

**CONSERVATION OF THE DUGONG (*DUGONG DUGON*) ON THE  
EASTERN COAST OF THE GULF OF THAILAND (THAILAND &  
CAMBODIA)**

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## Abstract

The dugong (*Dugong dugon*) is an example of a marine mammal whose survival is critically endangered by the proximity of its habitat to nearshore human settlements. Outside of Australia, the country with the largest estimated dugong population, dugongs only survive in fragmented population groups in the Eastern hemisphere. Neither the number of dugongs remaining in these groups nor the range of its habitat is known outside of incidental sightings and the reports of fishers (Marsh *et al.* 1999). This project was the continuation of research in 2003 to locate dugongs and assess the numbers of animals and the location of population groups along the eastern Gulf of Thailand in both Thailand and Cambodia. Based on the results of the 2003 research, we carried out aerial surveys, concentrating our efforts in Rayong, Chanthaburi, and Trat provinces in Thailand. Based on consultation with scientists from the Department of Fisheries in Phnom Penh, we chose various research sites along the coast of Cambodia. In Thailand two interview teams were formed that included the principal investigators as well as personnel from Phuket Marine Biological Center in Phuket, and the Eastern Marine and Coastal Resources Center in Rayong. These teams conducted 160 interviews with local villagers. We documented seagrass bed locations from aerial surveys, and in Trat, we used spot sampling to determine species of seagrass in the areas that dugongs were sighted. From the aerial surveys in Rayong we saw a daily minimum of 0 dugongs and a maximum of 8, including 5 calf sightings. In Trat, we saw a daily minimum of 0 dugongs and a maximum of 7, with no sightings of calves. We also saw Irrawaddy dolphins in groups of up to 30, with a minimum of 16 animals seen in one day to a maximum of 73. During four days of aerial surveys in Cambodia we saw dolphins near Koh Kong, but no dugongs. We conducted 42 interviews with villagers in two areas along the coast. In Trat especially, we recommend immediate consideration of coastal management strategies to protect what we believe to be a hot-spot of coastal biodiversity. In Cambodia we recommend that research and interviews be continued, as well as, in collaboration with the Cambodian government and local NGO's, an exploration of alternative non-destructive fishing methods and the initiation of an education campaign based on conservation of marine wildlife and the near-shore environment.

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#### **List of Collaborating Researchers or Institutions**

- In Thailand:
  - Phuket Marine Biological Center: Kanjana Adulyanukosol, Marine Biologist
  - Eastern Marine and Coastal Resources Center (Mannai Station): Mickmin Charuchinda, Director
- In Cambodia:
  - Department of Fisheries
    - Mr. Phay Somany
    - Mr. Leng Sam Ath
  - Wildlife Conservation Society

#### **Background**

The dugong (*Dugong dugon*) is an example of a marine mammal whose survival is critically endangered by the proximity of its habitat to nearshore human settlements. Outside of Australia, the country with the largest estimated dugong population, dugongs only survive in fragmented population groups in the Eastern hemisphere. Neither the number of dugongs remaining in these groups nor the range of its habitat is known outside of incidental sightings and the reports of fishers (Marsh *et al.* 1999). In

Thailand, the endangerment of the dugong is a matter of concern to scientists and the government; the dugong has been under Federal protection since 1947 (Humphrey and Bain 1990). In Cambodia there is currently no legislation protecting marine mammals (Marsh *et. al.* 2002). The IUCN classifies the dugong as vulnerable on a global scale based on declines in occurrence and quality of habitat, and human exploitation (Hilton-Taylor 2000). The Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) has banned international trade in dugong products.

In the recent Dugong Status Report, compiled by Marsh *et. al.* (2002) for the World Conservation Union (IUCN) and the United Nations Environmental Programme (UNEP), it was noted that no recent dugong research had been conducted in the Gulf of Thailand. Estimates by various researchers suggested that less than 50 animals remained in the Thailand Gulf. For Cambodia, dugongs were projected to be extinct near the Thailand border, and potentially present along the southeastern coast near Vietnam (Figure 1).

