DUGONG AND SEAGRASS HABITAT

Alor, 30 May – 6 June 2016

CONTENTS

SUMMARY

Dugong (*Dugong dugon*) or commonly known as Duyung (in Bahasa) is one of thirty-five marine mammals' species which is found distributed in Indonesian waters, especially in a seagrass meadow habitat. Despite of its body weight which reaches 600 kg, this marine mammal species has a sociable behavior and live closely associated with seagrass habitat as its feeding ground.

Dugong has a complicated life threats. Biologically, dugong has a low reproduction rate which at least needs 10 years for the species to be mature. Once it becomes mature, a female dugong goes through 14 months of pregnancy before giving birth to one offspring within 2.5-5 years of interval. Another possible threats are accidental catch by fishing gears (bycatch), massive hunt for meat consumption, tusk, and "tears" which are claimed to be economically valuable.

Mali beach and Pante Deere village are two potential areas in Alor regency which are usually reported to be the most frequent spot where Dugong may be seen especially around seagrass habitat. Unfortunately, research on Dugong and seagrass in this area is limited on general observation of the behavior. Because of this reason, WWF-Indonesia believe in the necessity of further research on Dugong and seagrass in Mali beach and Deere is essential to conduct.

The study was conducted in Alor Island, Eas Nusa Tenggara. Data collection of Dugong and seagrass was done in Mali Waters (three stations), PanteDeere Village (three stations), while participatory data or questionnaire was conducted in Kabola Village, Deere, Alila and Buaya Island.

Based on the observation of seagrass distribution in Alor waters especially surround Mali beach and Deere beach, there were seven species identified from two major family, i.e: 1) Family Hydrocharitaceae (*Enhalus acoroides, Thalassia hemprichii* dan *Halophila ovalis*), 2) Family of Potamogetonaceae (*Cymodocea rotundata, Cymodocea serrulata, Halodule uninervis* and *Syringodium isoetifolium*). The higher cover and density was found in Mali beach stations, with 68% coverage and inhabited by *Halophila ovalis* (565 – 1082 shoots/m^2).

Based on the analysis done on the feeding trail (in station 2, Mali), the average length of trail was 80-100 cm, while the width of 15-20 cm. The feeding trail is overgrown by many types of pioneer seagrass such as *Halophila ovalis, Halodule uninervis and Cymodocea rotundata.*

Based on visual observations and aerial observation for five days at Pante Deere and Mali beach, there are only two Dugongs found in the waters particularly in between Mali Beach and Sika Island. Dugong was found active on seagrass which situated within the waters.

Nowadays, the potential threats that may interfere Dugong sustainability in Alor is tourism activity. Local and foreign tourist have started to know that in Alor, particularly in Mali, they can easily see Dugong while diving and this type of activity has been occurred for a quite long time. Some tourists have started to visit and some have gone down to dive. This tourism activity if it is not well regulated and if it is unsafe, will affect negatively to the sustainability of this species. Dugong that is already settle down its life and routines in Mali waters may travel to other places which is more comfortable to live in, have minimum disturbance, and a place in which its favorite feed grows plenty.

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INTRODUCTION

Background

Dugong (*Dugong dugon*) or commonly known as Duyung (in Bahasa) is one of thirty-five marine mammals' species which is found distributed in Indonesian waters, especially in a seagrass meadow habitat. Despite of its body weight which reaches 600 kg, this marine mammal species has a sociable behavior and live closely associated with seagrass habitat as its feeding ground.

Dugong has a complicated life threats. Biologically, dugong has a low reproduction rate which at least needs 10 years for the species to be mature. Once it becomes mature, a female dugong goes through 14 months of pregnancy before giving birth to one offspring within 2.5-5 years of interval. Another possible threats are accidental catch by fishing gears (bycatch), massive hunt for meat consumption, tusk, and "tears" which are claimed to be economically valuable.

Stranding phenomenon of Dugong also sometimes tends to cause tragic death, and this affects the population of Dugong in the natural habitat. Furthermore, habitat degradation and pollution are argued causing massive destruction of seagrass meadow as Dugong foraging ground. Because of these reasons, the population of Dugong is significantly threatened and an even more vigorous protection effort is needed to overcome this matter.

Dugong is protected under National Act No. 5 of 1990 (UU No.5 Tahun 1990) about Natural Resources and Ecosystem Conservation and National Act No. 31 of 2004 (UU No. 31 Tahun 2004) about Fisheries. In addition, Dugong is also protected by international law and listed under 'Global Red List of IUCN' as 'Vulnerable to extinction'. Dugong is also included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) which signifies that all body parts of Dugong should not be traded in any forms.

Despite of being protected under both national and international law, the conservation process of Dugong seems to have not been optimal. Insufficient data and information about either Dugong population or its habitat leads to limitation in conservation efforts that related to Dugong and seagrass in Indonesia. In this manner, further research to identify spots in which Dugong may present, such as Mali beach, Pante Deree villahe dan its surrounding.

Mali beach and Pante Deere village are two potential areas in Alor regency which are usually reported to be the most frequent spot where Dugong may be seen especially around seagrass habitat. Unfortunately, research on Dugong and seagrass in this area is limited on general observation of the behavior. Because of this reason, WWF-Indonesia believe in the necessity of further research on Dugong and seagrass in Mali beach and Deere beach in order to collect any information that especially related to population, behavior, habitat condition, threats, and even about the social-culture aspect of the indigenous community. The result of the research is expected to be useful as a reference in conservation management of Dugong specifically speaking in Alor, and generally in Indonesia. Additionally, this study is also expected to help improving the draft of Dugong and seagrass monitoring protocol in Indonesia which is being prepared by Ministry of Marine Affairs and Fisheries of Repucblic of Indonesia (MMAF), Indonesian Institutes of Science (in bahasa Lembaga Ilmu Pengetahuan Indonesia, abbreviated as LIPI), Bogor Agricultural University (in Bahasa Institut Pertanian Bogor, abbreviated as IPB), and WWF-Indonesia.

Aims

1. Appreciate the distribution, population, body size, and sezx of Dugong in Mali beach and PanteDeere waters.
2. Examine the association between the presence of Dugong and its primary feed, Seagrass, in Mali and PanteDeere beach.
3. Learn about both environmental and anthropogenic threats on Dugong and especially seagrass conservation that forms vital habitat and becomes feed resources.

METHOD

a. Time and Place

The study was conducted from May 29 to June 6 2016 in Mali beach and Pante Deere beach, Alor Regency, East Nusa Tenggara.

b. Data Collection

Seagrass species distribution

Data of seagrass species distribution was collected by using transect linear method; a method which is based on a perpendicular transect line which is made on shore line starting from the first seagrass observed to 100 metres towards abbys. On every

transect line, observation on seagrass ecosystem was done by using transect plot measured by 0.5 x 0.5m^2, and it was started from 0 m and repeated in every 10 m until it reached 100m. In each station, three transect line was drawn with 25m distance from each other (Rahmawati, 2014). The data collected in this process was: species identification of seagrass, seagrass density, seagrass cover, and seagrass biomass. Besides biological data, environmental factors (physical-chemistry) such as type of substrate, temperature, salinity, pH, Dissolved Oxygen (DO), and current was also recorded. All species of seagrass were observed and recorded by referring to the guidelines by Den Hartog (1977), Tomascik *et al*. (1997) and Mckenzie and Yoshida (2009).

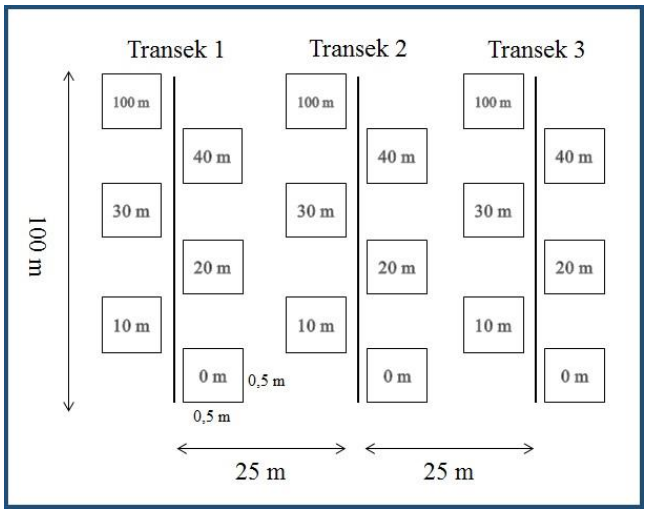


Figure 1. Scheme of Seagrass Data Collection

Biomass

The data of seagrass biomass in every plot was collected by using a 25 x 25 cm for four times. A number of seagrass sample were taken as a whole plant (root, rhizome, and leaves) and put into a plastic bag which is filled with 5% formalin. The samples were labeled and brought to the laboratorium.

Identification of Dugong Feeding Trail

Feeding trail is a typical trail/ track which is formed as a result of feeding activity of Dugong. In early stage of observation, manta taw activity was done onboard to detect the feeding trail of Dugong. Once the feeding trail is found, it has to be analyzed whether it is a recent or old trail. A recent feeding trail has to be documented by using camera,

marked its location by using GPS, recorded its length and width by using measuring tape and marked once it is recorded by using colored paper clip. This was done to know the condition of feeding trail and to avoid repetitive data recording. On the other hand, the old feeding trail was treated similarly plus has an extra measurement on the height of the seagrass in order to estimate the how long has feeding trail been presented. Observation on feeding trail was done by using basic diving gear (mask, snorkel, fins, GPS, and camera).

Aerial Survey

Aerial survey is done to collect the data of Dugong abundance and ditribution. Aerial survey can be done by using small plane or by using drone. In this study, drone was used, and was flown in approximately 15 m above the sea level with 1 m/s speed. In such height, the drone could capture a picture within 6 meters of right and left side of the transect ine. The transect line which was used during the observation was the 400 meter ones where the distance between each line was 100 meter. The area that could be monitored by the drone in one transect line was 4800 m^2. Illustration of aerial survey plan is shown in Figure 2.

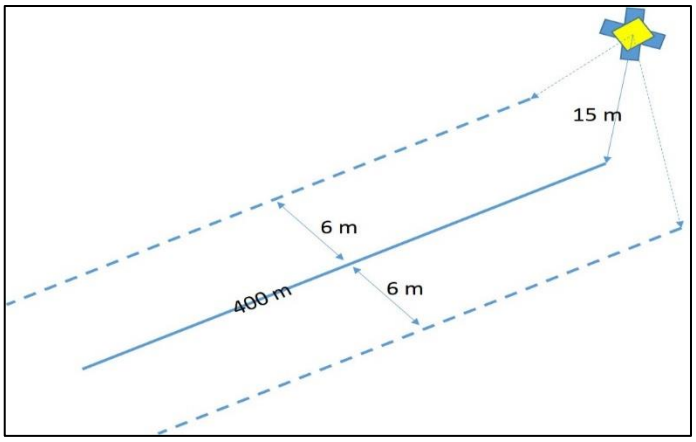


Figure 2. Aerial survey design of Dugong by using drone

Observation on Dugong Behavior

Observation on Dugong's behavior was done to understand the activity of the species in the waters. The observation was done by using *adlibitum* method: record every activity and its period from the observed Dugong. This observation required SCUBA

diving gears, camera, and writing materials. This method is advantageous to record rare and unusual event, but has significant implication in explaining such event descriptively. Moreover, the method eases the observer to describe ongoing event specifically.

