Survey of Dugongs *(Dugong Dugon)* on Cempedak Island, West Kalimantan

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Abstract

Dugong *(Dugong dugon)* are the only marine mammals that consume *sea grass* as their primary food source. Since 2019, authorities in West Kalimantan have received reports from local community members of dugong sightings, especially in the waters surrounding Cempedak Island. However, the actual existence of Dugong in the area was only confirmed in May 2020 by the Balai Konservasi Sumber Daya Alam (BKSDA) when a dugong rescue was carried out. From January 23 to March 23, 2021, a systematic survey of dugongs was undertaken around Cempedak Island in order to further assess the presence of dugongs in the area. The dugong surveys used two different methods: observations from the coast (edge-based) and boat-based observations. Both surveys were carried out for 15 days each. Semi-structured interviews were also carried out in coastal communities to gather local ecological knowledge and perceptions of dugongs. The edge-based observations yielded 16 different sightings with a total of 19 individuals, whereas boat-based observations resulted in 4 different sightings with a total 4 individuals. Our survey results revealed that the methods of observation's used can have a significant correlation on the encounter rates of dugongs and should be taken into consideration in future studies. Concerningly, results from our community interviews indicated a decreasing trend in dugong sightings compared to previous years.

Keywords
Cempedak Island, dugong, ecology, sighting, West Kalimantan.

1. Introduction

Dugong *(Dugong dugon)* is the only marine mammal that consume *sea grass* as its primary food (Priosambodo et al., 2017; Sunuddin et al., 2016). They are found in most coastal waters across the southern hemisphere. In Indonesia, dugong populations are evenly distributed along the coastal regions (Cleguer et al., 2020; Nontji et al., 2012). Dugongs are known to the people of Ketapang Communities as *duyungor duyong* fish. The dugong is a protected animal according to Law no. 7 of 1999 and Regulation of the Ministry of Environment and Forestry of the Republic of Indonesia Number P. 106/MENLHK/SETJEN/KUM.1/12/2018. This species is considered Vulnerable to extinction (*Vulnarable - VU*) by the IUCN, but in some specific countries, the status of this species is considered Endangered (*Endangered - EN*) (Marsh and sobtzick, 2019).

In May 2020, the Dugong's habitat was confirmed by the Balai Konservasi Sumber Daya Alam (BKSDA) Kabupaten Ketapang when a rescue of this animal was carried out in the Kendawangan area, Cempedak Island, Ketapang Regency. The local community had previously reported the appearance of dugongs on Cempedak Island several times, however,

there has never been sufficient documentation or evidence that listed that Cempedak Island as a habitat for these animals. Cempedak Island is located in Kendawangan Kiri, Kendawangan District, Ketapang Regency, West Kalimantan Province (Rumahorbo and Iswanto, 2020).

This study aimed to verify the presence and distribution of dugongs around Cempedak Island based. In addition, the results of this study can be used by the authorities in making decisions for the management of areas where dugongs are found. In particular, this research can encourage the community around Cempedak Island to be more concerned with the existence of dugongs and participate in the management and implementation of dugong conservation.

The dugong has a high diversity value, where this animal is the only remaining herbivore from the *Dugongidae* family and is still distributed across many countries in the world (Cleguer et al., 2020; Mamayu Utami et al., 2018; Marsh et al., 2012). To conserve this species, the distribution and population of existing seagrasses must also be considered because dugongs are very dependent on the seagrass ecosystem as its natural habitat (Nontji, 2015). Dugongs spend the majority of time feeding due to its high nutritional requirements (Dewi et al., 2018; Nontji, 2015).

The existence of Dugong is strongly influenced by the existence of a good seagrass ecosystem and the diversity of seagrass species at a location (Dewi et al., 2018; Juraij, 2014). The distribution of seagrass species in Indonesia is enough to be used as an indicator of the presence of dugongs (Dewi et al., 2018; Nishiwaki et al., 1979; Nontji, 2015; Priosambodo et al., 2017). In Indonesia, there are 13 species of seagrass found present in almost all coastal waters of the archipelago such as *Halodule sp, Cymodocea sp, Enhalus sp, Thalassia sp,* and *Halophila sp* (Bengkal et al., 2019; Rahmawati et al., 2014).