Research by Hines and Adulyanukosol in the eastern Gulf of Thailand in January of 2003 has shown there to be larger numbers of animals than previously thought, and in particular, a group of up to 30 dugongs was seen close to the border of Cambodia. In eastern Cambodia, near the Vietnam border, preliminary interviews by Hines, Adulyanukosol, Somany, Sam Ath, and Cox in the summer of 2002 showed that dugongs are sporadically found in fishing nets, and their body parts are sold for a relatively large profit. From interviews in Phu Quoc Island, a Vietnamese island close to the Cambodian coast, we learnt that dugongs are regularly found and hunted, again for high profits.

Fishers in Phu Quoc mentioned that dugongs were found along the eastern coast of Cambodia.

### Objectives of Research

The overall goals of this research were to assess the present distribution and population of dugongs and their habitat on the eastern coast of the Gulf of Thailand, in Rayong, Chanthaburi, and Trat provinces in Thailand, and along the Cambodian coast (Figures 1 and 2), and to provide recommendations on the management and conservation of dugongs in both countries. We also interviewed villagers to collect information about the way of life of the dugong and its role in the lives and history of local people.

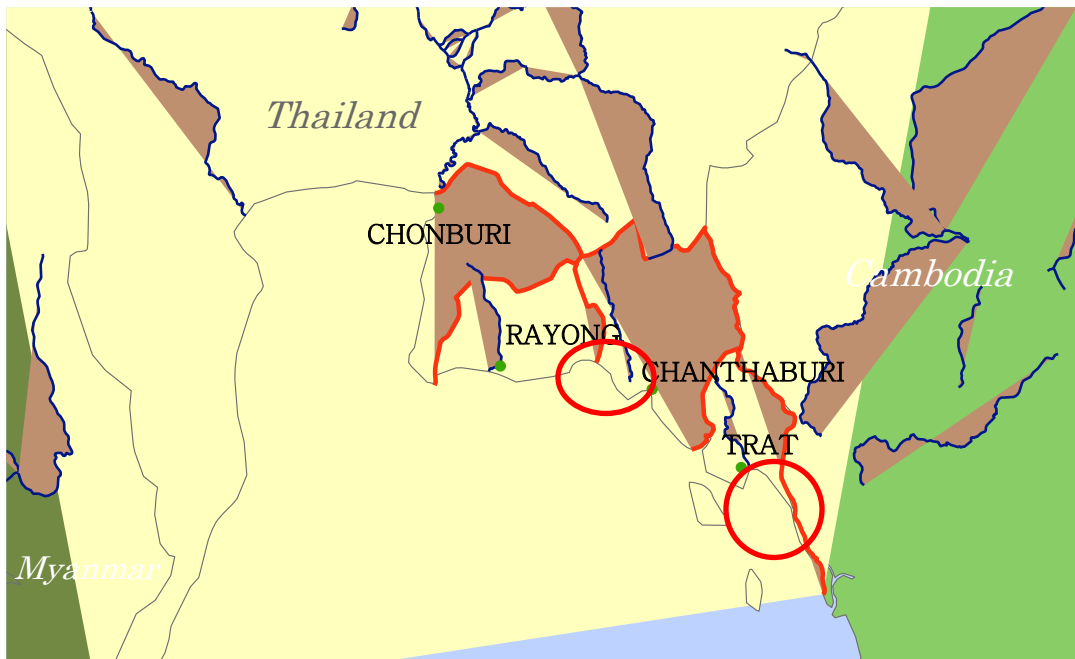


Figure 1. Field sites on the eastern side of the Gulf of Thailand in Thailand: Rayong, Chanthaburi, and Trat provinces.