Questionnaire survey

Participatory survey was done by questionaire-based interview (Akvo Flow) which is related to Dugong presence. The questionnaire was adopted from Bahasa Indonesia by using Rapid Rural Appraisal (RRA) method. The expected respondent in this study was government officer, local community and fishermen surround the research site. Equipment used in the survey were questionnaire sheets (Appendix x) and writing materials.

RESULT AND DISCUSSION

Research location

This study was done in Alor Island, Eas Nusa Tenggara. Data collection of dugong and seagrass was conducted in Mali waters (three station) and Pante Deeree Village (three statiosn), whereas participatory questionaire-based data collection was conducted in Kabola Village, Deere Village, Alila Village, and Buaya Island.

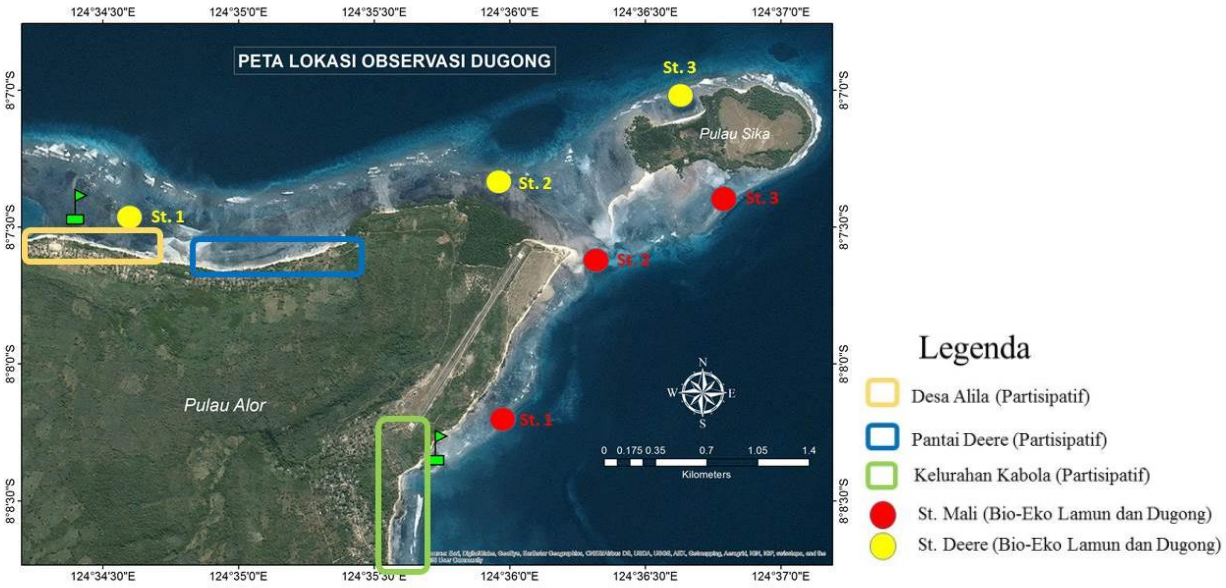


Figure 3. Map showing the study site

Characteristic of Seagrass in Study Site

Based on the observation of seagrass distribution in Alor waters especially surround Mali beach and Deere beach, there were seven species identified from two major family, i.e: 1) Family Hydrocharitaceae (*Enhalus acoroides, Thalassia hemprichii* dan *Halophila ovalis*), 2) Family of Potamogetonaceae (*Cymodocea rotundata, Cymodocea serrulata, Halodule uninervis* and *Syringodium isoetifolium*).

Table 1 Species Varieties of Seagrass

Family/Species	Mali Waters Station			Deere Waters Station		
	1	2	3	1	2	3
A. Hydrocharitaceae						
1. Enhalus acoroides	+	+	+	+	+	
2. Thalassia hemprichii	+	+	+	+	+	+
3. Halophila ovalis	+	+	+		+	+
B. Potamogetonaceae						
4. Cymodocea rotundata	+	+	+	+	+	+
5. Cymodocea serrulata		+				
6. Halodule uninervis	+	+	+			
7. Syringodium isoetifolium	+	+	+		+	+

Figure 4. a) Seagrass cover of *Enhalus acoroides*, *Thalassia hemprichii,* and some other unidentified seagrass species, b) Seagrass cover of *Halophila ovalis*, c) *Halophila* species.

Seagrass meadow that is situatated around the research site has a mixed characteristic of vegetation which generally consist of four to eight species. According to Hemminga & Duarte (2000), the characteristic of seagrass meadow in tropical region and the subtropical Indo-Pacific has a high species variety and composed of mixed vegetation.

In each station, it has been found a pioneer-type of seagrass such as: *Halophila ovalis*, *Halodule uninervis* and *C. rotundata*. These seagrass species are relatively small in size, fast growing, and have short life span (Hilman *et al*. 1989; Duarte 1991). A pioneer seagrass is the earliest plant that inhabit a certain site after disruption occurs (Duarte *et al*. 1997). One known order is *Halodule* which capable of growing in the prime substrate or survive after disruption occurs (Phillips & Menez 1988). Experimental study by Duarte *et al*. (1997) revealed that the last plants that grow in a certain site are relatively bigger in size and more sensitive to changes in the water turbidity. Howeber, some species managed to survive through this condition. These species are *E. acoroides* (Terrados *et al*. 1997) dan *C. serrulata* (Duarte *et al*. 1997).

Cymodocea serrulata species is only found in station 2 of Mali beach and absent in other station. This species is a typical seagrass which has serrated leaf tip and linear leaf blade with 13 – 17 longitudinal veins. Rootlets in each node were found numerous and ramified. In each node, there is only one erect shoots which bears 2-3 leaves. This type of seagrass is normally found in intertidal area which close to mangrove vegetation and it is also known as one of Dugong's feed.

Seagrass cover

Seagrass cover in a waters is closely related to habitat or morphology and the size of seagrass species. High seagrass density and tidal condition during the observation also have significant influence on the estimation of seagrass cover. According to Short and Coles (2003), one species of *Enhalus acoroides* will have higher cover value than one species of *Halodule uninervis*, since *Enhalus* species has a bigger leaf size. On the other hand, a smaller seagrass species such as *Halophila ovalis* will have smaller percentage of cover.

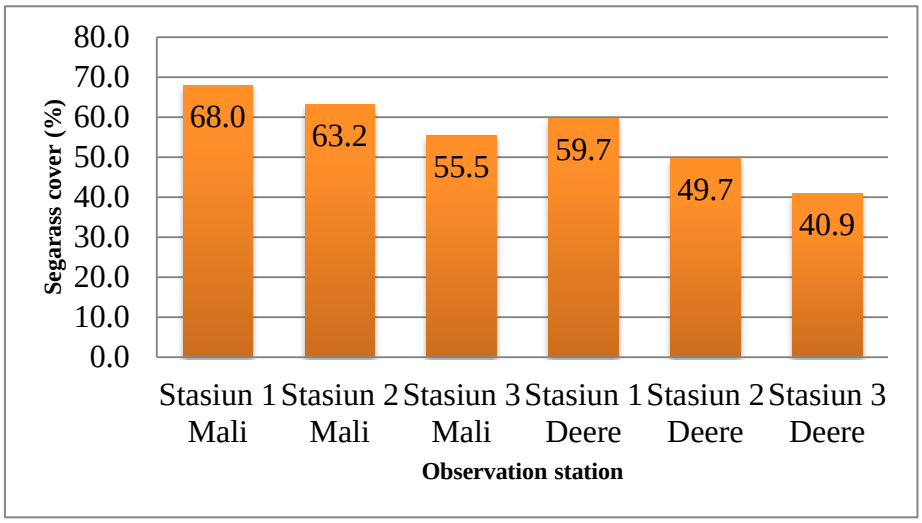
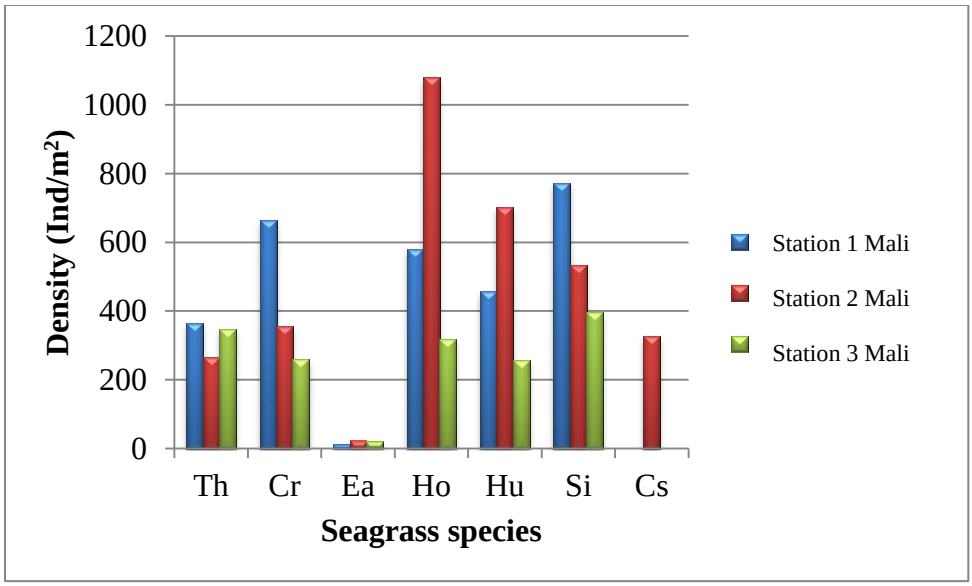


Figure 5. Seagrass cover (%) in research site

The level of segrass cover is correlated to a higher degree with density and morphology (size) of seagrass that present within a certain area. High seagrass cover is commonly dominated by the species that have larger morphology (*E. acoroides* dan *T. hemprichii*). Based on the observation in research site, station 1 and 2 which are located in Mali beach have a value of 68% and 63.2% respectively of seagrass cover. This shows that the stations may be considered as "rich" or "healthy" (>60%). On the other hand, the remaining four stations were considered as "less rich" or "less healthy" since the station only have cover percentage between 40.9% - 59.7%. (Figure 5). Generally speaking, the waters surrounding Mali beach has a rich and healthy seagrass cover. This also correlates to the distinctive substrate in Mali beach and Deere beach. The type of substrate in Mali beach is sandy loam; a fine substrate which is dominated by sand particles.

