1.26[a]	24.78±0.65[b]	30.55±0.83
Sea environment temperature (°C)	30.34±0.74	-	-	32.00±0.15

The values followed by the same letter in the row are not significantly different ($p<0.05$)
ACD1: adult captive dugong (8-9 years), Suprayogi *et al.* (2007); ACD2: adult captive dugong (9 years), Suprayogi *et al.* (2008); BCD: baby captive dugong (5-9 months), Suprayogi *et al.* (2008); WAD: wild adolescent dugong in Lingayan Island (3-5 years)

body. Wild dugong data on Table 1 were compared with previous literature to get representation of dugong physiological value difference based on differences in habitat, namely with adult and baby dugong in captivity as reported by Suprayogi *et al.* (2007) and Suprayogi *et al.* (2008).

This research showed that dugong as a marine mammal live in comfort zone with sea temperature (32±0.15)°C and air temperature (30.55±0.83)°C at 9.30-10.30 Central Indonesia Time. This kind of environment has become their natural habitat as a wild animal, but when compared to captive habitat this environment could be different

from their natural habitat. Suprayogi *et al.* (2007) and Suprayogi *et al.* (2008) reported difference in dugong physiological values in captive habitats with different sea and air temperature with dugong in their natural habitats. The sea and air temperature in captive habitat were approximately (30.34±0.74)°C and (28.73±0.69)°C respectively. Different habitat conditions between these natural and captive habitat could affect the physiological values of dugong body, mainly the heart rate frequency, respiration rate, and body temperature value.

On Table 1 it is shown that dugong in their natural habitat have higher physiological values, specifically higher heart rate frequency, respiration rate, and body temperature compared to captive dugong that are approximately (80.00±17.32) beat/minute, (17.33±6.80) inspiration/minute, and (32.75±0.07)°C vs (45.73±4.10) beat/minute, (10.11±3.44) inspiration/minute, and (31.42±0.41)°C respectively. Increased dugong physiological status in its natural habitat is very possible, considering the fact that in their entire life span dugong must live in their wild habitat faced with a lot of natural challenges and predators. This forces the body to balance through physiological adaptation mechanisms (Randall *et al.* 2002). Higher heart rate frequency and respiration rate on this wild dugong are possible due to increased sensitivity when living in their natural habitat, especially the sensitivity to sound. Marsh (1978) reported that the big corpora quadrigemina region of the dugong brain is sensitive and could hear acute sounds well. Captive dugong that lies in dried pool is able hear sounds with frequency of 3-8 kHz (Nair and Mohan 1977), while Dugong inside pool was reported able to hear lower sound frequency, that is 1-4 kHz (Marsh 1978). This sound sensitivity could affect the heart rate frequency and respiration rate of dugong. It is known that Dugong could hold their breath for some minutes before inspiration and expiration happened. It was reported Dugong that able to hold their breath during maximum diving for 8 minutes before reaching the surface to take some breath air (Kenny 1967).

Suprayogi *et al.* (2008) had also reported that the physiological status of baby dugong had different values compared to adult dugongs. Table 1 showed that baby dugong with body weight of 41 kg had higher heart rate frequency and respiration rate compared to adult dugong with body weight of 96 Kg in the same captive habitat that were approximately (87.11±8.70) beats/minute and (12.89±3.08) inspiration/minute vs (45.61±4.10) beats/minute and (11.00±3.76) inspiration/minute. Whilst the difference in body temperature between adult dugong and baby dugong were (31.42±0.41)°C vs (29.26±0.77)°C. It seems the difference in this mammal body temperature is purely due to difference in sea water and air temperature in its habitat to reach their conditions of body homeostasis (Randall *et al.* 2002). Looking at Table 1 above, especially on body weight and the comparison of physiological values between captive dugongs both adults (ACD1 and ACD2) and baby (BCD), it is estimated that this captured dugong in Lingayan Island beach was of adolescent age approximately (3-5) years old.

5. Conclusion

Physiological values of wild dugong in Lingayan Island beach showed heart rate frequency, respiration rate, and body temperature respectively (80.00±17.32) beat/minute, (17.33±6.80) inspiration/minute, and (32.75±0.07)°C. These physiological values are higher compared to those of dugong that lived in captivity, this is likely due to homeostasis process through physiological adaptation mechanism. These physiological values are important for the advancement of dugong animal health science and technology. In addition, these findings could be used as very useful medical references for veterinarians in the diagnostic and therapeutic process.

It is known that dugong is a highly protected marine mammal, so this research must be carried out very carefully. With high level of difficulties to capture wild dugong, it is then expected that repetition of this kind of research can be done to obtain more accurate physiological value data.

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