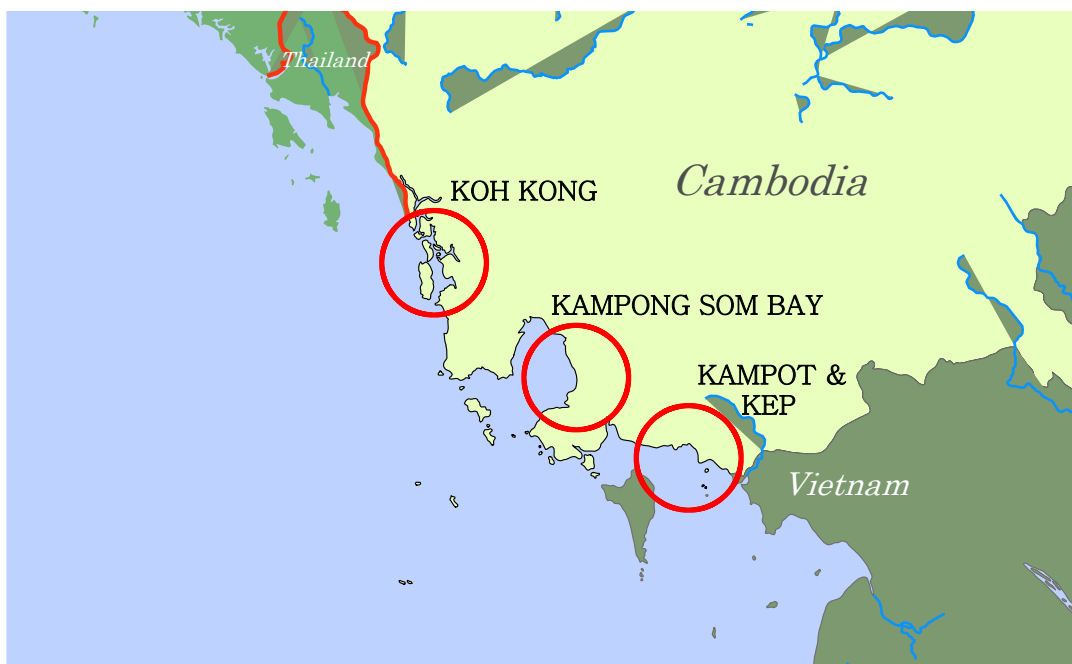


Figure 2. Field sites on the eastern Gulf of Thailand in Cambodia.

### Research Methods

In 2000 and 2001, the principal investigators created and implemented a repeatable and practical field protocol to provide baseline information and monitor populations of dugongs along the Andaman coast of Thailand (Hines 2002, Hines *et al.* in revision), and in 2003 along the eastern Gulf coast of Thailand (Hines *et al.* 2003). This year in Thailand and Cambodia we divided the methods into five parts, beginning with 1) aerial surveys using an ultralite (Zenair CH701) (Thailand) and a Cessna 206 (Cambodia) to find and assess the numbers of dugongs that remain on the coast, 2) interviews with villagers living close to dugong habitat areas to ask about their history of association with dugongs, patterns of dugong populations in their areas, and their opinions on dugong and seagrass conservation, 3) dugongs are wholly dependent on the presence of particular species of seagrass as their food source; therefore, our third objective was the assessment of species and cover in seagrass beds in this region, 4) to design a prototype database and

mapping system around this species that includes the ability to update the baseline and future monitoring of the regional ecosystem, local cultural and ecological knowledge, and species data, and 5) to provide output that is accessible to the needs of scientists, managers, educators, and the local community.

The areas upon which we concentrated our aerial survey efforts and interviews were selected in Thailand based on the results of our research in 2003 (Hines *et al.* 2003). In Cambodia, we concentrated our research efforts on areas suggested by our collaborating Cambodian scientists, Mr. Phay Somany, and Mr. Leng Sam Ath, from previous interviews that were conducted in eastern Cambodia during the summer of 2002, and from consultations with seagrass scientists at the Cambodian Department of Fisheries in Phnom Penh.

## RESEARCH METHODS IN THAILAND

### Aerial Surveys

We used an ultralite aircraft for our surveys from two locations, a small private airport in the eastern part of Rayong province, and a military airport close to Trat city.

As described in Hines (2002), we chose strip, or fixed-width transect surveys. To reduce the variance between the number of sightings found on transect lines, the transect lines should ideally be placed parallel to the density gradient of the distribution of the group of animals (Yoshida *et al.* 1997). Dugongs are generally found in more shallow waters, and while feeding will be in waters at most 11-12 meters deep, based on the distribution of seagrass (Reynolds & Odell 1991). Therefore, the density gradient is most



probably perpendicular to the shoreline and we placed the transect lines in that approximate aspect as well.