1.1. Research Aim

The aim of this research is to measure and prove the existence of dugongs from the reports we got after the dugong rescue was carried out on Cempedak Island in May 2020. In order to achieve the aim of study following objectives were defined it was carried out of existence the dugong with direct observation.

2. Methods

This research was conducted using two different survey methods to prove the existence of dugongs in the waters of Cempedak Island. Photo and video evidence were shared by the Yayasan Webe Konservasi Ketapang and BKSDA. Coastal or Edge-based Monitoring was carried out at three observation stations located on the eastern coast of Cempedak Island along with direct observations using boats (Aragones et al., 1997; Marsh et al., 2012). Each method was conducted with local community involvement and several local conservation activists on Cempedak Island.

2.1 Edge or Coast-based Observations

Observation from the coast (edge–based) was done from three different observation stations (Figure 1). The selected location of the station was chosen based on the visual condition of the waters of Cempedak Island, which was considered to have a fairly good condition of seagrass ecosystem. The first observation station (OS) was located in the southern part of Cepedak Island providing a visualization range that faced out across the east of the Island. The second OS was in the center of Cempedak Island, which headed towards the east of the island. The last OS was in the northern part of Cempedak Island which also faced towards the east. All observation stations pointed to the eastern part of Cempedak Island because only in that region of Cempedak Island were the presence of seagrasses scattered close to the shoreline.

The data collection technique on the presence of dugongs by observation from the edge was done by observing movement of the water surface using binoculars by two observers facing two different sides. We assumed the location used for data collection was based on the availability of facilities such as floating ponds or docks to make observations easier. If a dugong was observed, it was recorded and the distance was estimated by marking the location of the emergence using GPS. To be able to confirm the presence of dugongs, we checked the location of the emergence of the animal in the water for signs of a feeding trail. Additionally, we used a unique characteristic of the dugong for identification where the animal only reveals its nose and the back slightly out of the water, similar to a dolphin but without a fins on its back (Marsh et al., 2012; Nontji, 2015). The time of data collection was divided between morning from 06.00 - 10.00 AM (Local time) and afternoon from 14.00 - 18.00 PM. This time was divided based on the intensity of the appearance and behavior of dugongs that are active at high tide, which is in the morning or in the afternoon (Lanyon et al., 2005; Nishiwaki et al., 1979; Nontji, 2015).

2.1 Observation Using Boats

Boat–based observations were conducted using a boat with a minimum height of 1.5 meters above sea level (Herandarudewi et al., 2018). On the boat, the dugong monitoring crew consisted of three people as observers in a 1-1-1 position. One person observed from the front of the boat, one observed to the boat's right and left and one more person observed from back of the boat. All of the monitoring crew used binoculars as a monitoring tool to identify the appearance of dugongs similarly to the methods used during the edge-based observations and sightings were marked using a GPS for the encounter position. This observation method was done around Cempedak Island and repeated 15 times.

Data collection by boat was done for 1 full day starting from 07.00 AM – 17.00 PM. The boat surrounded the island at a speed of 3-5 knot/hour. Sometimes the boat's engine on locations that according to the crew, dugong is very commonly occurred there. For each occurrence the information recorded included: the time, coordinates, sea conditions and the number of individuals when the appearance was obtained.

2.2 Data Analysis

From the data obtained from the two observation methods, the data were processed using ArcGIS 10.3 and ArcGIS 10.8 applications to determine the coordinates of the presence of the dugong obtained. The results of the observations were plotted in a distribution map based on the of dugong sightings, the area of activity, and the radius of the observations made. Additional observations for the feeding trails and data on seagrass conditions were also added (Herandarudewi et al., 2018; Rahmawati et al., 2014). To verify the data obtained, community interviews were carried out with Yayasan WeBe Konservasi Ketapang Members and BKSDA. Results were presented in the form of a descriptive table to determine the of increasing or decreasing trends in the number of dugong sightings on Cempedak Island. All the dugong encounter were screened, and any unconfirmed or ambiguous sightings were rejected from the database (Pilcher and Kwan, 2011; Syafutra et al., 2018).

2.3 Time and Assumption Research

The research was conducted from 23 January to 23 March 2021, where each method ran for 15 days of observations. Semi-structured interviews were also carried out in coastal communities to gather local ecological knowledge and perceptions of dugongs. In addition, verification of the data found by dugong through the presence or absence of feeding trails left in the observation area.