Seagrass density

Seagrass densitiy per unit area depends on the species that grows above it. Seagrass species which has high erect density may also have high frequency of habitation and coverage. According to Terrasdos *et al*. (1997), the role of seagrass species (such as in density and biomass context) tend to be dominated by one or some species within a community. This is related with species ability to adapt to their environment.



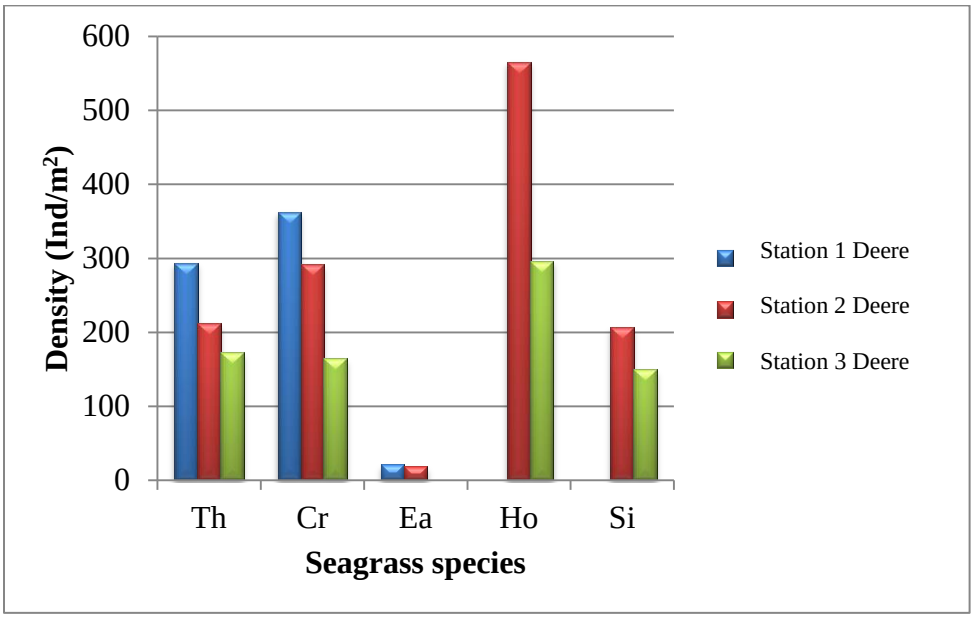


Figure 6. Graph of the Average (individu/m^2) of Seagrass species

The highest density site in both Mali beach and Deere beach is inhabited by *Halophila ovalis* (565 – 1082 shoots/$m^{2)}$ (Gambar 6). *Halophila ovalis* is a type of pioneer seagrass that can survive through poor condition or under disturbance and has a fast growing rate. Meanwhile, the species with lowest shoot is *E. acoroides* (13-21 shoots/m^2), which usually inhabit sand or muddy sediment and in an area with high bioturbation. Its morphology which is typically large and relatively wide lessen the closeness in each transect, and thus this leads to low density.

Zieman (1986) points out that the seagrass density in a certain area may be influenced by abiotic factors such as water transparency, circulation, depth, substrate and nutrient contents.

Seagrass biomass includes all living material in a certain per unit area, that grow either above or below the substrate. Based on analytical result, seagrass dry weight is 2.77 gr/bk/m^2.

Biomass variability correlates to environmental variable, namely light condition, temperature, sediment characteristic, and the local nutrient availability. One of many influences of plant biomass is the presence of one dominating species (Hemminga & Duarte 2000) since it is related to the plant morphology and varying degree of growing rate among seagrass species.

Environmental Condition in Research Site

Physical chemistry parameter of a certain water has a vital role in maintaining the sustainability of the biota that lie within, and this also includes seagrass species.

Tabel 2 Waters quality around research site

Site	Station	Waters quality			
		Temperature (^{0}C)	Salinity ($^0/_{00}$)	DO (mg/L^{-1})	pH
Mali	St 1	28.9	29.9	6.4	7.7
	St 2	29.7	29.7	9.8	8.5
	St 3	31.3	31.5	9.7	8
Deere	St 1	29.8	29.8	6.8	8.1
	St 2	30.3	31.5	10.3	8.4
	St 3	28.2	29.6	7.4	8.2

Temperature

Temperature is one of many factor which plays an important role in regulating the metabolism and distribution of an organism. Metabolism process will occur or work optimally within a narrow range of temperature, i.e, weak in between 0^0C to 40^0C. However, there is also an exception when a typical organism tolerates the temperature above 40^0C and below 0^0C, such as green-blue algae which can live in a temperature of 85^0C in hot spring. According to

Nybakken (1992), marine organism capable to adapt living and proliferate in an even narrower range of temperature than 0-40^{0}C.

The waters temperature in all six station was recorded within the normal interval, i.e. 28.2^{0}C to 31.3^{0}C. Looking at the measurement result, the temperature in all six stations may be considered as optimum condition in seagrass growth process. This circumstances, according Dahuri (2003) is due to the optimum temperature required by the seagrass to grow is still within the range of 28^{0}C – 30^{0}C. To seagrass, temperature can affect physiological processes such as photosynthesis, respiration rate, growth, and reproduction. If the temperature is beyond the optimal range of physiological processes, such circumstances may lead to significant declining rate. In addition, Bulthuis (1987) points out that the temperature of 25-35^{0}C is the optimum temperature for photosynthesis in seagrass.

Salinity

Distribution of salinity in the waters is influenced by many factors, i.e. evaporation, precipitation, water circulation patterns and content of fresh water which enter the marine waters. The sea water that goes into the ocean waters can come from rainfall or runoff and streams. Based on the results of field measurement results obtained at all six stations, the salinity is ranging from 29.6 to 21.50 / 00 which is considered as a normal value in the area of seagrass meadows.

Dahuri (2003) explains that the majority of seagrass species can tolerate a wide range of salinity and seagrass is actually able to grow in the salinity which ranges from 10 - 400/00. As an example, despite the short time of tolerance, Thallasia is found living in salinity between 3.5 - 600/00 (Zieman 1986), while the type of Halodule is able to live in salinity over 720/00 (Phillips & Menez 1988). However, this kind of seagrass has optimum growth conditions within 350/00 (Dahuri 2003). On the other hand, in Thalassia group, the optimum salinity for growth is ranging from 24 - 350/00 (Zieman 1986).

pH

The value of pH is essential to be appreciate in a waters as it define the type and the rate of biological reaction in the water. The value is an expression of the concentration of hydrogen ions (H^+) in the water. pH value variation can occur due to chemical and biological process of

marine compounds that produce both acidic and alkaline products. Additionaly, the pH value can be also influenced by acidic or alkaline waste runoff from the mainland.

The pH values that were recorded from the six stations ranged from 7.7 to 8.5 + 0.2. This circumstances is relatively normal according to Environment Decree No. 51 of 2004 which states that the threshold value of pH in marine waters is from 7 to 8.5 + 0.2. It is also described by Phillips and Menez (1988) that seagrass can grow well at the time of normal seawater pH which ranges from 7.8 and 8.5, a state where bicarbonate ions which is required for photosynthesis by seagrass is abundant.

Dissolved Oxygen (DO)

Dissolved oxygen is the concentration of oxygen dissolved in water and is required by almost all forms of aquatic life for the metabolism process in the body. According to Hutagalung and Rozak (1997), the main source of oxygen in seawater is the air through the process of diffusion and plant photosynthesis during the day. Furthermore, it is argued that the decrease in oxygen in the sea water can be caused by a rise in water temperature, respiration, the layer of oil on the sea surface and the entry of biodegradable organic wastes into the marine environment.

Based on the results of measurements at the six stations, the value of dissolved gas content is obtained ranging from 6.4 – 10.3 mg/L^{-1}. Fluctuation that occurs on DO in the research site waters may be due to the use of Oxygen by seagrass in respiration process, respiration of other aquatic organism, and the usage of gas in by nitrification bacteria in the nitrogen cycle process in the seagrass. According to Hutagalung and Rozak (1997) the level of dissolved oxygen in Indonesian waters ranges from 4.5 – 7.0 mg/L-1, therefore the DO value at the location of the research is considered as normal.

Substrate

Generally, seagrass can live in many different types of sediment or substrates, ranging from mud to the basic sediments consisting of 40% fine mud deposits (Dahuri, 2003). Seagrass requires a soft base to aid the roots to penetrate and the rhizome to support the body of the seagrass.

The observation of sediment at the research site reveals that it has a type of carbonate sediment that may come from crushed coral at Pante Deere and sandy loam at Mali beach.

The particle size distribution of sediment greatly influences the pore water exchange and the water column above it. Particle size distribution which tend to be dustier and clay will cause the pore water exchange with the water column becomes low (Huttel & Gust 1992). Thus, the concentration of nutrients and phytotoxin such as sulfides in the sediments will increase (Koch, 2001; Holmer & Nielsen, 1997). In contrary, the circumstances will occur by seagrass if it occupies a rough type of sand sediment (Huettel & Gust 1992).

Feeding Trail Identification

A significant number of feeding trail is found at station 2 Mali. The condition of the trail eating appears to be not recent, but it seems like the feeding trail has long been traversed by Dugong. This is clearly shown from the already large number of overgrown by pioneer species of seagrass. The feeding trail is also irregular and does not form a long sort of trail, in contrast to what has beenexplained by Mukai (1999), that Dugong can make feeding trail at the moment of eating + 5 metres.

Based on the analysis of feeding trail on *Dugong dugon* in feeding habitat (station 2), the average length of the trail is IE 80-100 cm, while the width is 15-20 cm (Figure 8). The feeding trail is different from ones what had been found by Heinshon et al. in 1977, which has an average width of 19-26 cm long and can reach 8 m. The feeding trail that is found on station 2 Mali is short and spotting at some point. This ciscumstances indicates that the Dugong on Mali's Beach forage by grazing; crawling with the pectoral fins while plucking whole seagrass up to its roots. This activity will leave a trace or track lengthwise on the seabed or better known as feeding trail. A feeding trail which has been long passed by Dugong is usually overgrown by species of pioneer seagrass such as *Halophila ovalis*, *Halodule uninervis* and *Cymodocea rotundata*. Around the trace, a numerous species of seagrass *Cymodocea serrulata, Thalassia hemprichii Halodule pinifolia, Thalasodendron, Enhalus acoroides* and ciliatum were found. Looking at the type of seagrass growing on the feeding trail, Dugong in Mali has preferences or a fondness for eating small-leaf seagrass, fibrous or cellulose. Dugong prefer a soft and easy to digest seagrass plants but have a high nutritional value, such as the type of *Halodule uninervis Halophila ovalis*, and *Cymodocea SP*. This finding is in accordance with the statement by Preen (1995) that explain the foods preference of Dugong namely *Halophila sp, Cymodocea SP*. and *Halodule sp*. In one day, Dugong are able to eat the seagrass as much as 25 kg per day (wet weight) or 8% of

total body weight (Toba Aquarium and PCP Report 1995), whereas the Dugong which was at Ancol were able to spend 30-40 kg seagrass wet each day (Azkab 1998).

to so. Research by Marsh et al. (1982) reveals that a Dugong eat seagrass around 10-30 grams of dry/m2. In other words, dugong eat seagrass in an area which has low density. Based on field analysis, it was obtained that dry weight of seagrass was 2.77 grams dried/m2. This reflects that the seagrass habitat in Dugong's foraging habitat has a low density as a large number of seagrass has been consumed by Dugong. It was also found in station 2 a number of feeding trails which was situated among *Enhalus acoroides* seagrass (Figure 7). Dugong appears to not eat *Enhalus acoroides* seagrass, but it indeed eats other type of seagrass which has smaller leaf size among it. Preen (1993) explains that carbohydrate is a vital factor that is needed by Dugong, and thus the species becomes selective in choosing its feed.

