

# Observations of the Dugong *Dugong dugon* in Con Dao National Park, Vietnam, and recommendations for further research.

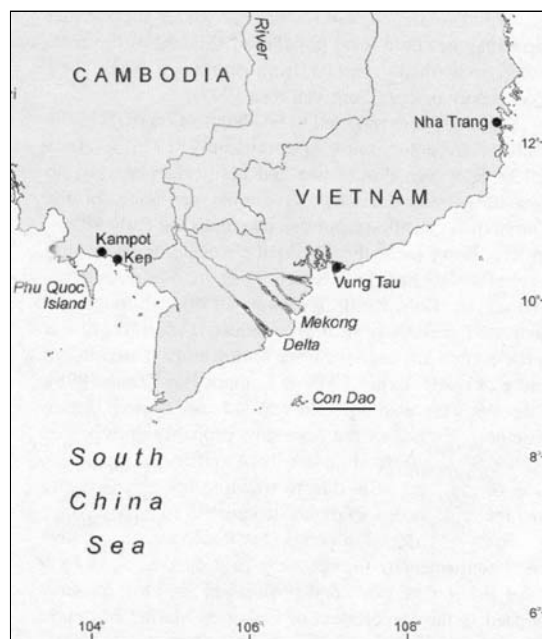
Nick Cox, February 2002

## Introduction

The dugong is perhaps the most endangered sea mammal in Vietnam. There are few scientific records available about the distribution, abundance and ecology of dugongs in Vietnam. Con Dao archipelago in southern Vietnam, is the only location in the country where dugongs are regularly seen. The scientific staff of Con Dao National Park only confirmed the existence of dugongs in Con Dao waters in 1995 (reported by Lang Van Ken, 1997), despite seven specimens having been caught in Con Dao almost twenty years previously and subsequently examined by Van Bree and Gallagher (1977). Recent seagrass surveys in the coastal waters of Phu Quoc Island (Figure 1.) recorded several apparent dugong feeding trails (Hoa pers. comm.), and evidence of the existence of dugongs around Phu Quoc is supported by reports of locally caught dugong meat being sold openly in markets (Giang pers. comm.). Results from local fisher surveys conducted in Cambodia suggest the existence of a dugong population around Kep and Kampot, near to the Vietnamese border and Phu Quoc island (Beasley *et. al.*, 2001).

Local fisher interviews conducted in October 2000 in Con Dao (Cox, unpublished) revealed that dugongs were seen much more regularly and in greater abundance 10-25 years ago than they are now. Whilst it appears that dugongs were often hunted specifically for meat and medicinal purposes, dugongs caught now, are done so accidentally, and mortality is presumably as a result of drowning in nets. Nine dugong carcasses were recorded in Con Dao between 1997 and 2000.

The results of this study add important information about this species to the sparse information currently available, and recommend further research required particularly for Vietnam and neighbouring countries.



**Figure 1.** Location map for southern Vietnam and Cambodia. (adapted from Marsh *et. al.* 2001)

## Study Site

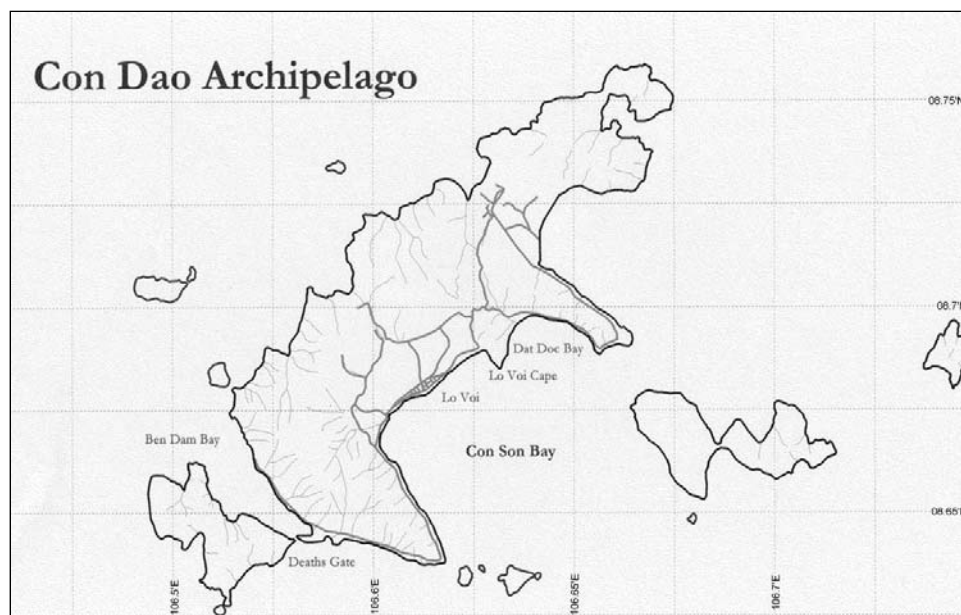
The study area consists of a number of small sheltered bays within the Con Dao archipelago (8°34' - 8°49'N, 106°31' - 106°45'E), located approximately 85km south-east of mainland Vietnam in the South China Sea. The group of 14 islands is characterised by a mountainous landscape, is largely forested and fringed with coral reefs and small patches of Mangrove forest. Con Dao National Park protects 80% of the total land area, including 5,998 ha of forest, 14,000 ha of sea and an additional sea buffer zone of 20,000ha. The present study was undertaken in three sites in Con Son Bay (Figure 2.), although predominantly in Dat Doc Bay.