Edge observations were carried out from January 27, 2021 to February 10, 2021. Meanwhile observations using boat were executed from February 25 to March 11, 2021. Observation time was done separately due to limited resources and to optimize observation times. In addition, the observation crew has previously attended training and the data obtained could be verified. To find out the condition of the sea waters, we also use the Beaufort scale criteria to assess the description (Table 1).

Table 1. Wind speed based on *Beaufort Scale* (Herandarudewi et al., 2018)

Beau for scale	Wind Speeds (Knots)	Description
0	0 – 1	Sea water like a mirror
1	1 – 3	Visible small water ripples, no foam
2	4 – 6	Small waves (Wave height: 0.2 – 0.5 m), but not breaking
3	7 – 10	The waves are getting bigger (Wave height: 0.6 – 1 m), and start to break, starting to look foam
4	11 – 16	Longitudinal waves (Wave height: 1 – 1.5 m), more foam
5	17 – 21	Medium wave lengthening (Wave height: 1.5 – 2.5 m), a lot of foam is partially splashed
6	22 – 27	Big waves (wave height: 2.5 – 4 m), lots of foam and splashing water

For seagrass cover conditions (see Table 2), we did vegetation analysis with line transects for 100 meters at every station (edge – based) with an interval of 10 meters for every single quadrant. After that, we recorded every condition from all several quadrants in 1 line transect for get an average cover. The calculation of cover and average cover was based on the seagrass formula (Gusmalawati and Sanova, 2018; Octavina et al., 2020; Rahmawati et al., 2014)

Table 2. Seagrass Cover From Quadran (Rahmawati et al., 2014)

Category	Cover Value Of Seagrass (%)
Full Cover	100
¾ Cover	75
½ Cover	50
¼ Cover	25
Empty Cover	0

3. Analysis Results

The results of observations from the two different observation methods yielded a total number of 20 dugong sightings. Sixteen encounters were recorded using the edge observation method, and four encounters using the boat-based method. The following tables and map reveal the dugong encounters on Cempedak Island.

3.1. Result Data from Coast Observation (Edge-Based)

Table 3. Dugong sightings from edge observation at station 1

No	Sighting Date	Sighting Coordinat	Individuals / Sighting	Sea Conditions (Beaufort scale)
1	27/01/2021	-2.635718, 110.126171	1 Individual	2
2	29/01/2021	-2.636029, 110.126563	1 Individual	4
3	31/01/2021	-2.636856, 110.127182	1 Individual	4
4	31/01/2021	-2.635827, 110.124671	1 Individual	4
5	04/02/2021	-2.636224, 110.124403	1 Individual	3
6	06/02/2021	-2.634574, 110.126109	1 Individual	5
7	07/02/2021	-2.635357, 110.126217	2 Individuals	2
8	07/02/2021	-2.636155, 110.127209	1 Individual	2
9	07/02/2021	-2.636203, 110.124875	2 Individuals	2
10	09/02/2021	-2.635935, 110.124398	1 Individual	3
11	10/02/2021	-2.637035, 110.125156	1 Individual	4
Total			13 Individuals	

Table 4. Dugong sightings from edge observation at station 2

No	Sighting Date	Sighting Coordinat	Individuals / Sighting	Sea Conditions (Beaufort scale)
1	31/02/2021	-2.633830, 110.126068	1 Individual	4
2	13/02/2021	-2.632962, 110.126197	1 Individual	3
3	13/02/2021	-2.633691, 110.126884	1 Individual	3
Total			3 Individuals	

Table 5. Dugong sightings from edge observation at station 3

No	Sighting Date	Sighting Coordinat	Individuals / Sighting	Sea Conditions (Beaufort scale)
1	30/01/2021	-2.630977, 110.128174	1 Individual	4
2	10/02/2021	-2.631707, 110.128553	2 Individuals	3
Total			3 Individuals	

The highest dugong encounter was in the area of station 1 where there were 11 appearances with a total of 13 individuals (Table 3). These results were recorded per day and when there was an encounter on the same day, but outside of a short time range, more than 1-2 hours between encounters, then we assumed that the dugong was a different individual. This is because dugong has a fairly great daily ranging behavior (Dewi et al., 2018; Nontji, 2015; Priosambodo et al., 2017).