Figure 7. Feeding trail among *Enhalus acoroides* seagrass

Based on the numerous feeding trail found in station 2, it is indicated that this station may be a foraging habitat of Duging which present around Mali waters, Alor.

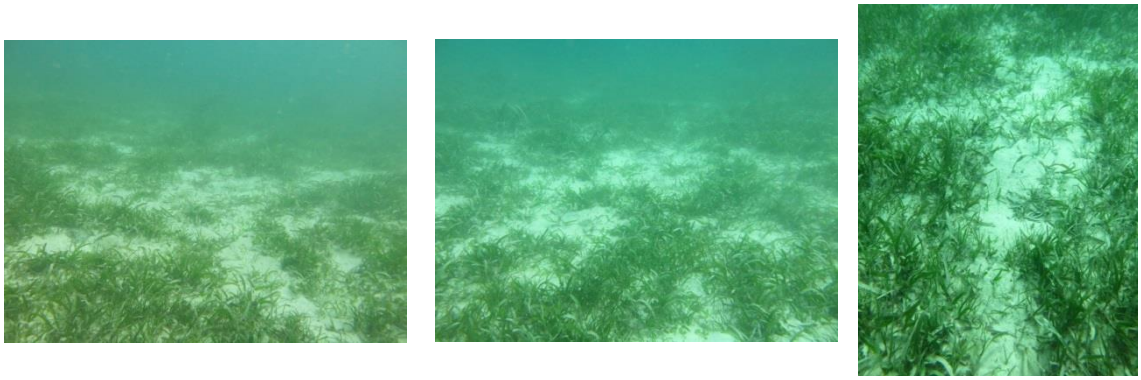


Figure 8. *Feeding trail* of *Dugong dugon* in research site

Observation on Dugong Behavior

Observations of the behavior of the Dugong could not be done in the water as the waters are quite cloudy especially on the water column. Therefore, the observation was conducted by using drones. There are time limitations at the time of observation, but it has recorded long enough around +25 minutes. Based on observations by drones, the activity of Dugong which were recorded were travelling or sightseeing and also interacting with turtles (Figure 9). From the analysis of behavior, it was revealed that sometimes the Dugong dive deeper and appear to forage not by grazing, but cropping.

There are 2 ways of Dugong foraging; (1). Cropping (Preen 1995) is a term used when Dugong just forage by taking the leaves and stem leaf only. (2). Grazing is a term used to describe foraging activity of Dugong by crawling with both pectoral flipper and picking off the entire seagrass up until its roots. This activity will leave a trace or lengthwise track on the seabed or better known as feeding trail.

Based on recorded video, Dugong can hold its breath for + 51.5 seconds to swim and interact with turtles, but according to Jefferson et al. (1994), Dugong has the ability to hold its breath while diving for 8 minutes. When it emerges to the surface, Dugong takes + 2 seconds to breathe. This is in accordance with the finding expressed by Grzimek (1975) that the inhaling is done by using two nostrils on the muzzle of his mouth for about 2 seconds.

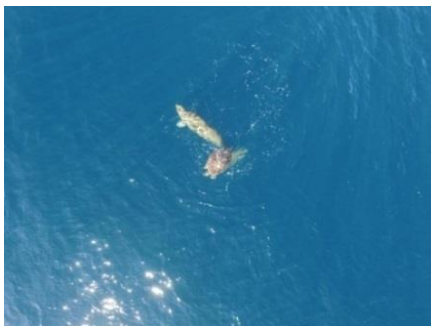


Figure 9 A) *Dugong dugon* dan B) One of Dugong activities: interacting with sea turtle

Distribution, Population, and Home Range of Dugong

Dugong is a marine mammal that is able to wander or move from one place to the other place. According to De Iongh et.al (1998) Dugong can wander for 17 to 65 km from one place to the other place. Dugongs are also able to go back to its original place after traveling far away, as the dugongs in Haruku (De Iongh et.al 1998).

Based on visual and aerial observation for 5 days in Pante Deere and Mali beach, it was only two Dugongs found in the waters between the Mali and Sika Island. The Dugongs swarm in the seagrass meadow which situated within waters area. According to information retreived from the public, there are more than one Dugong that is often seen wandering in the waters while during the survey, observer team found two Dugongs. Dugong has a core area known as "home range" which is always used for main activity, either for foraging, sightseeing or doing social interaction. The results of the study done by De Iongh et.al (1998) in the Lease-Maluku Islands, revealed thath the core area used by Dugong can range from 4 to 43 km^2. Based on the field analysis, the home range or core area used by Dugong in Mali coast and Sika island has an area of 2.38 km^2 (Figure 10), with plenty of overgrown seagrass species *Halophila ovalis, Halodule uninervis, Syringodium isoetifolium* and *Cymodocea serrulata*. These are the types of seagrass species that becomes Dugong preference.

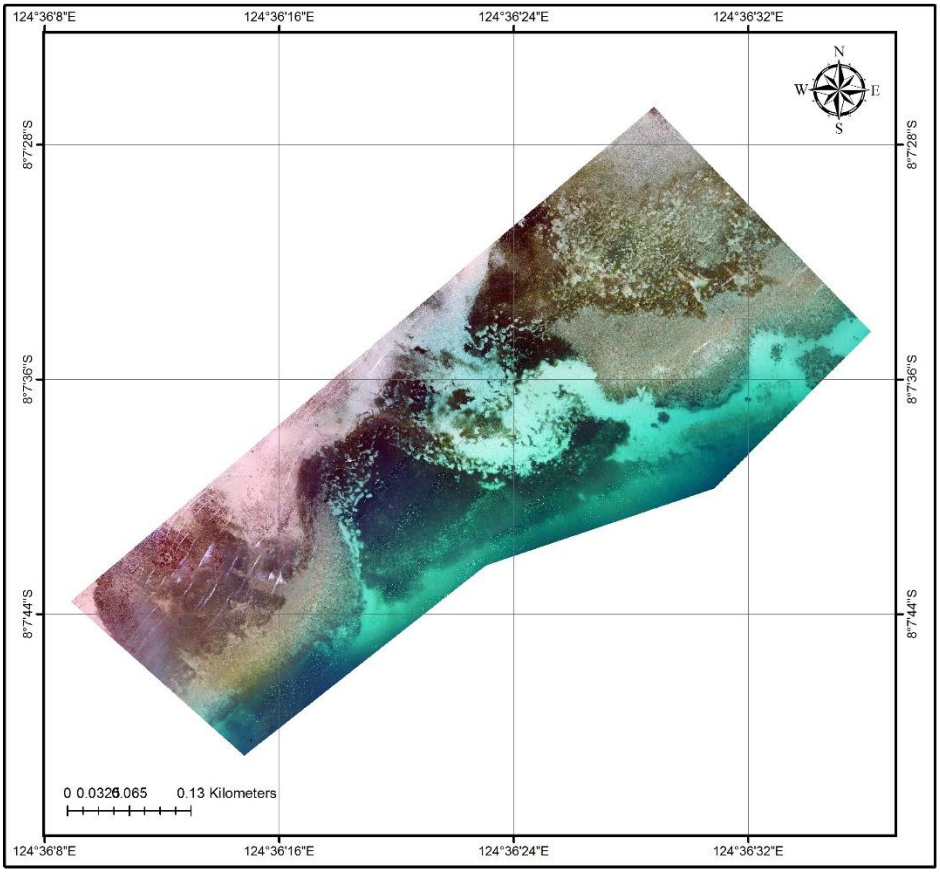


Figure 10. Mosaic illustration of *Dugong dugon* home range in Mali coast area, Alor.

If it is true that there are more than one Dugong appears on the waters of Mali, then the Dugong which was seen every day at the time of the survey is the Dugong that has been habituated to human presence and activity. If there is interference either from ships or human, Dugong will swim away to avoid the noise and other ship interference. This is because Dugong is basically a very sensitive and shy marine mammal. The results of the study by Anderson (1982) explain that Dugong will move 150-500 m away if there is disturbance with the sound of a passing ship. In addition, Preen (1992) reported that Dugong is capable to detect in a radius of + 1 km if there is a ship approaching. Based on interview, the distribution of Dugong is not only in Mali beach but in other area such as: Kepa Island, Kabir Island, Atapupu, Sagu Island (Adonara) and Pantar Island.

Questionaire survey

Pante Deere Village

Pante Deere village is one of the four villages and a suburb in the District of Kabola which is infamous for its white sandy beach. The village is frequently visited by tourists both local and foreign tourists since a long time ago. Before it is formed into the village, PanteDeere is part of the Kabola Village included in community group unit (Rukun Warga in Bahasa, abbreviated as RW) IV in 1971-1997.

Pulau Buaya Island

Pulau Buaya village was formed in 1994 resulting from the expansion of the Alor Besar village. At this stage of development, back in 1998 the region was officially separated into definitive village. Pulau Buaya village has a typical handicrafts of weaving products. Women who become sarongs and scarves weaver do the business either individually and in groups. Pulau Buaya Village area is divided into two, namely Hamlet (Dusun, in Bahasa) I headed by Hamid Massa and Hamlet II Sadikin Sokan

The Characteristic of Key Informants

The survey team was able to interview 45 key informants who live in the Kabola Village (15 people), PanteDeere Village (11 people), East Alila Village (13 people), and the village of Pulau Buaya (6 people). The key informant interviewed are the fishermen and local residents who do most of their activity in the Sika island waters (Table 3). Out of the 45 (98%) of key informants have a major job of fishing. Although fishing is the main occupation that does not mean it is the only job they do for the living as the fluctuative weather may limits their activity in the sea. To anticipate it, they have a second job to complement their income or as an alternative when they cannot sail. Among these informants, 45% have a second job as a farmer, 8.9% have a second job as labourer, and 2.2% have a side job as a merchant.

