

Research and Conservation of Dugong in Thailand

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ABSTRACT

Dugongs are rarely seen in Thailand, although they have distributed along coastlines both in the Andaman Sea and the Gulf of Thailand. The most abundant area of dugong is at Talibong-Muk Islands, Trang Province. Aerial surveys of dugong population along the Andaman Sea coast in 1997 and 1999 have been conducted and 50 and 38 dugongs were observed, respectively. So far, age determination had been made on 12 dugongs and the range of their ages was 1-43 years. Recently stomach contents of 6 dugongs have been investigated and 9 species of seagrasses were found in their stomachs. The composition of seagrasses found in dugong stomachs may be affected by the composition of seagrasses presented in dugong's feeding ground.

Dugongs were occasionally entangled in fishing gears. Among various types of fishing gears, gill nets were the main cause of the death of dugongs. The principal strategies to conserve the dugong in Thailand are: 1) to act of limiting or reducing some activities, which do harm dugong lives, such as the type of fishing gear, illegal fishing, speed boat, and tourism activity in seagrass beds and dugong habitats, 2) to promote the specific areas as national dugong sanctuaries, for instance, Talibong-Muk Islands in Trang Province, Sriboya-Cham-Pu Islands in Krabi Province, 3) to provide education and to increase public awareness on dugong and seagrass resources conservation, and 4) to promote a network of well-managed marine protected areas, which will conserve key dugong feedings sites through the both coastlines.

Key words: Dugong, aerial survey, distribution, conservation and management

INTRODUCTION

Among the most compelling and inspiring of creatures, dugong (*Dugong dugon*) is one of the "flagship" for marine species conservation in Thailand. This long-lived, magnificent marine mammal used to be generally found along both coastlines of the Andaman Sea and the Gulf of Thailand. However, dugongs are recently rare and only confined in some areas (Nateekanjanalarp and Sudara, 1992; Chantrapornsyl and Adulyanukosol, 1994; Adulyanukosol, 1995, 1998, 2000; Adulyanukosol et al., 1997, 1998, 1999a). Dugongs feed mainly on seagrass species and spend most time of their life in seagrass beds and adjacent areas.

Unfortunately, in Thailand dugongs being nearly extinction; their habitats are threatened by tourism development, settlements and fishing operations. At the present, the country has still lacked a well working conservation program and its existing laws are poorly enforced.

Objectives of Dugong Project Research

The primary purpose of the study on dugong of Phuket Marine Biological Center (PMBC), Department of Fisheries (DOF) is to support the biological knowledge on dugong needed for the conservation and management plan of this animal in Thailand. DOF had provided budgets for 5 years of dugong and seagrass researches under the “Seagrass Resource Management and Dugong Conservation Project” during October 1995 to September 2000. The main objectives of dugong researches are as follows:

1. To study the distribution of dugong together with estimating their population using the data of interview, ship survey, aerial survey, available skeleton and stranded specimens.
2. To studying the biology of external and internal characteristics of stranded dugongs. This knowledge is needed to fill up the basic biological data, which is necessary for dugong conservation plan in Thailand.
3. To study on skeletons, the allometry of skulls and the age from their hard tissues in order to know the allometric variation, sexual dimorphism, age and geographical variation between the specimens from Thailand and other areas.
4. To analyze the stomach contents in order to identify their selective preference food and feeding grounds.
5. To analyze the level of heavy metal and organochlorine in dugong tissues in order to know the toxic contaminants in dugongs.
6. To compare dugong population in Thailand to those from other countries by mean of the application of molecular makers (e.g. mt-DNA) in order to reveal possible divergence of each population.

RESEARCH OF DUGONG IN THAILAND

Distribution of dugong Andaman Sea (Figure 1)

Aerial survey of dugong was firstly conducted in Trang Province during 1991-1992 and 61 dugongs were observed (Aueng *et al.*, 1993). Subsequently, Adulyanukosol (1995) gathered the general information of dugong by making interviews to local villagers, from 200 families, inhabiting along the Andaman Sea coast. She found that the number of dugongs was rapidly declined over period of the least 20-30 years and recommended the areas critically needed for an aerial survey of dugong.