For station 2 (Table 4), there were three encounters with the number of individuals per encounter, namely one individual. While at station 3 (Table 5), there were two encounters. On the first encounter there was one dugong observed and on the second encounter there were two individuals encountered. In addition to the time of the encounter, the coordinates and the number of individuals per encounter, the sea conditions were also considered using the Beaufort scale as an assessment indicator (Herandarudewi et al., 2018).

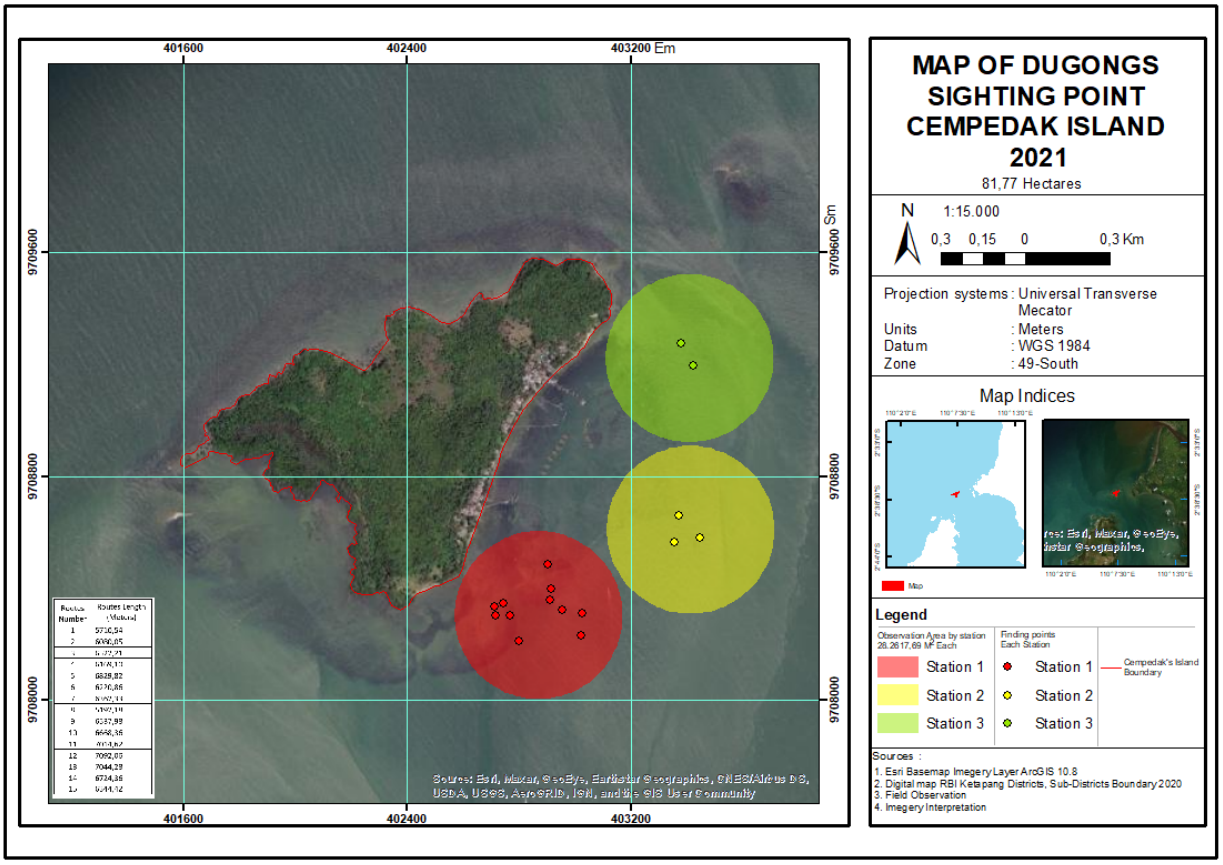

Figure 1. Map Of dugongs sightings point per observation station (edge – based)

The dugong distribution map was made based on data from the encounter tables at each observation station. For station 1, the observation area obtained was 221,788 m^2 (22.18 ha) with 11 occurrences and 13 individuals. For station 2, the observation area obtained was 254,879 m^2 (25.49 ha) with three occurrences and three individuals. While at station 3, the observation area obtained was 242,776 m^2 (24.78 ha) with two occurrences and three individuals. The total area was 72.45 ha with 16 occurrences and the total number of dugong individuals observed was19 individuals.