Table 3. Characteristic of Key Informants

No.	Name	Age	Employment	Basis (Dusun/Village)
1	Agustinus Hanapehing	36	Fishing, Farmer	Dusun Mali, Kabola Suburb
2	Agustinus Lahala	23	Fishing	Dusun I, East Alila Village
3	Ahmad Maroh	24	Fishing, Farmer	Dusun I, East Alila Village
4	Alexander Laukuang	28	Fishing, Labourer	Dusun I, PanteDeere Village
5	Alexius	33	Fishing	Dusun Buyungta, Kabola Suburb
6	AntipasBandael	42	Fishing, Farmer	Dusun I, PanteDeere Village
7	Arsyad Tanghan	44	Fishing, Farmer	Dusun I, East Alila Village
8	Bai Lolo	25	Fishing	Dusun I, East Alila Village
9	Bernabas Soares	50	Fishing	Dusun Buyungta, Kabola Suburb
10	Eskol Serang	35	Fishing	Dusun Mali, Kabola Suburb
11	Hamid Masa	43	Fishing, Merchant	Dusun II, Pulau Buaya Village
12	hamid Musa	54	Fishing, Farmer	Dusun I, East Alila Village
13	Hamka Laan	27	Fishing, Farmer	Dusun I, East Alila Village
14	Hasan Laahal	43	Fishing, Farmer	Dusun I, East Alila Village
15	Imanuel Koilbain	40	Fishing, Farmer	PanteDeere Village
16	Jannati	39	Fishing, Labourer	Dusun I, East Alila Village
17	Jannati moutang	39	Fishing	Dusun I, East Alila Village
18	Jawa	32	Fishing	Pulau Buaya Village
19	Jimbris Bandail	69	Fishing, Farmer	Dusun I, PanteDeere Village
20	JoblinaDjahapen	60	Fishing, Farmer	Kabola Suburb
21	Kader Kapu	55	Fishing	Dusun Buyungta, Kabola Suburb
22	Kariman Mansur	35	Fishing	Pulau Buaya Village
23	Lamahala Syarif	48	Fishing	Dusun I, East Alila Village
24	Martalotang	52	Not working	Kabola Suburb
25	Marten O Djaha	50	Fishing, Farmer	Dusun I, PanteDeere Village
26	Melianus Adangdjaha	33	Fishing, Farmer	Dusun I, PanteDeere Village
27	Muhidin Haji	33	Fishing, Labourer	Dusun I, East Alila Village
28	MuhtalibMiso	36	Fishing	Dusun Buyungta, Kabola Suburb

29	Musa Serang	46	Fishing, Labourer	Dusun Mali, Kabola Suburb
30	Nohjahtang	57	Fishing	PanteDeere Village
31	Nurdinalen	44	Fishing, Farmer	Dusun I, East Alila Village
32	Paris Penmani	38	Fishing	Kabola Suburb
33	Paulus Djaha Enang	43	Fishing, Farmer	Dusun Mali, Kabola Suburb
34	Rahim Tango	44	Fishing, Farmer	Dusun I, East Alila Village
35	Rahmad Haji	55	Fishing	Pulau Buaya Village
36	Rahmad Rasyid	32	Fishing	Pulau Buaya Village
37	Sahbudin Rahman	50	Fishing, Farmer	Dusun I, Pulau Buaya Village
38	Samun Dukapen	51	Fishing, Labourer	Dusun Buyungta, Kabola Suburb
39	Sardin Lotang	44	Fishing, Farmer	Dusun Buyungta, Kabola Suburb
40	SimranMotole	44	Fishing, Farmer	Dusun I, PanteDeere Village
41	Syukur Siri	43	Fishing	Kabola Suburb
42	Tia Koilbaim	36	Fishing, Farmer	PanteDeere Village
43	Yermias Pentele	41	Fishing	Dusun I, PanteDeere Village
44	Yopi Tanghana	28	Fishing, Farmer	Dusun I, PanteDeere Village
45	Yusub Oudjaha	54	Fishing	Kabola Suburb

Dugong and Seagrass in Sika Island Waters

According to the people who live in the area of Island Sika Waters and information added by fishermen who regularly do their activity around the place, Dugong is often seen between Tanjung Bandara and Sika Island precisely in the west of the sand arise that seem to connect the two islands. Based on the recorded information, it is shown that the coast from Kabola beach to PanteDeere is inhabited by seagrass which becomes the foraging ground of Dugong.

From the total of 45 key informants who were interviewed, 28 (62%) informants claimed to have seen Dugong and 17 (37.7%) have never seen the species. The people who live around survey area have no idea about “Dugong” term since they often call the species as mermaid (in Bahasa: Duyung). In PanteDeere Villahe, people use “Abnaminoo” term for Dugong, while in Kabola, East Alila Village, and Pulau Buaya Village, the most common term used is “Jurung”, which is also applicable in Alor Besar Island. Although some of the community have seen

Dugong before, they do no know much particularly about Dugong. This can be inferred from the interview of 45 key informants, only 28 informants have seen Dugong. Out of 28 informants, only 20 persons capable of estimating the age of Dugong; two person estimates the age is from 1-20 years, another two persons estimate 21-40 years, five persons estimate 41-60 years, six persons estimate 61-80, and the rest five persons estimate 81-100 years

Of the key informants who have seen the Dugong, the majority explained that the species is found nearby the fishing location (56%), accidentally caught in nets (16%) and the rest informant answered to see Dugong while fising, diving, and on the way home from a fishing trip (28%) (Figure 11).

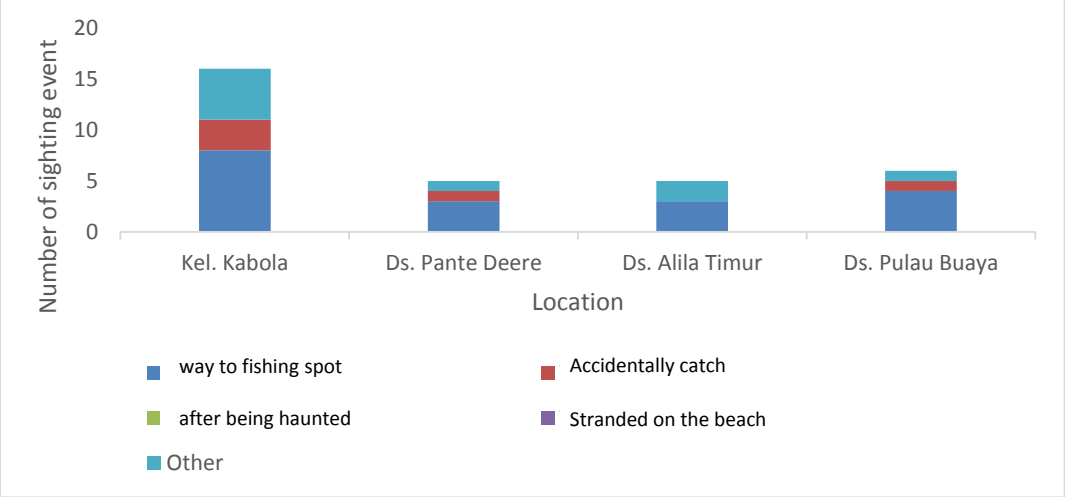


Figure 11. Questionnaire response of "When do you see Dugong?"

The majority of key informants responded; Dugong is seen frequently (50%), occasionally (32.1%), once (14.3%), and every year in the last 5 years (3.6%) (Figure 12). Of all key informants who have seen Dugong stated that Dugong was found particularly in Sika island waters last year. Key informants did not only see Dugong from above sea level, but also in the sea while diving to catch fish. Interestingly key informants explained that they had seen Dugong consuming / prey turtles, some stating that the Dugong and turtle "fisticuffs" or fighting. This statement needs to be proven.

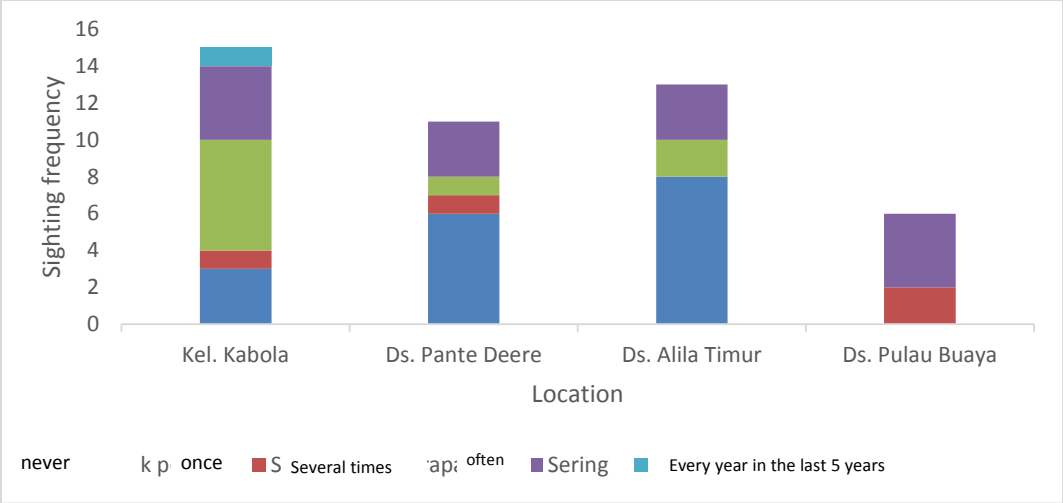


Figure 12. Questionnaire respond on "How often do you see Dugong"

Refer to the distribution map of Dugong and seagrass habitat in Alor (Figure 13), the information retrieved from the interview of key informants assert that Dugong is often seen in PanteDeere Coast, particularly in the southern part of Sika Island. It has also been seen on the island of Ternate and the furthest, in which it is seen by informants is in the area of Atapupu and Atambua. Meanwhile, seagrass is scattered along PanteDeere Coast and around Sika Island. Additionally, there are also Hokulen and several other points in Pantar Distric. Informants who fish further have also seen seagrass around North Timor Tengah

