Short communication: Dugong's presence confirmation in Bintan Island based on local ecological knowledge

[1]Fadhliyah Idris, [1]Ita Karlina, [2,3]Sekar M. C. Herandarudewi, [1,3]Aditya H. Nugraha

[1] Department of Marine Science, Raja Ali Haji Maritime University, Tanjungpinang, Indonesia; [2] Research Center of Oceanography, Indonesian Institute of Sciences, Jakarta, Indonesia; [3] LAMINA, Indonesian Seagrass Foundation, Depok, Indonesia. Corresponding author: A. H. Nugraha, adityahn@umrah.ac.id

Abstract. Dugong (*Dugong dugon*) population continues to decline due to the high pressure coming from the environment and hunting by humans. Bintan Island is one of the *D. dugon* habitats in Indonesia. This study aims to confirm the existence of dugongs and identify threats to the survival of dugongs through interviews with local communities based on local ecological knowledge. The study was conducted at five locations on Bintan Island which included Berakit, Pengudang, Teluk Bakau, Kelam Pagi and Kelong. The results obtained indicate that the majority of respondents of Berakit (100%) and Kelong (78%) have seen the presence of *D. dugon* in nature with a fairly frequent level of intensity. The threat to the survival of *D. dugon* on Bintan Island originates from the existence of fishing gear such as nets and fishing traps. Besides, at several locations it is still in the habit of the communities to hunt *D. dugon* and this is one of the biggest threats to the *D. dugon* species conservation.
Key Words: conservation, diversity, *Dugong dugon*, marine mammals.

Introduction. Dugong (*Dugong dugon*) is one of the mega fauna living in the marine ecosystem, which belongs to the class of mammals. According to the data released by IUCN, dugong is a species threatened by extinction, its population being in a continuous decline, due to several factors including a very low reproductive rate anthropogenic pollution consequences and excessive hunting (Marsh et al 2015).

The distribution of dugong in the world covers the Indo-Pacific region and some parts of Africa. Indonesian waters are an important habitat for dugong populations in the world. The distribution of dugongs in Indonesian waters is very broad, according to the results of a research that has been carried out, covering the Gulf of Cendrawasih, Padaido, Biak, Maluku, Aru Islands, Flores, Ujungkulon, Sunda Strait, Bangka-Belitung, Bintan, Kalimantan (Marsh et al 2002). Due to the breadth of Indonesian waters information related to dugong population estimates is very scarce. Bintan Island is one of the islands in the Riau Islands region, located in the western part of Indonesia, which is geographically bordered by Malaysia and Singapore. Dugong population in the waters of Bintan Island was reported as being mostly extinct.

Further observation is needed regarding the existence of dugong species in the waters of Bintan Island to ensure its population distribution and habitat preservation. *D. dugon* observations can be done with various methods such as aerial surveys, tracing food traces in the seagrass ecosystem and hydroacoustics.

Another method that can be used to confirm the presence of *D. dugon* in the Bintan Island waters is to use local ecological knowledge principles (Adulyanukosol & Poovachiranon 2006; Cullen-Unsworth et al 2018). Interviewing the community, based on the principle of valuing the local ecological knowledge, is considered to be the most effective method for observing the existence of dugongs in nature (Cullen-Unsworth et al 2018). This method can be used in the context of preliminary studies related to

monitoring the population of dugongs in their habit, given the appearance of *D. dugon* that makes them difficult to identify. The principle of local ecological knowledge has been widely used, especially in the context of creating ecosystem conservation areas (Frans & Augé 2016).

Material and Method. The research was carried out on Bintan Island covering five locations: Pengudang, Berakit, Teluk Bakau, Kelong and Kelam Pagi (Figure 1). The interview sites were selected based on the frequency of their past apparitions in the areas the most likely to be their habitats. The interview process was conducted with people involved in sea related activities. In total, 56 respondents were successfully interviewed in the current study, the process being based on the rapid rural appraisal (RRA) method (Juraij 2016). The questions included the dugong sighting frequency and locations, the type of fishing gear interfering with the dugong's survival conditions and the community habit of hunting and eating dugong.