Since then, the attempts to survey the number of dugongs and to study their behavior were initiated by PMBC in 1997. Adulyanukosol *et al.* (1997) conducted the aerial surveys at 8 seagrass areas within 4 provinces, *i.e.*, Phangnga, Krabi, Trang and Satun, using the “Polaris Flying Boat” (inflatable boat with wings and 64 HP engine) in 1997 and found a total of 48 dugongs including 5 calves. With the incorporation from the Royal Thai Navy, the other aerial surveys had also been conducted in 1997 and 1999 using either helicopter (Bell and S-76B) or Dornier-228 (fixed-wing aircraft with capacity of 8 passengers) (Adulyanukosol *et al.*, 1999a). The large assemblage of dugongs was found at Talibong-Muk Islands, Trang Province. The results from overall surveys made in 1997 and 1999 revealed an actual number of 50 and 38 dugongs being seen, respectively. Additional flights were conducted around the

seagrass areas of Sriboya-Cham-Pu Islands, Krabi Province in March 2000 using a microlite (Airbone; microlite with 3 wheels and 64 HP engine) and 6 dugongs including 1 calf were observed (Adulyanukosol, unpublished data).

Gulf of Thailand (Figure 1)

There are few researches conducted on dugong in the Gulf of Thailand. Dugongs used to be found at Kung Krabaen, Chantaburi Province, and Makhampom Bay, Rayong Province, on the east coast of the Gulf of Thailand. (Nateekanjanalarp and Sudara, 1992). Nevertheless, dugongs were occasionally found at Makhampom Bay and Prasea River Mouth, Rayong Province. Dugongs were often seen during feeding on seagrass at Kung Krabaen Bay around December-January. Each year about one dugong is dead by trawler or other fishing operations in Rayong Province. In Trat Province, one and 5 carcasses of dugongs were found in 1996 and 1997, respectively. Recently in Chonburi Province, a dead calf, of about 30 kg in weight, was found at Chong Samae San, in April 1999 and a female calf of 108.5 cm in length was dead in June 13, 2000 at Sattahip Bay (Adulyanukosol, 1999, and unpublished data).

On the west coast of the Gulf of Thailand, a dugong was reported to die causing by trawler at Khanom District, Nakhon Si Thammarat Province in 1996. During 1997-1998, three dugongs died from trawlers at Samui Island, Surat Thani Province. A rotten male dugong was found floating in the sea off Lamae District, Chumporn Province in February 1998 and, in the same year, another freshly dead female was stranded in the same district (Adulyanukosol, 1999).

The living dugongs have never evidently been observed so far: this might be because of their rarity in nature or inadequate survey program. However, on the evidence of dead individuals from several localities in the Gulf of Thailand, as pointed out above, it is believed that a viable population might be established either along the east coast or the west coast of the Gulf of Thailand.

The aerial surveys showed that the diurnal inshore feeding is normal for dugongs living in the Andaman Sea coast. During feeding activities, they ascended to surface for breathing every few minutes. The relationships between mothers and calves were closely observed during the flights using the Polaris Flying Boat, particularly at Cham, Pu and Sriboya Islands in Krabi Province and at Muk-Talibong Islands in Trang Province. The cow-calf pairs were seen together feeding on seagrass, swimming and surface breathing. During surface breathing, calves stayed beside their mothers or on the dorsal of mothers (Adulyanukosol *et al.*, 1997). In an observation during low tide, the dugongs appeared at the distance of about 4-6 km from shore (Adulyanukosol *et al.*, 1999a).

The main problems concerning the aerial survey in Thailand are: 1) the extremely high operating cost, 2) the lack of personnel and 3) a long period for discovering dugong populations. Since a small number of dugongs in Thailand, it might be very difficult to assess the actual number using systematic method such as the fixed-width aerial transect. To conduct aerial surveys using aircraft for long distance area and using helicopter, Polaris Flying Boat, microlite and balloon for survey or studying dugong behavior in specific areas are recommended.

Dugong in captivity

PMBC is probably the first institute in Thailand that had involved in marine mammal work since 1979. Four dugongs had been brought to PMBC during 1979-1982 and 3 of them survived in captivities for 77-153 days. *Halophila ovalis* was the preference-food species for those dugongs among several other offering seagrass species (Boonprakob *et al.*, 1983). PMBC has occasionally received the entangled dugongs since then and the attempts to rearing them in captivities had been conducted by Boonyanate (1994) and Adulyanukosol and Patiyasevi (1994).

The maximum survival-keeping period for a captive dugong was 200 days. Over the period, the dugong consumed mainly *H. ovalis* for 6.7 kg/day in average. It gained 15.5 kg in weight and 2 cm in length during keeping time (Adulyanukosol and Patiyasevi, 1994). Furthermore, the breathing pattern of this captive dugong was observed and shown that the average breathing interval was 102.5 sec/time and the maximum diving time was 480 sec (Adulyanukosol, 1997). The major problems concerning the keeping dugong in captivity were; foods, size and type of enclosures, injuries inflicted during catching and transportation, susceptibility to diseases, and medical treatments (Boonprakob *et al.*, 1983; Adulyanukosol and Patiyasevi, 1994).