The area obtained was the result of calculating the distance used as the radius in the formula for the area of a circle ($L=\pi r2$). For station 1, the radius obtained was 255.4 m, while station 2 had a radius of 284.9 m, and station 3 had a radius of 278 m. The radius for calculating the area was obtained by calculating the outermost distance from the island to observation points such as the end of the pier at station 3, floating cages at station 2 and monitoring houses at station 1. Observer position at every station was in the center of the circle, and therefore we could calculate the observation circle to be the area of observation.

3.2. Result Data from Boat – Bases Observation

Table 6. Dugong sightings from boat-based observations

No	Travel Date	Sighting Coordinat	Mileage (Meters)	Individuals / Sighting	Sea Conditions (Beaufort scale)
1	25/02/2021	-	5710,54	0	2
2	26/02/2021	-	6080,05	0	3
3	27/02/2021	-	6522,21	0	3
4	28/02/2021	-2.640852, 110.123730	6169,10	1 individu	3
5	01/03/2021	-	6829,82	0	3
6	02/03/2021	-	6220,86	0	4
7	03/03/2021	-2.639776, 110.125510	6362,33	1 individu	3
8	04/03/2021	-	5192,18	0	2
9	05/03/2021	-2.632162, 110.133034	6537,98	1 individu	4
10	06/03/2021	-	6668,36	0	3
11	07/03/2021	-	7014,62	0	5
12	08/03/2021	-	7092,06	0	5
13	09/03/2021	-2.628130, 110.133624	7044,28	1 individu	3
14	10/03/2021	-	6724,36	0	2
15	11/03/2021	-	6344,42	0	5
Total			96.513,17	4 individuals	

The dugong sightings yeilded from the boat totalled 4 sightings with a total of 1 individual in each appearance. The total distance covered in the observation was 96,513.17 m with an average distance of 6434.21 m/route. For sea conditions, the average was quite shaking waves and had an average Beaufort scale of 3-4. Dugong sightings for the average route was 0.26 sighting/route and for distance was 0,041 sighting/km.

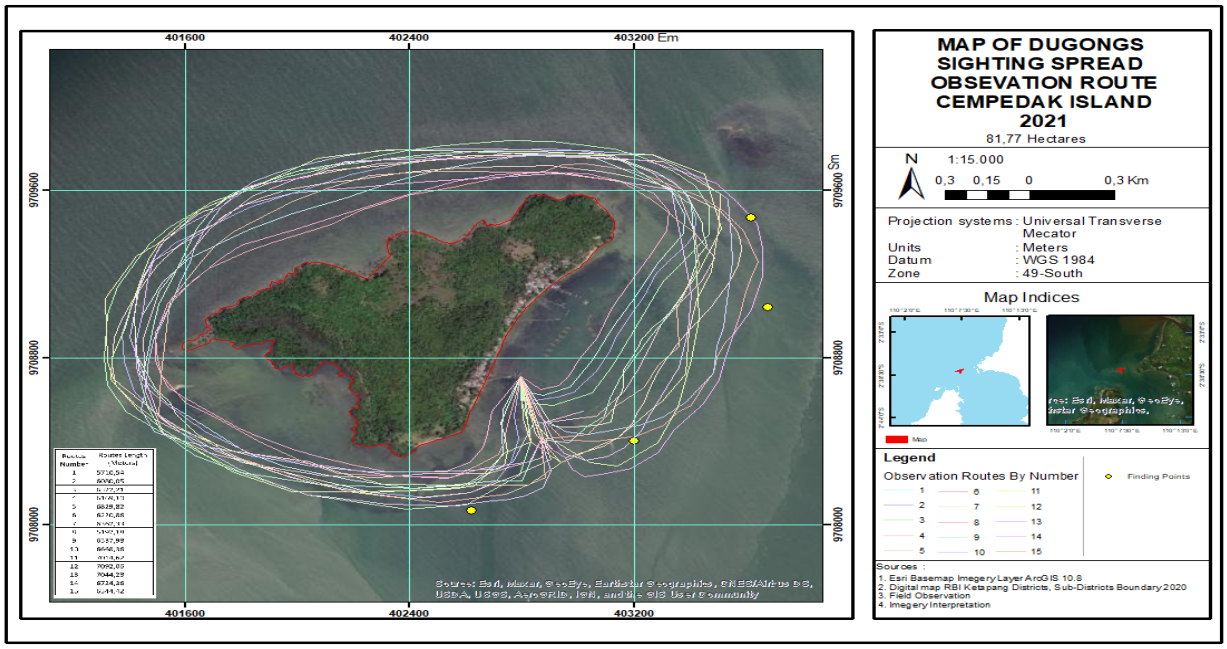

Figure 2. Image map of the dugong *(Dugong dugon)* distribution route using boats