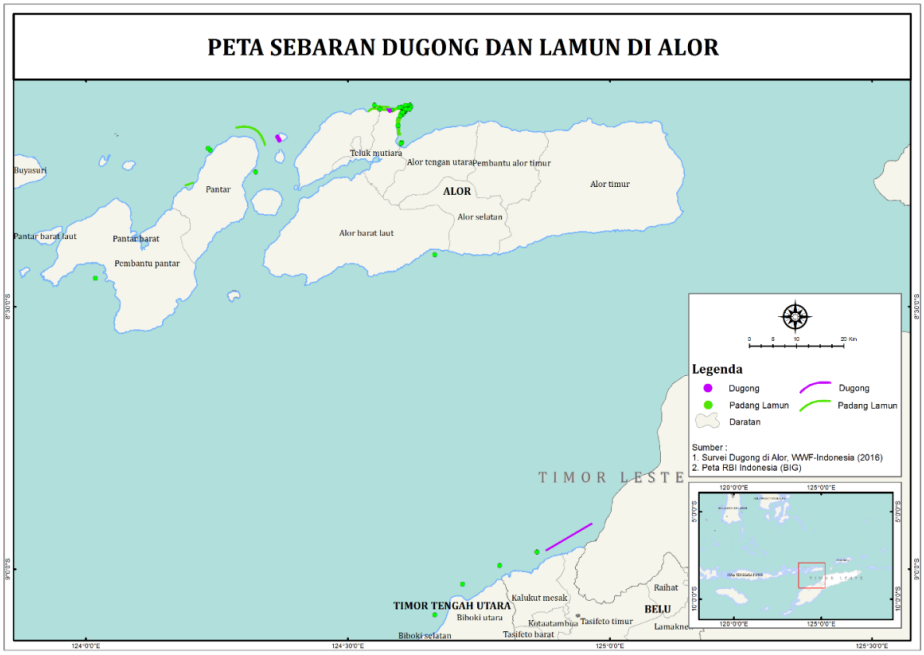


Figure 13. Distribution of Dugong and Seagrass habitat in Alor

In regards to the number of Dugong that live in the waters of Sika Island, 35.7% of key informants answered the number is less than 10, 32.1% answered only one, 28.6% answered do not know, and 3.6% answered more than 10 (Figure 14). The answer about the number of dugong that live around Sika Island water which is less then ten was supported by the statement of fishermen who have seen not only one, but sometimes two and even three Dugongs at once. Those who have seen three Dugongs at once also stated that they have also encountered Dugong calves with approximately 1.5meter length which are located in the southwestern part of the island Sika. However, it was all seen back in the 1970s. Another testimony comes from those who saw Dugong calf in Muara Mali in 1985. In addition, there are four key informants who have also seen Dugong calf but not in the waters of Sika Island but in an area called Atapupu, particularly in the location known as "Swimming Octopus" (Kolam Gurita, in Bahasa), in Timor Leste and in Adonara district, East Flores.

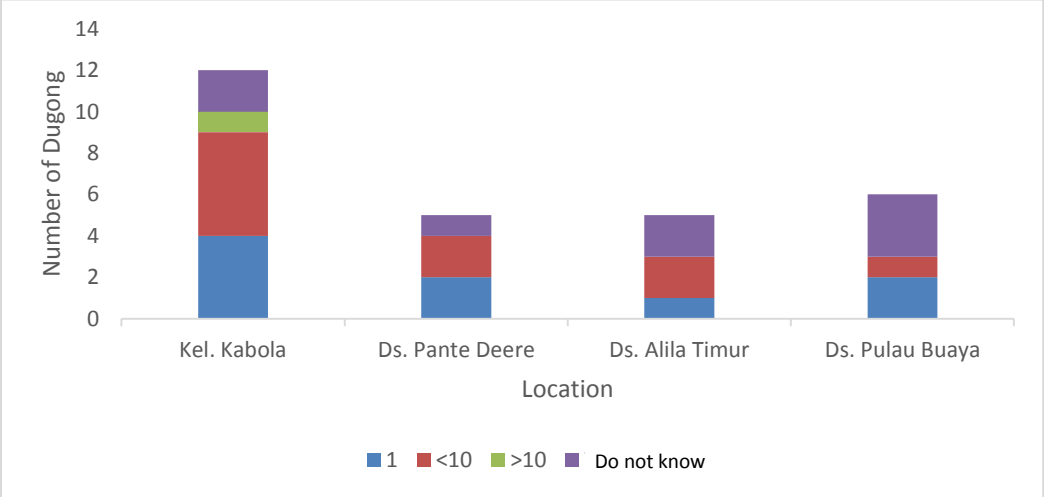


Figure 14. Estimation on Number of Dugong around Sika Island

Nowadays, there is no more people or communities who haunt Dugong intentionally. However, accidental catch sometimes still occurs outside Sika Island waters. Dugong had been caught accidentally for three times. It is commonly experienced by fishermen who sail for a week to a month. Dugongs which are caught accidentally, die entangled in the nets. No location or information on time of even is retrieved from the fishermen since they get information by word of mouth from other fellow fishermen.

Meanwhile for Dugong that die resulting from stranding events has never been found, but Dugong that died floating in the waters has been caught in sight before. This may due to fishing

nets entanglement in the western part Tublang Pante Deere Village in 1982. All key informants explained that have never found a dead dugong with back wound.

Based on their perceptions regarding the number of Dugong, the interviewed key informants estimate the amount of alive Dugong is as shown in Figure 15. The majority of key informants which accounted for 42.8%, gave similar answer, while 35.7% of the informants do not know the answer, 17.9% of the informants said more, and the rest 3.6% of the informants said less. Those who answered "more" still frequently witnessed more than one Dugong with varying size in the waters of Sika Island. Additionally, key informants also explained that the feed of Dugong spread in a plenty amount around Sika Island waters, which is seagrass, but know better as seaweed among the informants. There are also informants who emphasize the informatioan that Dugong continue to breed well resulting from the absence of illegal haunt. The key informant who have answered "less" explain that they do only see one Dugong so far.

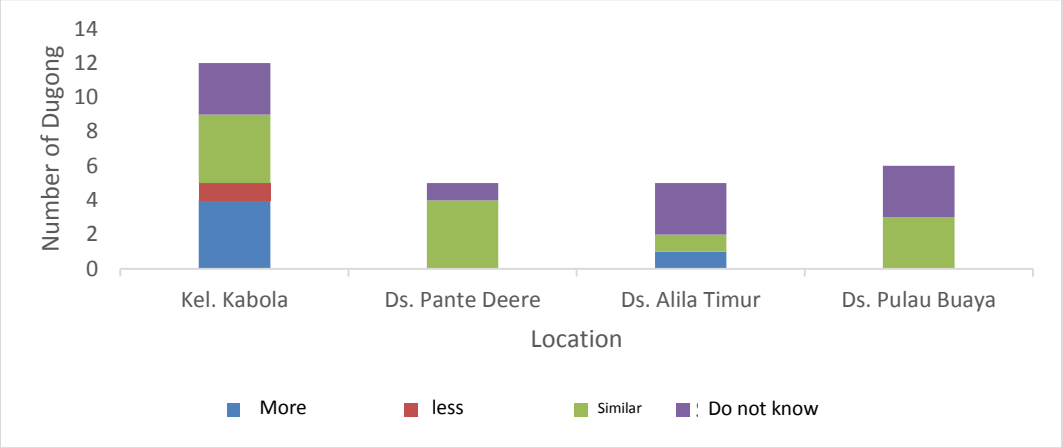


Figure 15. Estimation on number of alive Dugong

Based on the information retrieved, Dugong which live around Sika Island has been observed to emerge to mainland, particularly in the sand signage which connects Sika Island and Tanjung Bandara.

For the communities in Sika Island and the surrounding waters and also those who are often active in the spot where Dugong is often emerge, a question of whether Dugong existence is important or not is asked (Figure 16). As much as 57% of informants answered "yes" as dugong is considered as rescuer animal whose condition becomes scarcer, and its hunt prohibition is now established. However, there are informants who answer inversely, Dugong tears has special features that are used by a lot of people and thus making it popular to be looked for and sold. For this reason, therefore Dugong existence is considered important. Meanhwhile,

36% of the informants said do not know because there was no dissemination of information or counseling about the ecological function of Dugong. The rest 7% answered "no"because the morphology of Dugong is similar to human so that no one will ever consume it.

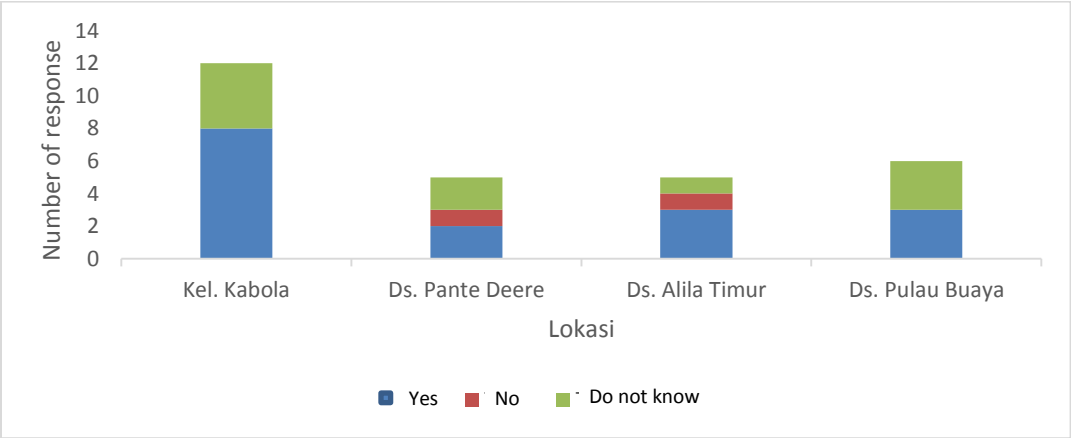


Figure 16. Questionaire result of "Is dugong important"?

Seagrass beds is the foraging habiat of Dugong. However, the community in Alor Regency which represent the four villages involved in this study prefer to call it seaweed. Although living within the coastal area, many people in the regency still have no idea about seagrass. The majority of key informant which accounted for 39 person (86.7%) appreciate and has seen seagrass, while the rest 13.3% said no idea.

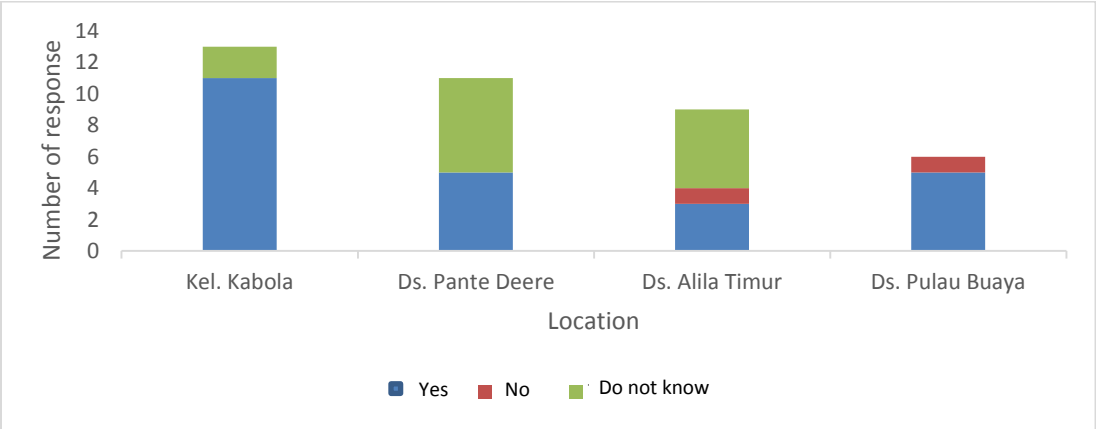


Figure 17. Questionaire result on "Do you know about seagrass?"

