Dugong Aerial Surveys 2011-2012: Declining Trend of the Dugong Population in Muk-Talibong Island, Thaland

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ABSTRACT
The Muk-Talibong Islands in Trang Province is a habitat for the largest group of dugongs on Thailand's Andaman coast. Since 1994, the Phuket Marine Biological Center has regularly conducted aerial surveys over the area with various kinds of aircrafts. In 2011 and 2012, the small aircraft model Tecnum P92J was used in line transect aerial surveys. Survey efforts were four flights (15.01 hours) and seven flights (17.14 hours) respectively. In 2011, the dugong detection rate was 51±50 animals per day, with a maximum count of 122 animals. In 2012, however, the dugong detection rate was 26±14 animals per day, with a maximum count of 54 animals. As a result of comparing the dugong detection rates for both years, we found that the number of dugongs is decreasing, even though the aerial survey periods in each year were the same month and tidal time. Windspeed is likely to be a physical factor that might lead to these results. Ranges of wind speed were 0-6 knot in 2011 and 5-17 knot in 2012. The wind speed affects waves and turbidity, and this may negatively affect visual detection of dugongs. Therefore, further aerial surveys in different weather conditions and dugong stranding reports may help to better understand the declining trends of dugongs in the area.

Keywords: Dugong, aerial survey, Muk-Talibong Islands

INTRODUCTION

Dugongs (*Dugong dugon*; Müller, 1776) are a vegetarian, marine mammal species distributed widely in the Indo-Pacific region in tropical and subtropical coastal waters. However, the geographic distribution is not continuous. Dugongs are found from Southeast Africa to the Northern Red Sea, the Persian Gulf, Western India to Sri Lanka, the Indo-Malayan Archipelago including Thailand, the Pacific Islands, the Ryukyu Islands, and the north and central coasts of South Australia, where the largest dugong population in the world is found (Jefferson *et al*., 2008).

The Phuket Marine Biological Center (PMBC) and Department of Marine and Coastal Resource have been gathering sighting information and stranding records of dugongs from both the Andaman Sea and the Gulf of Thailand since 1979 and conducting aerial surveys since 1997. The study areas were selected from three major data sets; 1) data on dugongs and interview data regarding their habitat, 2) stranded records of dugong and 3) data on seagrass beds. Conclusions from aerial surveys have shown that the distribution of dugongs in Thai waters can be categorized into six groups: a) Northern Andaman, approximately 10-15 animals, b) Phang-nga Bay, approximately 35-40 animals, c) Southern Andaman, approximately 150 animals, d) Eastern Gulf, approximately 20 animals, e) Western Gulf, approximately 10-20 animals, and f) Southern Gulf, approximately 2-3 animals, from stranding records only. Many kinds of aircrafts such as helicopters, Polaris flying boat, microlight aircrafts, ultralight aircrafts, and light aircrafts, were used in each survey (Adulyanukosol, 2010).

The largest group of dugongs was found around the Muk-Talibong Islands in Trang Province, in the Southern Andaman group. The preliminary identification was followed by more intense surveys. Maximum counting and period of each study are shown in Table.1 (Adulyanukosol, 2000, 2002; Adulyanukosol and Poovachiranon, 2006; Adulyanukosol and Thongsukdee, 2005; Adulyanukosol *et al*., 2008). Nowadays, light aircraft are used to conduct aerial surveys. Use of this technology began in 2008, and has enabled more accurate collection of information which is useful in the proposing of conservation plans for improved management of this dugong 'hotspot' area.

MATERIALS AND METHODS

The study areas were Muk Island (N7.37307, E99.29420) and Talibong Island (N7.23203, E99.38851), situated in Trang Province, off the Andaman coast of southern Thailand. The largest seagrass bed in Thailand was found in Talibong Island, and most of the seagrass areas were located in the intertidal zone (Poovachiranon and

Adulyanukosol, 1999). Under these conditions, it was necessary to conduct aerial surveys during the highest tide in spring tide periods.

Since 2008, the light aircraft model Tecnam P92-JS, has been used because of the priority for safety. Furthermore, this aircraft has a longer lasting duration compared with a microlight aircraft. The survey used a strip transect, specified by markers on the wing struts, adjusted by sixty degree, fixed-width line transect method adapted from Marsh (1995). Consequently, at an altitude of 500 feet, the eyesight of observer can cover an area of approximately 260 m. However, in our study, the survey was possible on only one side of the observer. In 2011 and 2012, we conducted the survey in January because the local winds were calm. Details of the flights are summarized in Table. 2.

The area of interest was divided into nine blocks (Figure 1). The interval in each line varied from 1000 m. to 2000 m. depending on areas of interest and perpendicular line transects (Buckland *et al*., 1993). The ashore line was set to cover an area of 408 km^2. A more intensive transect line was set for seagrass beds and shallow water because dugong feeding trails were found in inter-tidal zone of seagrass beds at Talibong Island (Nakanishi *et al*., 2006).