An image map of dugong distribution route using boats was produced (Table 6 and Figure 2). We obtained dugong sightings data on route 4, 7, 9, and route 13. On the other route, we did not find any sightings of dugongs during the observation. Dugong sightings obtained during observations using boats were in areas that had a lot of seagrasses and were not far from the coast. The records of the dugong sightings were always in motion and moving towards the shore. Below is an example of a sighting of a dugong during observations using a boat, when the dugong swam across the waters of the Cempedak Island (Figure 3).

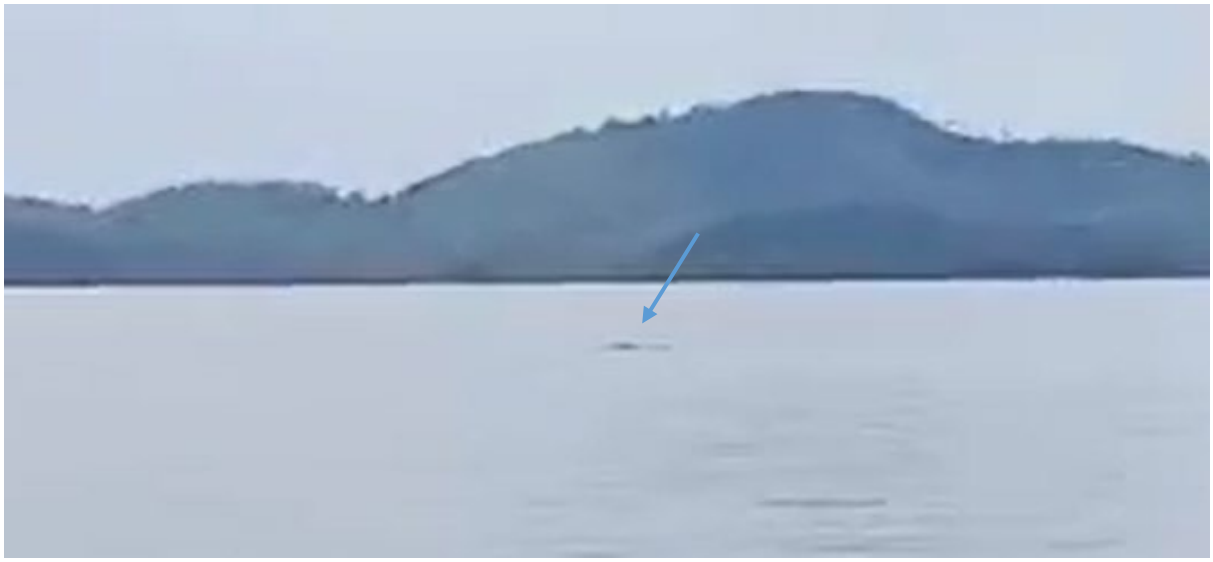

Figure 3. Sighting of dugong *(Dugong dugon)* record from observation using a boat

3.3 Result Data Support

Observational data obtained have shown the existence of dugongs through direct observation using edge observations and observations using boats. In addition to this data, we also took several additional data samples in the form of the distribution of the feeding trail that was left around the dugong sighting area. The feeding trail is one indicator of the presence of dugongs in an area, especially in seagrass ecosystems because it has a specific shape character (Tol et al., 2016). In addition, interviews are also very important in verifying and validating data on the existence of dugongs in an area (Ashari et al., 2018; Herandarudewi et al., 2018).

Table 7. Data *Feeding Trail* at the edge observation station

Code	Location (Station)	Size (Cm)	
		Length	Width
F1	Station 1	327	27
F2		228	28
F3		239	27
F4		402	29
F5		137	14
F6		222	18
F7		179	23
F8		272	28
F9	Station 2	226	22
F10		116	22
F11		209	21
F12		304	20
F13	Station 3	367	25
F14		221	22
F15		377	23
F16		253	18
F17		365	23

Feeding trail data was taken at low tide on the day that edge observations were carried out. We took a sample of the feeding trail size in the form of length and width. Most encountered feeding trails were at station 1, with a total 8 samples. The least encountered feeding trail was at station 2, with a total 4 samples. Of the total samples, we obtained 17 feeding trail samples. However, we didn't take any samples of feeding trails while carrying out boat observations because location and depth was not compatible for sampling (Table 1). We found 13 individuals of dugong, and that data confirmed that in station 1 we had the most feeding trails encountered.