Age determination of dugong

Dentinal growth layers group (GLGs) of dugong tusks were examined from 12 stranded animals (6 in each sex) for the purpose of age determination. Body length of the specimens ranged from 1.60-2.73 m, and the tusk length varied from 1.6-21.0 cm. The GLGs counts ranged 1-43 for the female and 2-16 for the males. The oldest female obtained from Ranong Province was 2.71 m in body length and 293 kg in weight. The Von Bertalanffy growth curve was calculated as the following equation; $L = 2.747 (1 - \exp(-0.265 (A + 1.125)))$, where L is body length in m and A is age in year (Adulyanukosol *et al.*, 1998).

Decrease in number

Since 60 years ago, local people in Rayong Province had killed dugongs and consumed their meat as for protein source. The fishermen had to chase the dugongs into shallow water or river mouth and hit them or pierced them with harpoons until they died. In the southern part of the Andaman Sea coast, fishermen used to chase the dugongs into the shallow water together with an operation of enclosing net (Adulyanukosol, 1999).

Dugongs are no more killed for food at present; however, they were occasionally caught in fishing gears. They easily died while being entangled in fishing gears, particularly in various types of gill nets. They generally tried to be free and finally drowned. For the case of being trapped inside a stake trap, they tried to leave, but always got hurt by bamboo and net of the trap and then finally died (Adulyanukosol, 1999).

The dugongs have a maximum longevity of about 70 years and a minimum prereproductive period of 9-10 years for both sexes. A single calf is born after a gestation period of about 13-14 months and estimate of calving interval ranges from 3-7 years (Nishiwaki and Marsh, 1989). Since the low number of dugongs in Thai waters, a small number of new calves may not enough to replace the loss number.

Therefore, the dugongs in Thailand are considered to be critical in danger of extinction.

Analysis of stomach content

Adulyanukosol *et al.* (2000) had studied the stomach contents from 6 stranded dugongs, collected in Trang Province during January 1997- January 1999. Basing physio/morphological characters of leaves and epidermal cells, seagrass fragments were identified down to species under stereo- and compound-microscopes. They reported that nine species of seagrasses were found in dugong stomachs and their biomasses were determined in terms of dry weight. The percentage dry weight of each species (eight out of nine) found in the stomach contents was as follows: *Halodule* (*H. pinifolia* and *H. uninervis*) 0.84-44.99%, *Halophila ovalis* 3.11-29.60%, *Thalassia hemprichii* 3.50-28.69%, *Cymodocea* (*C. serrulata* and *C. rotundata*) 5.06-42.52%, *Syringodium isoetifolium* 0.42-22.39%, and *Enhalus acoroides* 31.76-41.39%. The biomass of *Halophila decipiens* was not determined because of its scarcity.

In addition, algae was found in almost all stomachs but, interestingly, polychaete tube was found in only one stomach in the void of algae. The composition of seagrasses found in dugong stomachs may be affected by the composition presented in dugong's feeding ground. The species of seagrass predominated in stomach contents seemed to coincide with the dominant species found in the seagrass area nearby the places where the stranded dugongs were collected (Adulyanukosol *et al.*, 2000).

CONSERVATION AND MANAGEMENT OF DUGONG

Vision for future

At present, PMBC is a center of marine mammal (dugong, dolphin and whale) research in Thailand. PMBC is preparing to provide a network of marine mammal research and conservation covering all coastal provinces of Thailand. Moreover in future, PMBC plans to extend this network to Southeast Asia region e.g.. Cambodia, Vietnam, Myanmar, Malaysia. The success of these purposes will not happen, if there is a lack of the cooperation among various groups, for instance, government officers, Non Government Organizations (NGOs), and local communities.

Dugong feeding sites will be jointly managed and provide tourism benefits to communities, local governments and the private sector. Some of the following conservation and management strategies are raised after obtaining the basic biological information of dugongs.

For Thailand's dugong and the nation's natural heritage

1. To minimize the fishing gears, which cause harm to dugongs around dugong's feeding ground such as gill nets, fish traps, and illegal fishing operations.
2. To promote certain fishing gears, which do not cause harm to dugongs around dugong's feeding ground such as small traps (fish, squid and crab) and hand lines.
3. To ban the fishing operations, which cause damages to seagrass beds such as power push net fishery.
4. To promote the specific areas as dugong sanctuaries of Thailand such as Talibong-Muk Islands in Trang Province, Sriboya-Cham-Pu Islands in Krabi Province.