The climate in Con Dao is strongly influenced by the monsoon seasons. The wet season occurs between May and November, coinciding with the south-west monsoon. The dry season is characterised by strong winds from the north-east, particularly in January and February, which cause rough seas and poor visibility. Sizeable inter-tidal and sub-tidal seagrass beds occur in four sites in Con Dao with a total of nine species recorded, dominated by *Halophila ovalis* and *Halodule uninervis*.

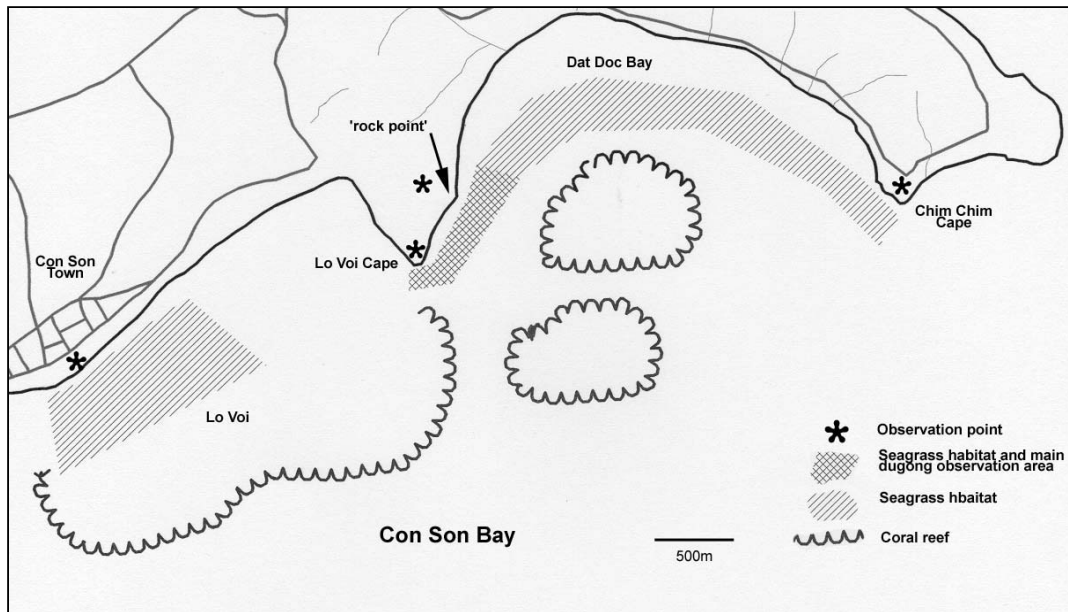
## Methods

### *Dugong surveys*

Dugongs were observed during November 2001 – January 2002 from a number of elevated hillside vantage points. One site in particular, Lo Voi Cape (Figure 2.), was frequently used to observe dugongs. A number of sites were selected on the cape ranging from 15m to 150m above mean sea level (a.m.s.l), depending on the time of day and therefore the effect of sunlight on the surface of the water. Observations were made with unaided sight and aided sight using 10x50 binoculars mounted on a tripod for long-range observations. Lo Voi Cape overlooks Dat Doc bay, which is largely protected from large waves by a series of small patch reefs (Figure 3.). The seagrass beds here are largely sub-tidal, extending from very near to more than 1km from the shore, and ranging from 3m to 10m in depth, and covering an area of more than 100ha. Patches of seagrass are also found adjacent to the coral reefs, however, observation effort was concentrated on seagrass patches totalling no more than 50 ha and within 400m of the shore.