We used bathymetric maps from the Hydrographic Department of the Royal Thai Navy to plan the path and bearing of each transect for the various areas. We designed a zigzag pattern in order to equalize the effort on all parts of the transect line (Dahlheim *et al.* 2000, Buckland *et al.* 1993). Transects were flown at a predefined interval of between 400 and 500 meters, at aspects perpendicular to shore. In this part of the coast, the tidal amplitude is negligible (Tide Tables, Hydrographic Department, Royal Thai Navy 2004), and did not influence the timing of our surveys. Instead, we generally flew surveys in the morning to avoid afternoon winds and afternoon glare. We flew one afternoon flight each in both Rayong/Chanthaburi and Trat as an extra control. The ultralite flew at an average height of 152.4 meters, and an average speed of 60.8 knots. Table 1 shows the area of the sampling strata, and the length of transects. Figure 3 shows the sampling blocks and transect paths.

Table 1. Areas of sampling strata, and lengths of strip transects.

Area	Area (km <sup>2</sup> )	Length of Transect (km)
Rayong/Chanthaburi	398.37	302.436
Trat	386.88	388.79

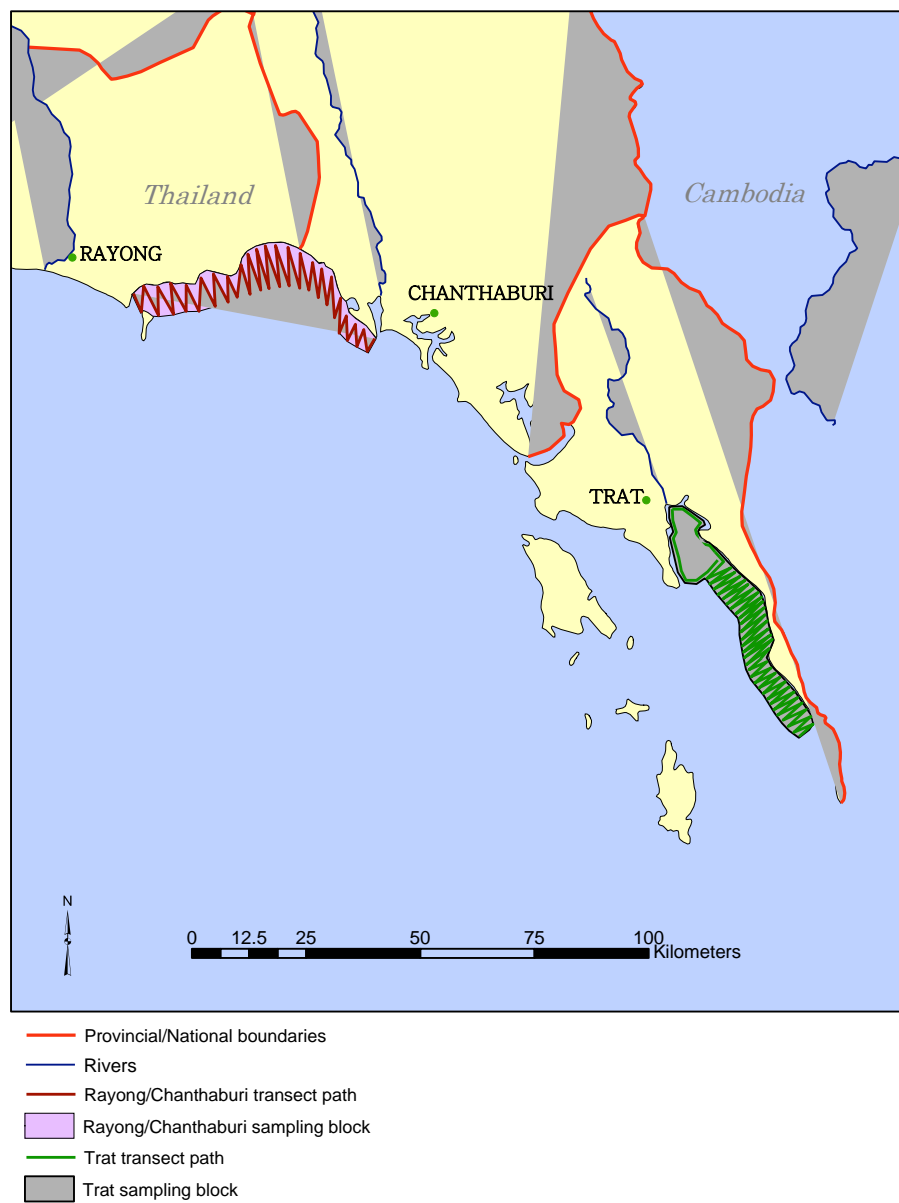


Figure 3. Sampling blocks and transect paths for aerial surveys in Rayong, Chanthaburi, and Trat provinces.