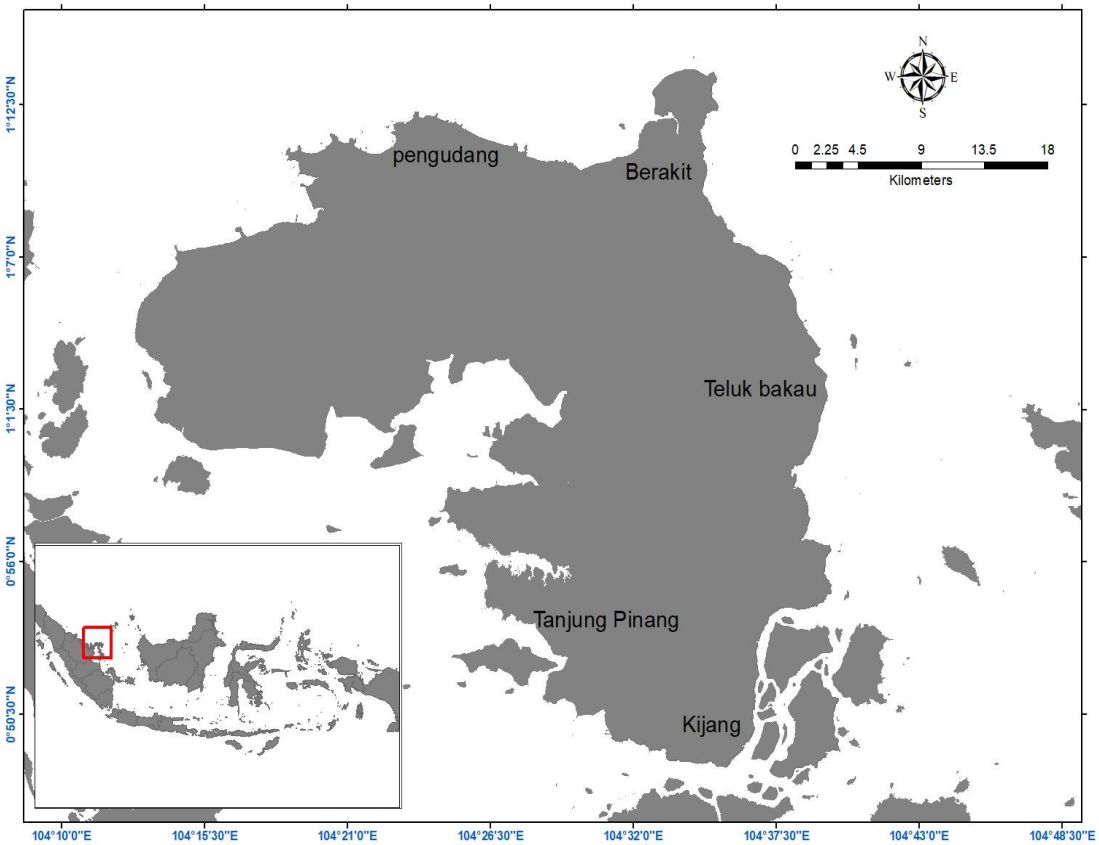

Figure 1. Research map location.

Results and Discussion

D. dugon encounter. Observations related to the encounter of Dugong on Bintan Island were carried out by interviewing the communities in five different locations. Based on the interview results, data concerning the frequency of *D. dugon* presence in Bintan Island was presented in (Table 1).

Table 1

The results of interviews related to the appearance of *Dugong dugon* on Bintan Island

Region	*Knowing D. dugon*		*Occurrence rate*		*Habitat*		
	Yes	*No*	*Frequent*	*Infrequent*	*Seagrass ecosystem*	*Other habitat*	*Unknown*
Berakit	100%	-	100%	0	100%	-	-
Pengudang	100%	-	11.11%	88.89%	78%	-	22%
Teluk Bakau	100%	-	0	100%	0	-	100%
Kelam Pagi	100%	-	0	100%	81%	-	19%
Kelong	100%	-	67%	33%	89%	-	11%

Based on the results of interview, generally all respondents already knew about *D. dugon* and were able to distinguish them from other types of marine animals. *D. dugon* occurrences were still frequently found in Berakit and Kelong areas. The majority of respondents having sea related activities reported frequent apparitions of *D. dugon* in these waters (Table 1), but also in Pengudang waters, although with a lower incidence rate. Communities from the areas of Teluk Bakau and Kelam Pagi reported rare *D. dugon* apparitions in the waters. The respondents explained that they generally emerge into the quiet waters.