Out of 39 informants who know about seagrass, only 61.5% were able to show the location where the seagrass beds can be found, while 5.1% could not tell the location of seagrass beds, and the rest 33.54% did not know the location of seagrass.

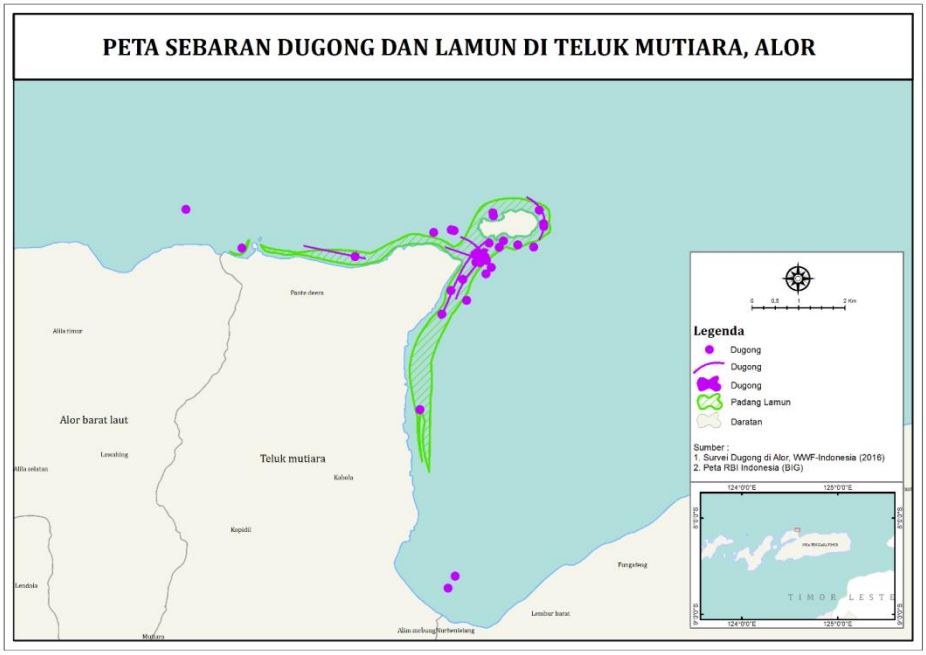


Figure 18. Distribution of Dugong and Seagrass habitat in Mutiara Gulf, Alor

The key informants are considered to be able and well enough in distinguishing species of seagrass in the Sika islands waters and its surrounding. The informant explained that there are some seagrass which attached to stone, or like a reed in the ground, some are branched, round fruitful, some are leafy smooth and fruitful, fine short, black leaf, yellow leaves with a height 1-3 meters, leafy yellow but not long, yellow, soft and small fruits, yellow hard stem with seeds as cabbage (most frequently mentioned), brown and tall, yellow as seaweed, straight-green leafy, mix of green and pink in color, green-whitish in color, leaves and fruit smooth and long / high , small leaves with large fruits, similar to coral reefs but mushy, grows round and many, like fruitful weeds, leafless and slithering on the sand and a yellow triangle on the sand. Key informants further explain that seagrass grow in the 0-15 depth. Their fishing activity is also done in this seagrass bed area. They believe that seagrass is important as it becomes shelter for fish and squid to breed, retreat, and forage.

Regarding whether it si illegal or not to kill Dugong, 55.5% of the informants answered do not know, while 40% answered “yes” and 4.5% answered no (Figure 19).

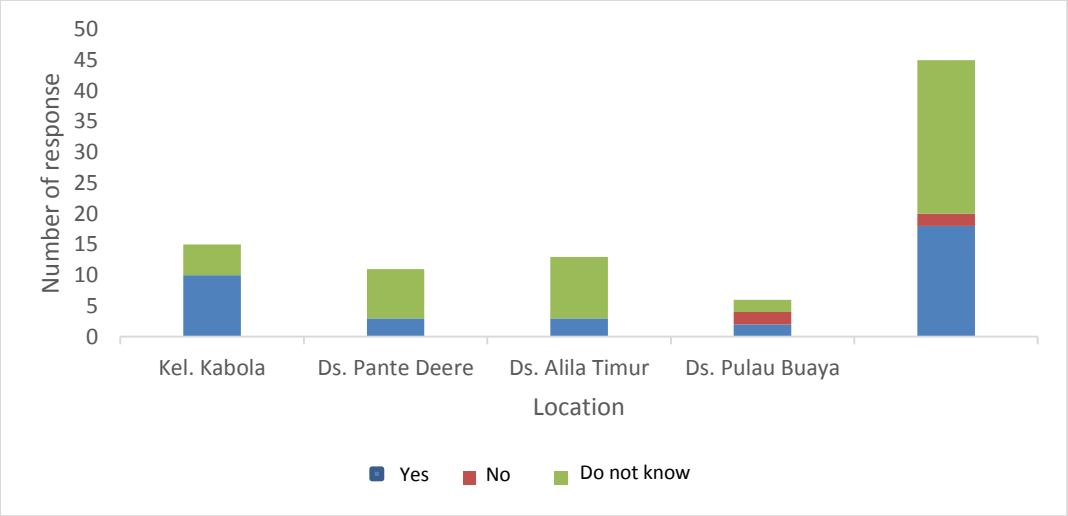


Figure 19. Questionnaire respond on "Is killing dugong illegal?"

THREATS ON DUGONG AND SEAGRASS

Dugong dugon is a marine mammal species that are very sensitive to environmental stress. Its presence in Mali beach, Alor is different compared to the emergence in other regions in Indonesia. Everyday, fishermen and tourist who pass through Mali coast region can clearly see this marine mammal appearance. The total number of sighting frequency is not too much; it varies from two Dugongs per day. However, this can be a sign that Dugong live and posses its natural behavior conveniently within the region. Despite of the absence of significant disturbance on Dugong in this area, the existence of its favorite feed makes Dugong to move more often. Dugong is a marine mammal that mainly eat seagrass. In a day, Dugong is able to eat seagrass for ten hours and the amount may be up to 20kg/ wet weight. Thus, Dugong tend to not travel away from the place in which its primary feed grows.

Nowadays, the potential threats that may interfere Dugong sustainability in Alor is tourism activity. Local and foreign tourist have started to know that in Alor, particularly in Mali, they can easily see Dugong while diving and this type of activity has been occurred for a quite long time. Some tourista have started to visit and some have gone down to dive. This tourism activity if it is not well regulated and if it is unsafe, will affect negatively to the sustainability of this species. Dugong that is already settle down its life and routines in Mali waters may travel to other places which is more comfortable to live in, have minimum disturbance, and a place in which its favorite feed grows plentily.

SUMMARY

Based on the result of the study, it can be summed up that:

1. *Dugong dugon* is more frequent to be found in Mali beach, especially in the area between Tanjung Bandara and Sika island. It is observed that there are two dugongs in the area.
2. Feeding trail of Dugong is only found in station 2 (Mali beach) in which the species of seagrass *Halophila ovalis, Halodule uninervis* and *Cymodocea rotundata* are found populous.
3. There is no considerable antropogenic pressure that may give trouble to seagrass and Dugong life sustainability. All anthropogenic activities are observed within the normal limits, however, any potential tourism threat has to be prevented early.

RECOMMENDATION

Based on the result of the study, there are some important suggestions, i.e:

1. Dugong-based tourism regulation has to be formulated
2. Dissemination of information about Dugong protection status has to be since most of the local community (55%) seems to miss the information that killing dugong is considered as illegal action.

REFERENCES

Anderson PK. 1982. Studies of dugongs at Shark Bay, Western Australia.II. Surface and subsurface observations. *Aust. Widl. Res*. 9:85-99.

Azkab, M. H. 1998. Duyung Sebagai Pemakan Lamun. *Oseana*. 23(3 dan 4) : 35 – 39.

Dahuri R. 2003. *Keanekaragaman Hayati Laut Aset Pembangunan berkelanjutan Indonesia*. Jakarta: PT Gramedia Pustaka Utama.

De Iongh HH, Langeveld p, and Van der Wal M. 1998. Movement and home ranges of dugongs around the Lease Islands, East Indonesia. *Marine Ecology*, 19 (3): 179-193.Den Hartog. 1977. *The Seagrass of the word. North Holland Publ*. Co. Amsterdam. 112p

Duarte CM. 1991. Allometric scaling of seagrass form and productivity. *Mar Ecol Prog Ser* 77: 289-300.

Duarte CM, Terrados J, Agawin NSR, Fortes MD, Bach S, Kenworthy WJ, 1997. Response of a mixed Philippine seagrass meadow to experimental burial. *Mar Ecol Prog Ser* 147: 285-294.

Grzimek, B. 1972. Grzimek's Animal Life Encyclopedia. Van Nostrand Reinhold Company. New York.

Hemminga MA, Duarte CM. 2000. *Seagrass Ecology*. Australia :Cambridge University Press.

Heinshon. G.E. J. Wake dan A.V. Spain 1977. The Dugong *(Dugong dugon* (Muller) in the sea grass system. *Aquaculture* 12:235-248.

Hettel M, Gusts G. 1992. Impact of bioroughness on interfacial solute exchange in permeable sediments. *Mar Ecol Prog Ser* 89:253-267.

Hilman K, Walker DI, Larkum AWD, McComb AJ. 1989. Productivity and nutrient limitatition. Di dalam: Larkum AWD, McComb AJ, Shepherd SA. (eds) *Biology of Seagrasses*: A treatise on the biology of seagrasses with special reference to the Australian Region. Aquatic Plant Studies No.2 *Elsivier*, Amsterdam, p. 635-695.

Holmer M, Nielsen SL. 1997. Sediment sulfur dynamics related biomass density patterns in *Zostera marine* (seagrass) beds. *Mar Ecol Prog Ser* 146:163-171.

Hutagalung HP, Rozak A. 1997. Penentuan kadar oksigen terlarut Di dalam: Hutagalung HP, Setiapermana D, Riyono HS, editor. *Metode Analisis Air Laut, Sedimen dan Biota*. Buku 2. Jakarta: Pusat penelitian dan Pengembangan Oseanologi LIPI hlm 32.

Koch EW. 2001. Beyond light: Physical, geological, and geochemical parameters as possible submersed aquatic vegetation habitat requirements. *Estuaries* 24: 1-17.

Jefferson, T. A, S. Leatherwood dan M. A. Webber. 1994. FAO Species Identification Guide : Marine Mammals of the World. FAO and UNEP. Rome.

McKenzie LJ, Yoshida RL. 2009. Seagrass-Watch: Proceedings of a Workshop for Monitoring Seagrass Habitats in Cape York Peninsula, Queensland, 9-10 March 2009. (Seagrass-Watch HQ, Cair.ns). 54pp.

Mukai H. Aioi, Lewmanomont K, Matsumasa K, Nakaoka M, Nojima M, Supanwanid S, Suzuki CT, Toyohara T. 1999. Dugong grazing on *Halophila* beds in Haad Chao Mai National Park, Trang Province, Thailand - How many dugong can survive? *Proceedings of Grazing and Disturbance by Dugongs and Turtles on Tropical Seagrass Ecosystems*. Ocean Research Institute, the University of Tokyo. pp. 239-254.