**Figure 2.** Map of Con Dao archipelago



**Figure 2.** Map showing study site.

On spotting dugongs at the water surface, notes were taken on the period of time the animal spent at the surface (surface time), the time spent submerged between successive surfacings (submerged time), and also on the behaviour of the dugong at the surface including the number of breaths taken (recorded as the number of times the nostrils were seen above the surface – often aided by an accompanying water spray as the nostrils opened). Submergence times were recorded from the last breath taken at the surface to the first breath immediately after a subsequent submergence period. If the dugong was in shallow water, notes were also made on behaviour under the water surface. Additional notes were made on weather and tidal conditions. Free-ranging dugongs were observed on 13 separate days in November 2001, 7 days in December 2001 and 9 days in January 2002, out of a total of 37 days spent observing. On 5 separate days attempts were made to approach dugongs by snorkelling.

### ***Seagrass assessment***

Transect surveys were conducted in Dat Doc Bay and Lo Voi in order to assess seagrass species composition and density of dugong feeding trails. Line transects were set out, perpendicular to the shore and at approximately 50m intervals.

## **Results**

Table 1. lists the dugong observations made during November 2001 – January 2002. A summary of all observations of dugong individuals made in Lo Voi and Dat Doc bay is presented below.

Thirty-three free-ranging dugongs were observed in Lo Voi and Dat Doc Bay between November 2001 and January 2002. Dugongs were seen during morning and afternoon observation periods and at both high and low tide. Dugongs were observed feeding in seagrass beds ranging from 3m to 10m in depth. Seagrass beds in Lo Voi and Dat Doc Bay were mainly composed of 3 species: *Halophila ovalis*, *H. minor*, and *Halodule uninervis*. No dugong feeding trails were observed in either Lo Voi or Dat Doc Bay.

On several occasions, mother and calves were seen together and in each case the behaviour of the juvenile dugong was observed rather than the adult. On one occasion 3 dugongs were seen together.

Only two attempts were made to observe dugongs from a small boat due to poor weather conditions during the majority of the survey period, though one individual was seen ‘rolling’ (as described by

Anderson and Birtles, 1978) at the surface 15m off the boat's bow during one of the two days spent on a boat.

### **Surfacing and diving behaviour**

On most occasions, dugongs were seen rising to the surface almost horizontally (as described by Anderson and Birtles, 1978) and with either the nostrils raised clear of the water before any other part of the body or soon after the back or head was seen (Plate 1.). Often, water spray was seen above the nostrils following an exhalation, and this helped with the recording of submergence times. For observation periods where more than 10 consecutive dives were recorded for an individual dugong, a total of 264 dives were timed. The mean submergence time was 4.2 ( $\pm 1.09$ ) minutes, ( $n = 15$ ), and surface time ranged from 2 seconds to more than 8 minutes, and number of breaths from 1 to 5 breaths. The longest surface times and highest number of breaths was often observed during the rising tide as dugongs drifted along in the current around Lo Voi Cape to enter the seagrass beds in front of the coral reef in Lo Voi.

There was a marked difference between submergence times at high tide as compared to low tide: 5.0 ( $\pm 0.6$ ) minutes, and 2.4 ( $\pm 0.2$ ) respectively (Table 3.). No significant difference was observed for submergence times between adults and juveniles.

On several occasions, and particularly when weather conditions were good for making several observations over a long period, a pattern of surfacing behaviour emerged. A number of successive surfacings were made by a dugong individual where only one breath was taken followed by an arching, or rolling of the back and a head-first dive (sometimes accompanied with a tail flick – the tail flukes seen clear of the surface). Then followed one or two surfacings whereby the dugong appeared to rest at or just below the surface taking two or more breaths before submerging to continue feeding (Plate 2.).

### **Non-feeding activity**

The observation point on Lo Voi Cape at 150m elevation provided an excellent view of the nearshore seagrass beds, and also allowed for the observation of dugongs swimming below the surface near to location referred to as 'rock point' (Figure 2.). On two occasions dugongs were seen in water as shallow as 1m, approaching the beaches to the left and right-hand-side of the rock point. During the first occasion two similarly sized dugong juveniles were observed chasing each other at swimming speeds considerably faster than normal, nudging one another with their heads. A second event involved a dugong adult spinning along its length whilst swimming forwards in the shallow surf. Clearly visible on this dugong were large fish that were attached to the dugong's flanks mid-way between the flippers and tail.