5. To promote a network of well-managed marine protected areas, which will conserve key dugong feedings sites through the both coastlines (the Andaman Sea and the Gulf of Thailand).
6. To provide education and to increase public awareness on dugong and seagrass resources conservation.

For communities, government and businesses

1. Environmental tourism will increase, and tourism-related business will grow, as people come to see revived dugong-feeding sites.
2. Communities near dugong feeding sites and habitats will enjoy sustainable economic benefits from both fisheries and tourism.
3. Local governments will command more respect and be strengthened by better enforcement of the laws.
4. The seagrass resources and their biodiversity values will be maintained.

CONCLUSION AND DISCUSSION

Dugongs are rare and confined to some areas of both coastlines of Thailand. In the Andaman Sea, they have been found along the coast from Ranong to Satun Provinces. In the Gulf of Thailand, they have been found in several coastal provinces, namely, Chonburi, Rayong, Chantaburi, Trat, Chumporn, Surat Thani and Nakorn Si Thammarat. Although, the systematic and comprehensive aerial survey on dugong population in Thai waters has not been conducted yet, they are believed to present more in the Andaman Sea than in the Gulf of Thailand.

Dugongs are still found at a substantially high number at Talibong-Muk Islands, Trang Province. This seems likely be the last place in Thai waters where exists the large viable population of dugongs. Thus, it is critically needed to conserve and manage the area. In particular, the fishing practices that might cause violation to dugongs should be either regulated or prohibited in the dugong habitats. Dugongs will soon vanish from Thai waters if conservation strategies of dugong are not succeeded. The recommended areas to be established as the National Dugong Sanctuary are the areas around Talibong –Muk Islands, Trang Province and Sriboya-Cham-Pu Islands, Krabi Province in the Andaman Sea.

REFERENCES

- Adulyanukosol, K. 1995. The status and tendency of declination of dugong population in Thailand. (in Thai). In *Proceedings of the Seminar of the Department of Fisheries in 1995*, Bangkok, Thailand. 385-392.
- Adulyanukosol, K. 1997. Breathing behavior of dugong (*Dugong dugon*) in captivity. (in Thai). In *Proceedings of the Seminar of the Department of Fisheries in 1997*, Bangkok, Thailand. 7 pp.
- Adulyanukosol, K. 1998. Dugong in Thailand. (in Thai). *Phuket Marine Biological Center*. Technical paper. 12 pp.
- Adulyanukosol, K. 1999. Dugong, dolphin and whale. In *Proceeding of the First Korea-Thailand Joint Workshop on Comparison of Coastal Environment: Korea-Thailand*. Sept 9-10, 1999 Seoul, Korea: 5-15.
- Adulyanukosol, K. 2000. Dugong survey in Thailand. In *Proceedings Fourth International Seagrass Biology Workshop*. 26 September-2 October 2000, Corsica, France. 191-194.

- Adulyanukosol, K., M. Amano and N. Miyazaki. 1998. Preliminary study on age determination of dugong (*Dugong dugon*) in Thailand. In *Proceedings of the Fourth International Scientific Symposium*, 2-7 February 1998. Okinawa. Japan. 369-377.
- Adulyanukosol, K., O. Patiyasevi. 1994. Feeding behavior of dugong (*Dugong dugon*) in captivity. (in Thai). In *Report of the Seminar of the Department of Fisheries in 1994*, 386-392. Bangkok, Thailand.
- Adulyanukosol, K., S. Chantrapornsyl and S. Poovachiranon. 1997. An aerial survey of dugong (*Dugong dugon*) in Andaman Coast, Thailand. (in Thai). *Thai Fisheries Gazette*. 50(5): 359-374.
- Adulyanukosol, K., S. Chantrapornsyl, S. Poovachiranon and K. Kittiwattaniwong. 1999a. Report on aerial surveys of dugong along the Andaman coast in 1997 and 1999 using the Royal Thai Navy aircraft. (in Thai). In *Technical Paper of Phuket Marine Biological Center*, Department of Fisheries, Phuket, Thailand. 15 pp.
- Adulyanukosol, K., S. Poovachiranon and P. Na-takuathung. 2000. Analysis of stomach content of dugong (*Dugong dugon*) from Trang Province. (in Thai). *Thai Fisheries Gazette*. 16 pp. (in print)
- Aueng, S., W. Witayasak, R. Lukanawakulra, W. Rearkwisaka and P.S. O'Sullivan. 1993. A survey of dugong in seagrass bed at Changwat Trang. (in Thai). In *Proceedings of the 31st Seminar of Kasetsart University*, Thailand: Kasetsart University, Bangkok, Thailand. 363-368.
- Boonprakob, U., S. Chatrapornsyl and O. Bhatia. 1983. Occurrence of dugong (*Dugong dugon*) in coastal waters of Phuket Island and attempt to keep dugongs in captivity. *A Symposium on Marine Mammals of the Indian Ocean*, 22-25 February 1983, Columbo, Srilanka. 13 pp.
- Boonyanate, P. 1994. An attempt on rearing unweaned dugong (*Dugong dugon*) calves. (in Thai). *Phuket Marine Biological Center*. Technical Paper. No. 1/1994. 11 pp.
- Chatrapornsyl, S. and K. Adulyanukosol. 1994. Occurrence of dugongs (*Dugong dugon*) and the status of the dugong in Thailand. (in Thai). In *Proceeding of the Seminar of the Department of Fisheries in 1994*, Bangkok, Thailand. 380-385.
- Nateekanjanalarp, S. and S. Sudara. 1992. Dugongs and a plan for their management in Thailand. In: L.M. Chou and C.R. Wilkinson (eds.), 1994. *Proceedings, Third ASEAN-Science and Technology Week Conference*. Singapore: Department of Zoology, National University of Singapore. 459-462.
- Nishiwaki, M. and H. Marsh. 1989. Dugong *Dugong dugon* (Müller, 1776). In: S. H. Ridgway and Sir R. Harrison, F.R.S. (eds). *Handbook of Marine Mammals*, Vol 3. 1-31.