Nybakken JW. 1992. *Biologi Laut Suatu Pendekatan Ekologis*. PT. Gramedia. Jakarta

Preen AR. Thompson J. and Corkeron PJ. 1992. *Wildlife and management: dugongs, waders and dolphins*. In 'Moreton Bay in the Balance'. (Ed. O. N. Crimp.) pp. 61–70. Australian Littoral Society & Australian Marine Science Consortium: Brisbane).

Preen AR. 1993. *Interactions between dugongs and seagrasses in a subtropical environment*. PhD thesis, James Cook University of North Queensland

Preen A. 1995. Diet of dugongs: Are they omnivores?. *Journal of Mammals.* 76(1),163-171.

Short FT, Coles RG, eds. 2001. Global Seagrass Research Methods. Amsterdam: *Elsevier*.

Terrados J. Duarte CM, Fortes MD, Borum J, Agawin NSR, Bach S, Thampanya U, Kamp-Nielsen L, Kenworthy WJ, Geerts-Hansen O, Vermaat J. 1997. Changes in community structure and biomass of seagrass communities along gradient of siltation in SE Asia. *Estuarine, Coastal and Shelf Science* 46: 757-768.

Toba Aquarium and PCP Report. 1995. Dugongs of the Philippines. A Report of the Joint Dugong Research and Conservation Program.

Tomascik T, Mah AJ, Nontji A, Moosa MK. 1997. *The ecology of Indonesian seas. Part two*. The Ecology of Indonesia Series, 752p.

Zieman JC. 1986. Gradients in Carribean seagrass ecosystem. Jamaica: *Unesco reports in Marine Science*: 25-29.

Appendix 1 Manta tow activity

Appedix 2 Observation on Seagrass Ecosystem

Appendix 3. Seagrass Data Sampling

Appendix 4. Survey team

Appendix 5. Questionaire form

QUESTIONAIRE

Interviewer: ……..Date …….Data Sheet Serial Number ……..

City/ Village ……Province……..

DECLARATION

Note: Reading out the statement to the respondent is obligatory. This will guarantee that all the respondents receive the same treatment

I am …… I work for the project conducted by ……
Which is an organization based in …….. (*provide location*) which support the protection of the sea for fishermen and wildlife. The purpose of this project is to study further about the capture of Dugong in ……..(*provide location*). We intend to ask questions/questionnaires to you about Dugong you have seen, fishing gears you are using (if any), in which you catch, and such other questions. We provide maps and images/photos that can be used to help answering some of the questions we asked. Questions/questionnaires will take approximately 30-45 minutes to be completed. The results of our research can be used to help reduce the capture of Dugong, perhaps through direct support from the community, or also with the regulation and effective law enforcement. Your participation in this survey is voluntary and confidential. We will not record your name or personal information that you convey to us, unless you give your consent. Individual answers will be combined and reported as a group to get an overview about the current status, and we are definitely not going to deliver your individual answers to anyone beyond our research team. You don't have to answer the question if you do not wish. THANK YOU FOR YOUR PARTICIPATION.

RESPONDENT BACKGROUND

(*Tick the boxes on the left for the question which is not asked. Prepare a favorable map for the respondent to help pointing out location*)

☐1. Name ……

☐2. Age …….. Sex: Male ☐ Female ☐

☐3. Have you ever participated in an interwiew which relates to:

Fisheries ☐ Marine mammal☐ Marine Protected Area☐ Ecotourism ☐

Sea turtle ☐ Others ☐ Never ☐

When did you participate in the interview? ……

Explain …….

☐4. What is your primary job?

Fishermen ☐ Tour guide ☐ Sailor ☐

Others ☐ Explain …….

☐5. How many years have you been doing your current job? ……..

☐6. Do you have any fisherman background? Yes ☐ No☐

☐7. Are you parents fishermen? Yes ☐ No☐ Grandfather? Yes☐ No☐

☐8. Is fishing your primary employment? Yes☐ No☐

☐9. Is fisherman your only job? Yes ☐ No☐

(*If not*) What is your alternative job? ……..

☐10. In what month do you usually go fishing (in the last 12 months)? ……...

(if it is seasonal, explain when the season start and end) ……..

☐11. How many days in a week do you usually go fishing? ……days (during low season)

……days (during peak season)

☐12. What is your position in the boat/ship? Helmsman/ pilot ☐ Cabin crew ☐ tentative ☐

not work in this field ☐

☐13. How many people who work in your boat/ ship? ……

☐14. How long is your boat/ ship (in meter)? ……..

☐15. Is your boat/ship equipped with engine? Yes ☐ No ☐

(If Yes) : inboard ☐ outboard ☐

☐16. How much is its horsepower? ……

DUGONG CAPTURE

☐17. Have you ever seen Dugong in your waters? Yes ☐ No ☐

What is other nickname of Dugong in your place? ……..

☐18. Explain the different between Dugong and Dolphin ……

…….

☐19. In your opinion, how long Dugong can live? …….. Do not know ☐

☐20. When do you see Dugong? While fishing ☐ On sail to fishing site ☐ when it is caught accidentally or entangled in fishing net ☐

Haunted ☐ Stranded on the beach ☐ Others …….

☐21. How often do you see Dugong? Never☐ Once in my lifetime☐ Several time in my lifetime☐ Frequently ☐ Every year in the last 5 years ☐ Once in the last 12 months ☐ Several time ☐ Every month ☐ Every week ☐ Every day ☐

☐22. In what month do you usually see Dugong? (mention month and/or season) ……

☐23. When did the last time you see Dugong? ……(If it was a quite long time, mention the year)

☐24. Do you know the place or spot in which Dugong is regularly seen? Yes ☐ No ☐ *(Note: Regular/periodical indicates that Dugong is repetitively seen in the same period of time every year)*

Where is this location?? (*Point the location on the map given*)

☐25. Do these locations change over the time? Yes ☐ No ☐ Do not know ☐

☐26. According to your estimation, how many Dugong that lives in this area? 1 ☐ <10 ☐ >10 ☐ Do not know ☐

☐27. Have you ever seen Dugong calf? Yes ☐ No☐ When? …… (*what month*). Where did you see it? (*ask the respondent to point the location on the map*).

☐28. Are there any people or community form other village who catch Dugong? Yes ☐ No ☐ Do not know ☐ (*If yes*) How many person)? ……. Which village? ……..

Can you explain in more detail? ……

Is the capture intentional or accidental? Accidental ☐ Intentional☐ Both☐

☐29. Are there any great hunters in your village? Yes☐ No ☐ How many person?

☐30. Is there anyone or any community that catch Dugong in your village? Yes ☐

No☐ Do not know☐

(*If yes*) How many person? ……. For how long? …….in more detail? ……..

Is the capture intentional or accidental? Accidental ☐ Intentional☐ Both☐

☐31. Have you, yourself , ever caught Dugong for the past years? (*either intentionally or accidentally*).

Yes ☐ No☐ (*If yes*) How many Dugong that you caugh? 1-2 ☐ <10 ☐ >10 ☐ In more detail (*if any*) ……

Is the number of capture considered as normal in a period of one year? Yes ☐ No☐

(*If No*) Is that number higher or lower than the usual? Higher ☐

Lower ☐

Is it accidental capture of intentional hunt/ capture? Accidental☐ Intentional☐

Both ☐

☐32. How many Dugong that you have caught for the past 5 years? 0 ☐ 1-2 ☐ <10 ☐ >10 ☐ In more specific (*If possible with numeral*) …….

☐33. How do you catch Dugong? Using harpoon ☐ Using net ☐

Other method ☐ Explain……

☐34. Compare to when you first started becoming a fisherman, is the Dugong caught:

More than before ☐ Less than before☐ Quite the same☐ Do not know☐

(*Note: this testimony is based on actual numbers, not perception*)

(*If more or less than before*) What makes you think that way? ……...

……..

☐35. What will/ do you do when you catch Dugong intentionally? Consume it☐ Sell it ☐

Make fish bait of it☐ Others ☐

…… (*Note: Do not guide respondent*)

☐36. What will/ do you do when you catc Dugong accidentally? Dispose it (*when dead*) ☐ Release (*when alive*) ☐ Consume it☐ Sell it☐ Make fish bait of it☐ Others ……

☐37. Have you ever found ☐ or heard☐ Dugong which is stranded on the beach?

Yes☐ No☐ (*Explain*) ……

Or, have you ever found ☐ or heard☐ Dugong which died and float in the waters?

Yes ☐ No☐

Or, have you ever found ☐ or heard☐ Dugong with scars on its back? Yes☐ No☐ (*explain*) …….

(*If yes*) Where is it, when is it and how many? (*ask the respondent to point location on the map*) ……..

What happened next to the Dugong? ……

38. What will you do if you discover a Dugong which is stranded on the beach? ……..

……

SEAGRASS

☐39. Have you ever seen this plant?

Yes ☐ No☐

(*If yes*) Where do you see it……

☐40. How many type (species) of seagrass that you know?

☐41. In which depth you may see seagrass?

0-5 m ☐ >5-10 m ☐ >10-15 m ☐ >15-20 m ☐

☐42. How is the seagrass condition recently compare to the past?

☐43. How do you feel if you are no longer able to see seagrass?

PERCEPTION

☐44. Compare to when you first started becoming a fisherman, do you think the number of dugong:

Becomes more ☐ Becomes less ☐ Quite the same ☐ ? Do not know ☐

☐45. Do you think Dugong has always to be in the water?

Yes ☐ No ☐ Do not know ☐

☐46. Do you think the presence of Dugong is important?

Yes ☐ No ☐ Do not know☐

☐47. Do you know what seagrass beds/ meadows is?

Yes ☐ No☐ (*Note: Interviewer showing the pictures*)

Is there any seagrass beds/ meadows around your place?

Yes ☐ No☐ Do not know ☐ Where is it?

(*Note: the interviewer insert/ point on the map*)

Do you fish on or around the seagrass meadow? Yes ☐ No ☐

Does seagrass meadows have any vital role? Yes ☐ No ☐

Why? …….

☐48. Is catching/ hunting Dugong against the law? Yes ☐ No☐ Do not know☐

What if the Dugong caught accidentally in the net, is it against the law? Yes ☐ No☐ Do not know☐

Will you report the accident to the related- local institution?

Yes ☐ No ☐

In more detail (*If Any*) ……

☐49. Is the waters patrolled or monitored regularly? Often ☐ Occasionally ☐ Never ☐

Do not know ☐

☐50. If yes, has the law/ regulation being enforced? Often ☐ Rarely ☐ Never ☐

Do not know ☐

☐51. Is there any custom, belief, fairytale or worship that is related to Dugong? Yes ☐ No☐

(*If Yes*) Explain……