When dugongs were found, they were first counted, and then the sighting location was immediately recorded using a GPS device. Next, photographs were taken to confirm the number of dugongs. Additionally, the airplane's door was removed in order to make it easier to take photographs. Finally, number of the dugongs was recorded by voice recording.

The population abundance of the study were calculated using $\hat{N}_i = \hat{D}_i A_i$ (Thomas *et al*., 2002). D_i is strip transect density, estimated as D = n/wL, n is the number of animals seen in transect in each block, L is the total length of transect in each block, and w is the strip half width (only one side of observer). A_i is the total area in each block, and i is the number of block. Finally, the summation of $\hat{N}_i$ is the population abundance of study area.

RESULTS

The 2012 survey involved seven flights, and the total flight time was 17.14 hours, with an average of 2.28 hours per day. In 2011, the number of flights was four, with 15.01 hours flight time, at an average of 3.45 hours per day. Table 3 shows number of dugongs (n), observation area (wL), and total area in each block (A) on the day of maximum counting for each year. Abundance of dugong in 2011 and 2012 are 421 and 111 animals, respectively.

Even though the aerial survey periods in both years were conducted in the same month and tidal period, in 2012 the average dugong detection rate was 26±14 animals per day which was significantly lower than that of the 2011 detection rate of 51±50 animals per day. However, the maximum daily dugong count in 2012 was lower than that of 2011, as well, by 54 animals. This included four calves and 122 animals, including 19 calves respectively. Additionally, a comparison of the detected number of animals between years 2011 and 2012 showed a the number to be decreasing, 421 animals and 111 animals respectively.

DISCUSSION

The previous study by Hines *et al*. (2005), conducted during 2000 and 2001 in the same area but using microlight aircraft and the Distance Sampling line transect method, reported that the maximum daily dugong count was 88 and estimated a population size of 123 animals. In addition, they suggested that one of the sighting's obstacles may be water turbidity occurring at the highest tide. In our study, we also found the same situation. In 2012 the water was turbid and the population size estimate was 111. In contrast, in 2011 the water was clear and the population size estimate was 421.

However, we propose that the turbidity may be due not only to water current during the highest tide but from wind speed as well. Normally, the wind speed in Andaman coast in January is low, yet the range of wind speed measured by instruments inside the aircraft in 2012 was unusually high. At 5-17 knots, these winds were stronger than those of 2011, which measured 0-6 knots. Therefore, the lower dugong count in 2012 may be a result of these environmental factors.

As can be seen in Table 4, comparison of maximum dugong count between 2012 and the previous study conducted by PMBC with light aircraft (Annual report of PMBC, 2010) shows that the daily dugong count and number of calves were decreasing. Additionally, the number of dead dugongs in Trang Province was increasing in 2012. This decline in the dugong population underway in the Muk-Talibong Islands is a cause for concern. Even if there a need for further follow-up aerial surveys in 2013, the information gathering in 2012 is adequate to start efforts to build cooperation between fishermen, NGOs and government officers, in order to create a strategic approach to protecting the dugongs before the situation becomes irreparable.