In response to the approach of swimmers (using snorkels and fins), dugongs swam out of the study area after only a few minutes after water entry. Attempts were made on several separate days to approach dugongs using spotters on the shore to guide swimmers to the last location the dugong was seen. On more than one attempt, an area of disturbed sand was seen where the dugong had just been feeding, the hurried response of the dugong disturbing more sand and so leaving a cloud of sediment and seagrass fragments suspended in the water.

**Table 1.** Summary of observations of dugong individuals. \* Obs. = Number of observations of the same individual. \*\* = Average surface interval (time between subsequent surfacings), DD = Data Deficient. \*\*\* Tide = ↑HT – Rising tide, ↓LT – Ebbing tide, HT – within 2 hours of high tide, LT – within 2 hours of low tide

No.	Date	Time	Obs.*	Site	Adult/ Juvenile	Remarks	Surface interval (mins) SD=1.1**	Weather	Tide***
1	7/11/01	10:18	1	Co Dong			DD	Choppy sea	
2	12/11/01	09:18	38	Dat Doc/Chim Chim	Adult	Diving head first, tail out of water	5.3	Calm	HT
3	13/11/01	09:44	8	Dat Doc/Chim Chim	Adult	As above, 100m-400m from shore	4.5	Dead calm	HT
4	14/11/01	10:02	5	Dat Doc/Chim Chim	Adult	Full body at surface	DD	Dead calm	↑HT
5	15/11/01	14:31	14	Lo Voi	Adult	Arched back, <50m from shore	5.1	Slight swell	HT
6	16/11/01	10:51	1	Dat Doc/Chim Chim	Adult		DD	Strong swell	LT
7	16/11/01	15:24	3	Lo Voi	Adult		4.3	Choppy	HT
8	21/11/01	09:21	1	Dat Doc/Chim Chim	Juvenile	3 breaths at surface	DD	Slight swell	LT
9	22/11/01	08:15	5	Dat Doc/Chim Chim	Adult	500m from shore	DD	Calm	↓LT
10	24/11/01	09:05	4	Dat Doc/Chim Chim	Adult		DD	Choppy	↓LT
11	26/11/01	14:52	1	Dat Doc/Chim Chim	?		DD	Rough sea	LT
12	28/11/01	10:03	30	Mui Lo Voi	Juvenile	15m-50m from shore (rock point)	5.0	Slightly choppy	↑HT
13	29/11/01	11:19	13	Mui Lo Voi	Juvenile	30m-250m from shore (rock point)	5.1	Small waves	↑HT
14	30/11/01	12:09	3	Mui Lo Voi	Juvenile	15m from shore, drifting in current	4.7	Small waves	↑HT
15	30/11/01	15:10	1	Lo Voi	Adult	50m from shore (opp. Hospital)	DD	Choppy sea	HT
16	1/12/01	12:00	5	Mui Lo Voi	Juvenile	25m from shore, scared by divers	DD	Choppy sea	↑HT
17	1/12/01	15:00	6	Lo Voi	Adult	20m from shore	DD	Choppy sea, poor light	HT
18	2/12/01	15:00	4	Lo Voi	Adult	15m from shore, scared by divers	DD	Choppy sea, poor light	HT
19	3/12/01	13:25	9	Mui Lo Voi	Juvenile	20m from shore, near rock point	2.8	Small waves	↑HT
20	3/12/01	16:25	1	Lo Voi	?	30m from shore (opp. Hospital)	DD	Small waves	HT
21	4/12/01	10:48	4	Mui Lo Voi	Juvenile	Drifting in current	DD	Calm	LT
22	29/12/01	10:52	29	Mui Lo Voi (150m)	Adult + Juvenile	15m from rock point	2.2	Rough sea	↑HT
23	31/12/01	10:34	22	Mui Lo Voi (150m)	Juvenile	5m-50m from shore	4.4		
24	2/01/02	12:36	39	Mui Lo Voi (150m)	Juvenile	10m from rock point	2.7	Choppy sea	LT
25	3/01/02	13:04	39	Mui Lo Voi (150m)	Juvenile	30m from shore	2.4	Choppy sea	LT
26	4/01/02	14:26	16	Mui Lo Voi (150m)	Juvenile	25m from rock point	4.0	Small waves	↑HT
27	6/01/02	15:13	11	Mui Lo Voi (rock point)	Juvenile	20m from rock point	2.2	Choppy sea	LT
28	10/01/02	09:47	1	Mui Lo Voi (60m)	?	30m from rock point	DD	Choppy sea	LT
29	11/01/02	10:11	3	Mui Lo Voi (60m)	Adult	Near rock point, longest at surface – 7.5 minutes	DD	Choppy sea	LT
30	14/01/02	11:35	1	Boat. Lo Voi – outer reef	?	15m from bow of boat – arched back	DD	Rough sea	LT
31	15/11/02	15:35	13	Mui Lo Voi (150m)	Juvenile	150m from rock point	5.9	Small waves	HT
32	17/11/02	15:31	8	Mui Lo Voi (150m)		30m from rock point	4.0		↑HT
33	28/11/02	14:30	3	Lo Voi	Adult	25m from shore	DD	Choppy	HT