In the communities of Bintan Island it is generally known that *D. dugon* has a connection with the existence of seagrass ecosystems. The results of interviews showed that most of the respondents saw the existence of *D. dugon* in surrounding seagrass ecosystems (Table 1). The majority of the people already knew that seagrass is a food resource for *D. dugon*, which are highly dependent on seagrass ecosystems (Adulyanukosol et al 2004; Tol et al 2016).

The exact locations of the *D. dugon* occurence in North Bintan were in Berakit and also between Berakit and Sumpat Island. The waters of North Bintan (Berakit and Pengudang) and Kelong Island were assumed to have a fairly good seagrass ecosystem condition, with no less than 10 species of seagrass identified in Bintan Island (Kawaroe et al 2016). Generally, seagrass species preferred by *D. dugon* are *Halodule, Halophila* and *Syringodium*, all of them abounding in Pengudang and Berakit, but also around Teluk Bakau (Juraij et al 2014; Nugraha et al 2019).

D. dugon threat. Communities from the study area explained that the presence of *D. dugon* populations in nature tends to decrease in number. This phenomenon is due to the many threats to the *D. dugon* survival (Table 2).

Table 2

The activities that threaten the survival of *Dugong dugon* in the observation area

Threat	*Berakit*	*Pengudang*	*Teluk Bakau*	*Kelong*	*Kelam Pagi*
Fisheries	No threats were found from fisheries activities	*D. dugon* has been found trapped in a fish trap and caught in a net	Many fishing activities	*D. dugon* was once found tied to fishing nets	*D. dugon* was once found tied to fishing nets
Hunt	There was found a *D. dugon* hunt	There were respondents who claimed of hunted *D. dugon*	Non-existent	There was found a *D. dugon* hunt	Non-existent
Stranded	Medium intensity for stranded *D. dugon*	Low intensity for stranded *D. dugon*	Low intensity for stranded *D. dugon*	Low intensity for stranded *D. dugon*	Non-existent