### **Seagrass Surveys**

The second objective of this study was to determine the distribution and species of seagrass beds considered to be suitable habitat for dugongs. We surveyed the general location of seagrass beds in Rayong, Chanthaburi, and Trat provinces from the ultralite. In Trat province, Mr. Potchana Boonyanate, a seagrass scientist from the Eastern Marine and Coastal Resources Center in Rayong, and his team, used spot sampling in transects along the coast south of Trat Bay to determine the species and percentage of seagrass coverage in the area. The area of sampling concentration was based on the locations of dugongs seen in the 2003 surveys (Hines *et al.* 2003).

### **Interview Surveys**

The third objective was to determine the cultural and economic importance of the dugong both currently and historically in the fishing villages that border dugong populations. Especially in more remote areas, interviews are also a way to identify areas that presently or in the past have supported dugongs, and to assess dugong populations. Another advantage of interviews is that further research can be based on new information gained from interviews (Silva & Araújo 2001, Perrin *et al.* 1995, Marsh & Lefebvre 1994, Chambers *et al.* 1989). The interview was also used here as an opportunity to disseminate information on the importance of conserving the dugong and seagrass beds in an area (Marsh & Lefebvre 1994, Hudson 1981).

Interview locations this year were planned to increase our concentration where we had seen dugongs in 2003; in eastern Rayong and throughout Chanthaburi provinces, as well as along the strip of Trat province near the Trat border. Interview respondents were chosen using several methods. In some areas the teams had contact names supplied by

local Non-Governmental Organizations (NGOs), local government representatives, or other connections. We also sought to interview the heads of villages as key informants, or a person whose role in the community exposes them to the type of information being sought (Tremblay 1982). Sometimes the heads of villages or contacts within the area also recommended people to talk with. We went to stores and restaurants where people gather, and also walked through villages and stopped at houses with nets outside. We purposely tried to mix ages and genders in choosing interview respondents whenever possible. While a more random sample of interview respondents would have been optimal, we were dependent on the limited availability of the villagers.

The interview questionnaires themselves were adapted from Hines (2002), and are in Appendices I and II of this report in English and Thai respectively. The content of the interview questions was initially based on a questionnaire survey done by Chambers *et al.* (1989). Questions in the interviews addressed the history of interactions with dugongs, also knowledge of legends or stories or beliefs. We also asked about temporal and seasonal patterns of dugong sightings (also including sightings of whales, dolphins, and marine turtles). In other questions we inquired about past or present hunting, and sources and levels of dugong mortality. We questioned the villagers about their opinions regarding threats to dugongs, the importance of conserving dugongs and seagrass, and designating areas off-limits to fishing to conserve dugongs, seagrass, and mangroves (Marsh & Lefebvre 1994). As in previous surveys (Hines 2002, Hines *et al.* 2003), we also asked villagers about their use and/or knowledge of the consumption or sale of dugong body parts as medicine or amulets.

## RESEARCH RESULTS IN THAILAND

### Aerial Surveys

We conducted ultralite surveys on nine days between the 3<sup>th</sup> and 11<sup>th</sup> of January, 2004. As shown in Figures 4 and 5, we concentrated our efforts in two areas: From Laem Thian Bay to Makhampom Bay past the Prasae and Phangrat River Mouths to Khao Bo Toei in Rayong and Chanthaburi provinces (Figure 4), and from Muang Trat Bay down the coast of Trat province to the village of Khlong Yai (Figure 5). All sighting sheets are included in Appendix III.