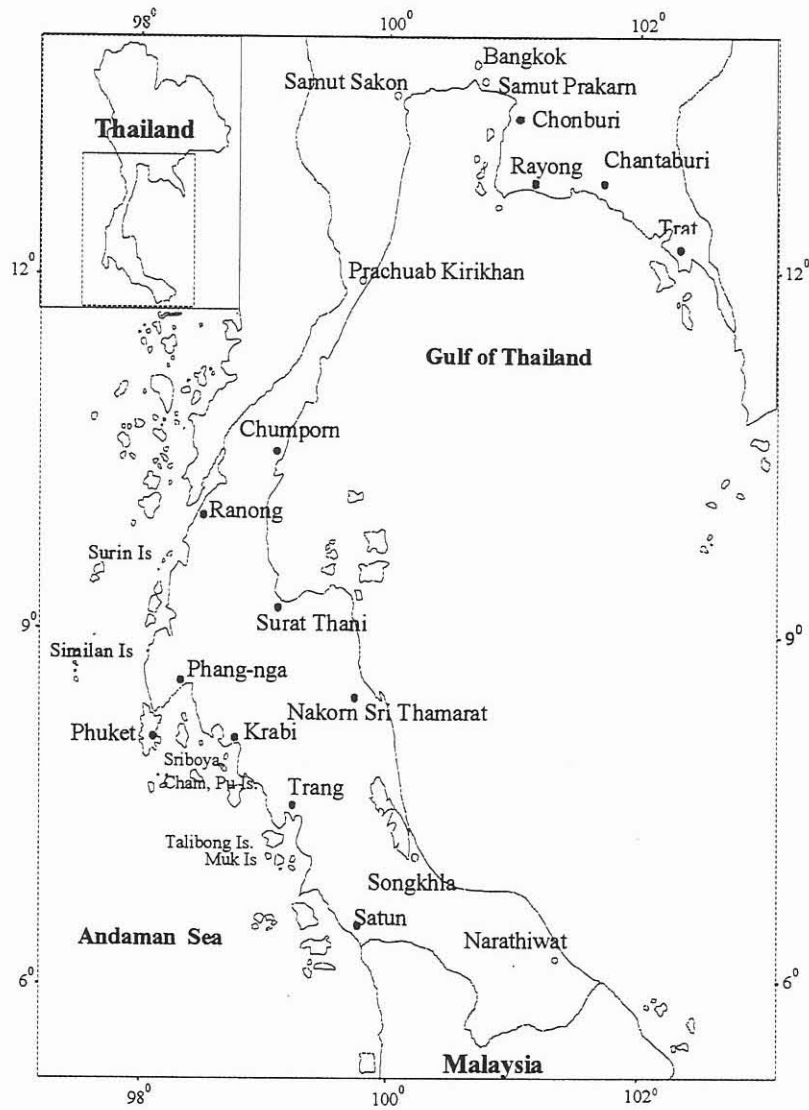


Figure 1. Map of Thailand showing the both coastlines; black circle indicates the province in which dugongs have been found.