**Table 2.** Mean duration of submergence for individual dugongs timed for 10 or more consecutive dives

Date	Number of Dives	Mean duration (mins)	Tide
12/11/01	38	5.3	High
15/11/01	14	5.1	High
28/11/01	30	5.0	High
29/11/01	13	5.1	High
31/12/01	22	4.4	High
02/01/02	39	2.7	Low
03/01/02	39	2.4	Low
04/01/02	16	4.0	High
06/01/02	11	2.2	Low
15/01/02	13	5.9	High

**Table 3.** Comparison of mean durations of submergence for individual dugongs at high and low tide

Mean duration at high tide (mins)	Mean duration at low tide (mins)
5.0 ( $\pm$ 0.6)	2.4 ( $\pm$ 0.2)



**Plate 1.** Horizontal surfacing of dugong in Dat Doc Bay.



**Plate 2.** Typical dugong surfacing, and submerging sequence.

## Discussion

Insufficient data was recorded to enable comparison between submergence times of dugongs feeding in deep water (up to 12m) and submergence times in shallower water (1-4m), although there may be other factors involved, such as seagrass cover (see below). However, there appears to be an affect of tides on submergence times with dugongs appearing to prefer making more frequent surfacings at low tide compared to high tide.

The mean submergence time of 4.2 minutes compares favourably with observations recorded in Indonesia by de Iongh *et. al.* (1997) of 4.6 minutes, surveys that were also done in deeper water up to 9m depth, compared to observations made in shallow water up to 3m in Australia by Anderson and Birtles (1978) who recorded an average submergence time of 1.2 minutes. This supports the suggestion by de Iongh *et. al.* (1978) that submergence time correlates with the depth of the seagrass bed.

No dugong feeding trails were recorded during the current study period, and although *Halophila ovalis* was observed to be the dominant species, *Halodule uninervis* was observed to be more abundant than had been recorded during previous surveys undertaken by researchers from Nha Trang Institute of Oceanography (NTIO) over the last 5 years. No estimates of % cover were made, however it is the author's impression that seagrass composition and abundance changes significantly according to season, and lack of observed dugong feeding trails may well be due to reduced seagrass cover. Reduced seagrass cover may also explain longer submergence times (even in shallow water up to 4m deep) if dugongs are forced to stay submerged longer in order to gather sufficient seagrass during one submergence.

The observed response of dugongs to the attempted approach by swimmers may simply be due to natural shyness. Alternatively, the frightened response may be the result of a number of previous disturbing encounters with local fishing boats and perhaps fishing nets. If the population in Con Dao is a relic population, with perhaps as few as 10 individuals, it is quite feasible, this author believes, that the dugongs in Con Dao may have had stress-inducing episodes in the past – episodes that may have caused long term psychological damage, though further research is required however.

An alternative to the hypothesis that the dugong population in Con Dao is a relic population, is that the dugongs seen in Con Dao are in actual fact part of a meta-population of dugongs moving between other seagrass habitats in coastal waters of other Vietnamese provinces and Cambodia and Thailand. This gives more hope to the prospect of the dugong's long term survival in south-east Asia, particularly if concerted and collaborative conservation efforts between neighbouring countries can formulate an action plan to conserve the dugong outside of its Australian stronghold.

## Recommendations for further research

- 1). Long term study of dugong population in Con Dao in association with seasonal changes in seagrass composition and abundance. Construct portable viewing platforms for erection in subtidal seagrass beds in Lo Voi and on Lo Voi Cape. This would be an ideal study for a Vietnamese Masters or PhD student with support from an institution such as the NTIO.
- 2). Research into the possibility of stabilising slopes adjacent to Con Dao's roads in an attempt to reduce soil erosion during heavy rains.
- 3). Surveys in other known seagrass habitats in Vietnam, including Phu Quoc island, and Nha Trang.
- 4). Local community interviews in other Vietnamese coastal provinces.
- 5). Collaboration with Cambodian and perhaps Thai authorities on transboundary dugong conservation initiatives.

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