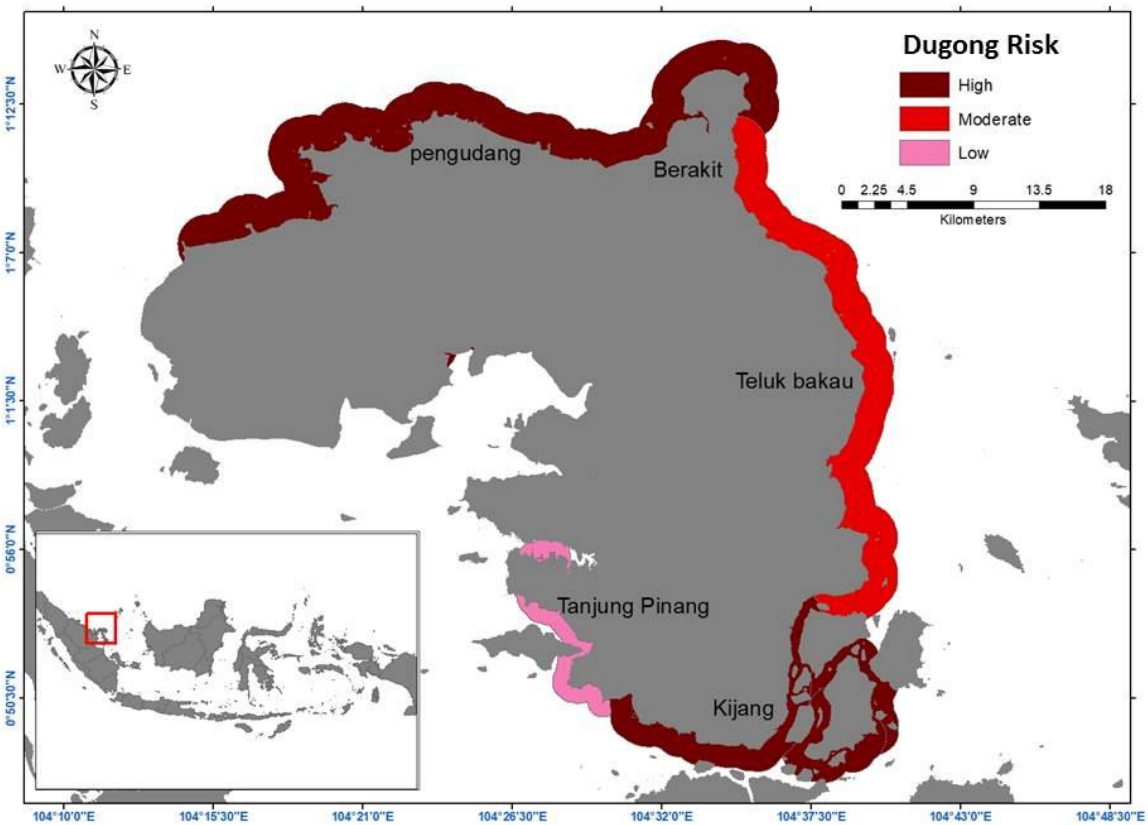

Figure 2. Spatial intensity threats of *Dugong dugon* in Bintan Island based on fishing activity, hunting and stranding history.

Based on the information presented in Table 2, fishery activity is one of the factors that threaten the survival of dugongs in waters. The presence of fishing nets in the sea can cause *D. dugon* to be entangled in a net. Pengudang area is one of the most productive areas in fishing activities, where many types of fishing gear are deployed by fishermen. There were some incidents, such involuntary captures of dugongs in a net or a kelong.

Some people in the research area have consumed *D. dugon*. The community claimed that *D. dugon* meat was obtained by hunting or buying it. Based on observations, dugong hunting was still frequent in the Berakit and Kelong areas. Some people coming from the coastal tribes and who have settled in the Berakit and Kelong areas, still carry out dugong hunting activities, both for consumption and for taking fangs and tears. The persistence of hunting protected animals is an indicator of a lack of understanding of the species conservation importance (Coll et al 2014). The economic condition of the community is thought to be one of the factors triggering such fishing activities (Augé et al 2012).

In addition to the threats that presented in Table 2, other threats can originate from pollution and tourism activities. Currently, the area of Teluk Bakau has many resorts and other tourism activities. These factors could determine the dugong's migration. The dugong has the ability to migrate over long distances (Sheppard et al 2006). It is supposed that dugongs originating from Bintan Island can migrate as far as far the Johor Malaysia waters, in accordance with the results of the research of Hashim et al (2017). Figure 2 is a compilation of all the information in Table 2, resulting in a risk map of the dugong's habitat sustainability in Bintan Island. Hunting activities are considered to represent the most significant risk for the *D. dugon* survival at Bintan Island.

A national action plan for *D. dugon* conservation in Indonesia was elaborated and it was promoted through a decree of the Ministry of Marine Affairs and Fisheries (MMAF 2018). The results of this study can be used as a way to encourage the government to

carry out a national action plan well through collaboration between stakeholders, through various activities, such as public awareness and monitoring of *D. dugon* populations so that it is hoped that its sustainability in nature remains protected.

Conclusions. A clear action plan is needed regarding the monitoring of *D. dugon* populations at Bintan Island, by scheduling surveys based on several methods. The threats to the survival of *D. dugon* in some areas require immediate solutions supported by coordination between stakeholders (government, universities, research institutes, NGOs, communities) in implementing the national action plan for *D. dugon* conservation.

Acknowledgements. The authors would like to thank the Research Grant Faculty of Marine Science and Fisheries Raja Ali Haji Maritime University for support in this research.

References

Adulyanukosol K., Boukaew P., Prasitthipornkul A., 2004 Analysis of stomach contents of dugongs (*Dugong dugon*) from Gulf of Thailand. Kyoto University 9(13):55-67.

Adulyanukosol K., Poovachiranon S., 2006 Dugong (*Dugong dugon*) and seagrass in Thailand: present status and future challenges. Proceedings of the 3rd International Symposium on SEASTAR2000 and Asian Bio-logging Science pp. 41–50.