#### *Rayong and Chanthaburi*

In Rayong and Chanthaburi, we saw a daily minimum of 0 dugongs, and maximum of 8, including a total of 5 sightings of calves during 4 transects. The average sighting per day was 3.00 dugongs, with a standard deviation of 3.83. Here we had a total of 7 separate sightings. The largest group size was of 2 animals, which were always cow/calf pairs (71% or 5 times). Maps of sightings for January 4<sup>th</sup> and 6<sup>th</sup> are in Figures 6 and 7 (no dugongs were seen on January 5<sup>th</sup>). We also had 1 sighting of a sea turtle, but were unable to determine the species.

#### *Trat*

In Trat, the minimum number of dugongs seen on a given day was none, and the maximum 7, with 1 sighting of calves during 5 transects. The average daily sighting was 2.00 dugongs per day, with a standard deviation of 1.56. In Trat we had a total of 6 separate sightings. We saw a group of 3 adults with a calf one time, a group of 2 adult dugongs once, and had 4 sightings of single adult dugongs. Sighting distribution maps for dugongs are in Figures 9 through 11 (dugongs were seen on January 7<sup>th</sup>, 8<sup>th</sup>, and 11<sup>th</sup>).

Other animals we saw included 5 sea turtles of undetermined species and Irrawaddy dolphins (*Orcaella brevirostris*). The minimum number of dolphins seen was 16 and the maximum 71. The average daily sighting per day was 44.40 and the standard deviation 20.67. We had a total of 37 sightings, including 12 sightings of calves. Group size minimum was 1 and the maximum group seen was 30 animals. Figure 12 is a histogram of dolphin group distribution. Maps of dolphin sightings are in Figures 13-17.



Figure 4. Extent of aerial surveys in Rayong and Chanthaburi provinces.