The remaining feeding trails can be used as an indicator that the edge observation station was a seagrass area, which was a feeding area for dugongs (Juraij, 2014). The feeding trail is also considered as one of the determining factors and a key factor in the feeding behavior of dugong (Tol et al., 2016). To find out the overall pattern of dugong feeding behavior, data on dugong feeding biomass is needed through further research. We also think that the feeding trail represents the most suitable data to be used as a reference for the existence of dugong at any location. In collecting feeding trail data, we found a certain pattern of the shape and size of the feeding trail found (Figure 4). The difference in size of the feeding trail can be used as an assumption, when the shape and size of the feeding trail differ significantly, the size of the dugong will also be different too. However, the number of feeding trails that we found was not sufficient to be used as a reference for this assumption and further research should be carried out on the dugong size pattern based on the shape and size of the feeding trail.

Figure 4. Feeding trail size data retrieval (Length and Width)

Table 8. Seagrass cover scale at station of edge observation

No.	Location	Seagrass cover average (%)	Category Scale	Observation area (Hektare)
1	Station 1	68,75	Good	22,18
2	Station 2	54,36	Good	25,49
3	Station 3	57,01	Good	24,78

From the seagrass cover obtained, it was not possible for dugong sightings to be determined on a group scale, although the dugong sighting data obtained was very high for the area of observation. Dugong sightings on Cempedak Island was quite unique where in each encounter only 1 to 2 individuals were found. In some areas close to Indonesia such as Australia, dugong sightings in each encounter has been reported to be quite high in terms of individuals, where in each encounter there were more than 2 individuals (D'Souza et al., 2015; Lanyon et al., 2005; Plon et al., 2019; Tol et al., 2016).

In our opinion, the dugong sighting data found were appropriate when compared to the availability of food resources in the form of seagrass. Therefore, we must understand that the interaction between dugong and seagrasses has a very high value and can trigger a shift in the seagrass ecosystem at the future (D'Souza et al., 2015; Joseph et al., 2019). The availability of seagrass as a food in the dugong habitat will affect the distribution and population of both seagrass and dugong itself (D'Souza et al., 2015; Nontji, 2015; Nontji et al., 2012). The relationship between dugong also looks very significant because the behavior of dugongs when eating is destructive by eating seagrass to the roots so that the ability to recover is slower (D'Souza et al., 2015)

Table 9. Verification of data through interviews to determine the distribution trend of dugong *(Dugong dugon)* sighting.

No	Informant	Response About Trend	Description
1	Tribal Chief of Cempedak Island	Decreasing	The Tribal Chief said that 20 years ago, dugong sightings could be ascertained easily because of the high encounter
2	Local Representative	Decreasing	Local people believe that dugong has a spiritual

			chemistry with the people on Cempedak Island
3	Conservation Activist	Don't Knowing about trend	activists do not know the details of the decline in the number of dugong sightings, but when we look globally, it is certain that dugong sightings have decreased in a trend
4	BKSDA Officer	Decreasing	Regulatory changes continue to be adapted to the latest conditions to continue to protect wildlife, especially dugong in this case
5	Expert Seminar	Decreasing	In the seminar, experts said that in Kalimantan, especially West Kalimantan, the population of dugong continues decreasing every year.

The results of the interview revealed that the trend of dugong sightings decreased significantly. Some communities in Indonesia believe that dugong has been allowed to be consumed since ancient times, especially people in Kalimantan (Ashari et al., 2018; Budiono, 2003; Nontji, 2015). But now, people have realized the existence of dugong, which has a protected status by the state, so that the behavior of eating dugong has greatly reduced. Initiatives that have arisen among the community must be considered by many parties, so that community can be a behavior and can be used as a local wisdom in the future.