Augé A. A., Moore A. B., Chilvers B. L., 2012 Predicting interactions between recolonising marine mammals and fisheries: Defining precautionary management. Fisheries Management and Ecology 19(5):426–433.

Cullen-Unsworth L. C., Jones B. L., Seary R., Newman R., Unsworth R. K. F., 2018 Reasons for seagrass optimism: Local ecological knowledge confirms presence of dugongs. Marine Pollution Bulletin 134:118–122.

Frans V. F., Augé A. A., 2016 Use of local ecological knowledge to investigate endangered baleen whale recovery in the Falkland Islands. Biological Conservation 202:127–137.

Coll M., Carreras M., Ciercoles C., Cornax M. J., Gorelli G., Morote E., Saez R., 2014 Assessing fishing and marine biodiversity changes using fishers' perceptions: The Spanish Mediterranean and Golf of Cadiz case study. Plos One 9(1):e85670.

Hashim M., Ito S., Numata S., Hosaka T., Hossain M. S., Misbari S., Ahmad S., 2017 Using fisher knowledge, mapping population, habitat suitability and risk for the conservation of dugongs in Johor Straits of Malaysia. Marine Policy 78:18–25.

Juraij J., Bengen D., Kawaroe M., 2014 [Diversity of seagrass as food source for *Dugong dugon*]. Omniakuatika 9(19):71-76. [In Indonesian].

Juraij, 2016 [Functional relationships diversity of seagrasses with *Dugong dugo*n appearance at Bintan Island (Pengudang and Busung), Riau Islands]. MSc Thesis. IPB University, Bogor, 38 p. [In Indonesian]

Kawaroe M., Nugraha A. H., Juraij, Tasabaramo I. A., 2016 Seagrass biodiversity at three marine ecoregions of Indonesia: Sunda Shelf, Sulawesi Sea, and Banda Sea. Biodiversitas 17(2):585-591.

Marsh H., Grayson J., Grech A., Hagihara R., Sobtzick S., 2015 Re-evaluation of the sustainability of a marine mammal harvest by indigenous people using several lines of evidence. Biological Conservation 192:324–330.

Nugraha A. H., Kawaroe M., Srimariana E. S., Jaya I., Apdillah D., Deswati S. R., 2019 Carbon storage in seagrass meadow of Teluk Bakau - Bintan Island. IOP Conference Series: Earth and Environmental Science 278(1):1-6.

Sheppard J. K., Preen A. R, Marsh H., Lawler I. R., Whiting S. D., Jones R. E., 2006 Movement heterogeneity of dugongs, *Dugong dugon* (Müller), over large spatial scales. Journal of Experimental Marine Biology and Ecology 334(1):64–83.

Tol S. J., Coles R. G., Congdon B. C., 2016 *Dugong dugon* feeding in tropical Australian seagrass meadows: Implications for conservation planning. Peer Journal 7:1–17.

*** MMAF (Ministry Marine Affairs and Fisheries), 2018 National action plan for marine mammals conservation in Indonesia 2018-2022.

Received: 30 December 2019. Accepted: 18 March 2020. Published online: 26 March 2020.
Authors:
Fadhliyah Idris, Raja Ali Haji Maritime University, Department of Marine Science, 29111 Tanjungpinang, Indonesia, e-mail: fadhliyahidris87@gmail.com
Ita Karlina, Raja Ali Haji Maritime University, Department of Marine Science, 29111 Tanjungpinang, Indonesia, e-mail:itakarlina@umrah.ac.id
Sekar Mira Cahyopeni Herandarudewi, Research Center of Oceanography, Indonesian Institute of Sciences, 14430 Jakarta, Indonesia, email: rrsekarmira2@gmail.com
Aditya Hikmat Nugraha, Raja Ali Haji Maritime University, Department of Marine Science, 29111 Tanjungpinang, Indonesia, e-mail: adityahn@umrah.ac.id

How to cite this article:
Idris F., Karlina I., Herandarudewi S. M. C., Nugraha A. H., 2020 Short communication: Dugong's presence confirmation in Bintan Island based on local ecological knowledge. AACL Bioflux 13(2):651-656.