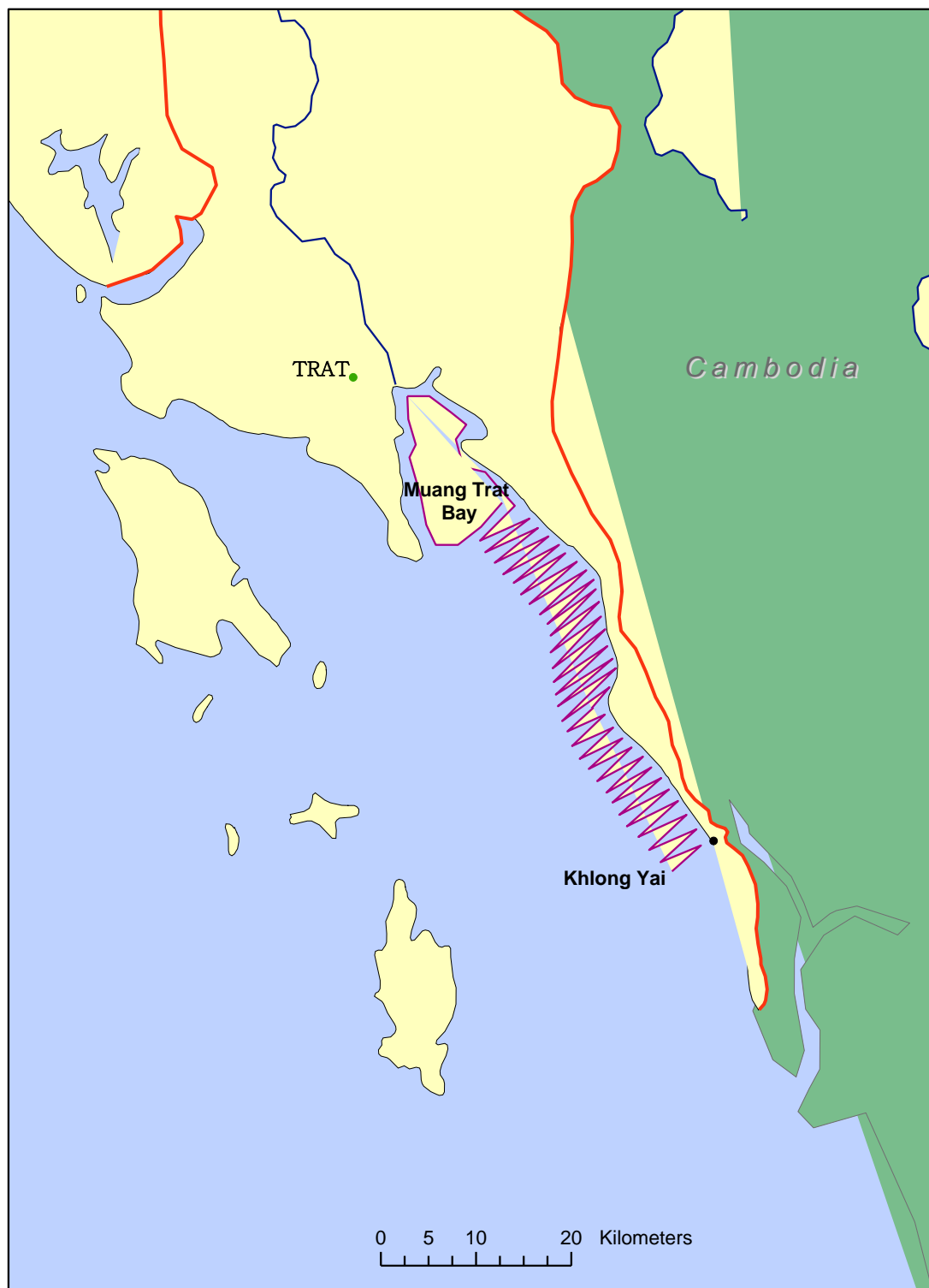


Figure 5. The extent of aerial surveys in Trat province in 2004



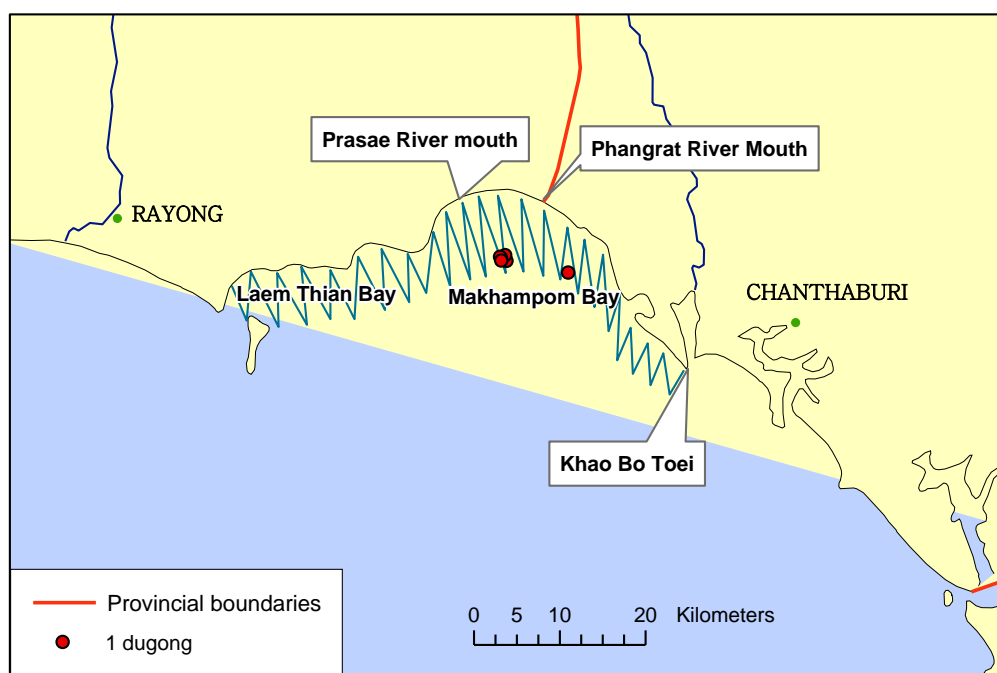


Figure 6. Sightings of locations and group numbers of dugongs seen in Rayong and Chanthaburi provinces on January 4, 2004.