This interview lasted for 47 minutes with questions related to local wisdom in Cempedak Island and the community's response to the existence of dugong. We conclude from this interview that at present, the existence of the remaining dugongs is very beneficial in terms of its ecological, social and economic impacts. In order to maintain the population and distribution of dugong, the community has the initiative to participate in the protection of these animals through routine patrols, punishment for catching perpetrators, and helping to restore seagrass ecosystems independently.

4. Discussion of Result

Comparing the results from 2 different types of observation methods, it was found that there were significant differences in the number of sightings and individuals. The edge observation method obtained 11 times the number of occurrences and 13 individuals, while the observation method using a boat only had 4 occurrences with a total of 4 individuals. This is because the dugong is an animal that is considered very shy and sensitive to water activities (D'Souza et al., 2015; Nontji, 2015; Sunuddin et al., 2016). In addition, according to the local wisdom of the local community conveyed by the chief of the Cempedak Island tribe that dugong can hear from a distance even to the rudder of the boat (Personal data).

Figure 5. The process of interviewing tribal chief and representatives of the Cempedak Island community.

The movement and the sound of the boat's engine can scare the dugong and make the dugong reluctant to appear. Thus, the presence data obtained from observations using a boat were less than those from edge observations, where there is little movement. In addition, dugong is also an animal that was very active in moving when looking for food (Dewi et al., 2018; Nontji, 2015). Existence based on the appearance of dugong is strongly influenced by the condition of seagrass in an area that is the movement and life cycle of the animal (Nurdin, 2019; Sunuddin et al., 2016).

Any dugong encountered during our observation was eating and moving to the shore. Dugong always moved to the shore because the *seagrass* ecosystem is in the coastal areas. In Bintan Islands, dugongs were most encountered at the shore as there are many *seagrasses* present. There were many captures of dugongs in coastal areas which were affected by the tides (Ashari et al., 2018; Juraij, 2014; Kawaroe et al., 2016). In Australian tropical regions, *seagrass meadow* has a high biomass for dugong *feeding trail* but just for a *seagrass* species lesser degree (Tol et al., 2016).
The waters around Cempedak Island have the potential to become dugong habitat and it is also possible for other islands near Cempedak Island and larger ones such as Bawal Island. Cempedak Island has a fairly good type of marine park with a high intensity of seagrass distribution visually. However, limited data regarding the exact number of existing populations of dugong and seagrass meadows is one of the obstacles in overcoming existing conservation problems. In Johor Malaysia, the government strongly supports conservation activities related to the protection of wildlife, especially dugongs in their area (Ponnampalam et al., 2015). This can be an example that dugong conservation activities must be supported by many parties, especially the government and the community itself.

5. Conclusion and Future Research Direction

Sighting surveys of dugongs are very useful to be used as a comparison and reference tool to determine the overall population on Cempedak Island. The data obtained were only findings of dugong sightings from two observation methods which was 20 Sightings and 23 individuals encountered. The data obtained has been verified through several stages such as looking at the condition of seagrass, finding the feeding trail, and interviewing several people. The existence of dugongs on Cempedak Island has been recognized from the data we have obtained. We also found that the number of dugong sightings seems to have decreased in number from several indications that we found. The recommendations from this research is to do other research related to the condition and distribution of seagrass species on Cempedak Island and its surroundings so that we can find out other indications of the existence and population of existing dugongs that are in accordance with the existing seagrass conditions.(Rahmawati et al., 2014).

5.1 Practical Implication

This study is very useful for Yayasan Webe Konservasi Ketapang as evidence that integrates academic and understanding of many perspectives. In addition, the results of this study are very useful to be used as a reference for similar research in the future with a wider perspective. This study also answers questions about the existence of dugongs on Cempedak Island.

5.2 Theoretical Implications

This study shows the fact that the survey conducted is very appropriate to the conditions in the field. this is due to the application of more than one method to make observations as a form of proof. Therefore, it is very appropriate if the results of this study can be developed by further research. In addition, many development methods can be adapted and reused especially in developing areas

5.3 Limitation of Study

like most researches, this research has its limitations. Some of the main limitations in this study are the lack of respondents, technology and costs needed to complete the research. Longer time in data collection is an important factor so that the data obtained is much better.

5.4 Future Research

Further research is highly recommended to further validate the results of this study as well as to enrich knowledge of existing weaknesses and by proposing solutions so that the existence of dugongs on Cempedak Island can be taken into consideration for many parties.

Acknowledgment

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