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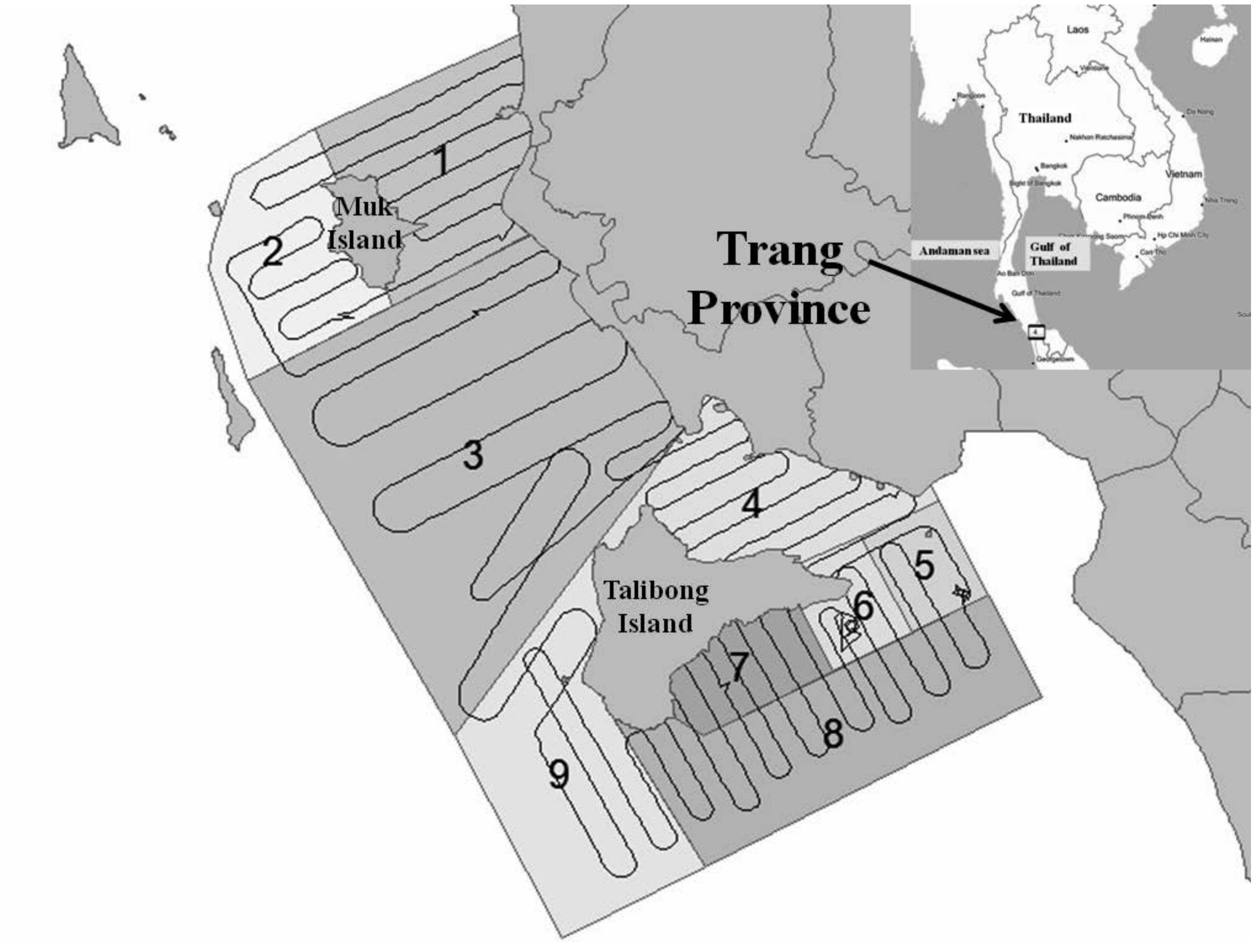

Fig.1 Study areas between Muk-Talibong Islands, Trang Province, Andaman coast of Thailand. The study area was divided into nine areas, seagrass beds dominated in areas 1, 4, 6, 7 and example line transects from January 23, 2012.

Table.1 Maximum count number of dugong detected by aerial survey in Muk-Talibong area, conducted by PMBC. (Adulyanukosol and Poovachiranon, 2006), (Adulyanukosol and Thongsukdee, 2005), (Adulyanukosol et al., 2008).

Time	Type of aircraft	Maximum number of detection
March 1997	Polaris flying boat	34
May 1999	Helicopter	28
March 2000	Microlight aircraft	66
March 2001	Microlight aircraft	88
February 2005	Microlight aircraft	126
November 2006	Microlight aircraft	128
January 2008	Light aircraft	96

Table. 2 Details of survey flights in 2011 and 2012.

Date	time of day	Total hours	Number of detections	Tidal level (m.)	Wind speed (knots)
17/1/2011	7:17-11:13	3.56	24	2.5	2
18/1/2011	9:30-12:40	3.10	14	2.8	0
19/1/2011	9:00-12:55	3.55	46	2.9	0
20/1/2011	10:05-14:05	4.00	125	3.1	6
22/1/2012	11:28-14:45	3.17	33	2.8	10
23/1/2012	9:38-13:21	3.43	18	2.9	5
24/1/2012	11:00-13:40	3.51	54	3.0	10
25/1/2012	10:40-14:16	3.36	23	3.1	17
26/1/2012	11:36-14:54	3.30	20	3.1	14
27/1/2012	14:08-17:17	3.09	20	3.1	10
28/1/2012	14:09-17:02	2.53	12	3.1	5

Table. 3 Results from each year showing highest number of dugong found. n = number of dugongs, wL = observation area (km^2) and A = total area in each block (km^2)

block number	block1	block2	block3	block4	block5	block6	block7	block8	block9
A	40.14	33.23	145.48	32.97	11.64	9.93	15.25	62.00	57.57
n -2011	5	0	1	8	22	80	7	2	0
wL-2011	16.28	6.63	24.11	14.16	2.70	3.61	6.82	2.33	6.09
n-2012	1	0	2	23	3	24	1	0	0
wL-2012	13.46	8.59	23.84	15.38	6.25	6.24	7.05	3.90	4.90

Table. 4 Comparison of maximum dugong count between the 2012 results and the previous study conducted by PMBC with light aircraft. The first row is maximum daily dugong count, including calves. The numbers in parentheses are the number of calves from aerial surveys in the Muk-Libong Islands. The second row is number of dead dugongs in Trang Province. In 2009, no aerial survey was conducted.

Years	2008	2009	2010	2011	2012
Maximum number of dugongs sighted	96 (17)	-	129 (17)	122(19)	54 (4)
Number of dead dugongs	4	6	6	4	1 1