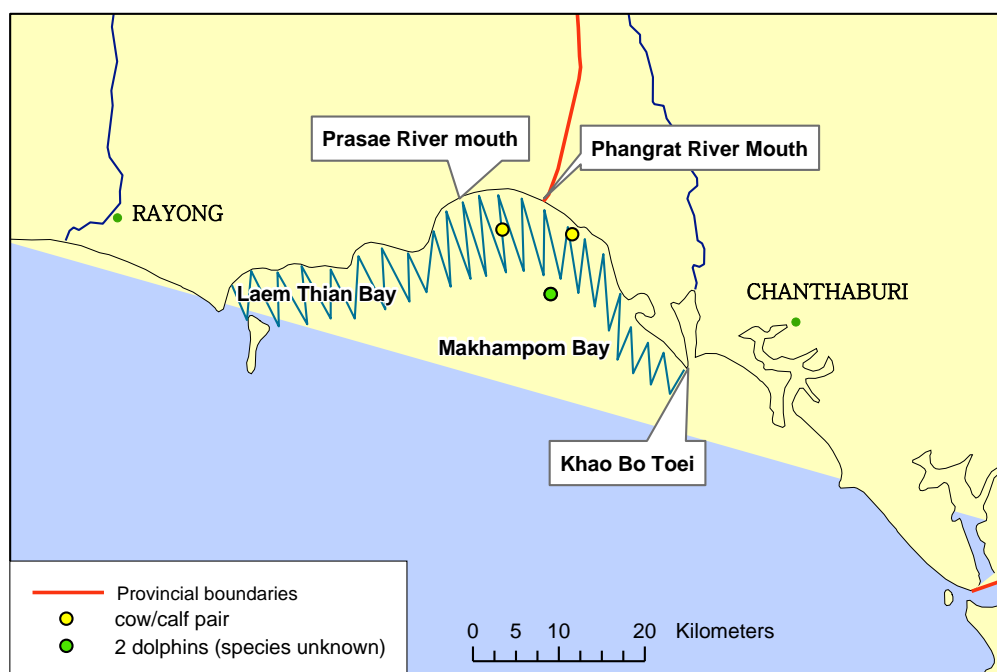


Figure 7. Sightings of locations and group numbers of dugongs seen in Rayong and Chanthaburi provinces on January 6, 2004.

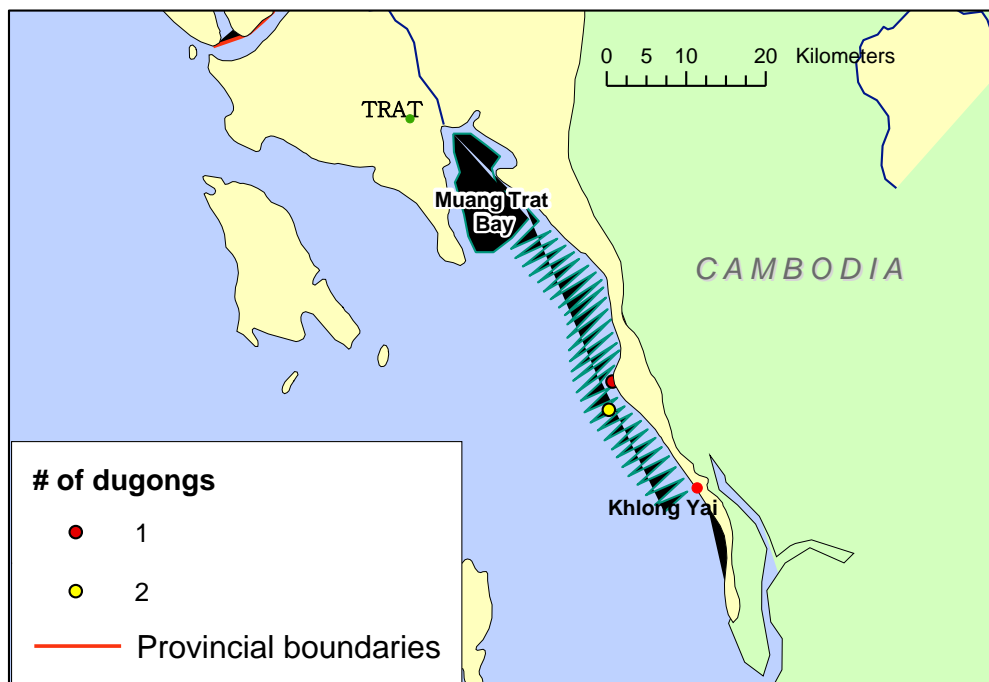


Figure 8. Sightings of locations and group numbers of dugongs seen in Trat province on January 7, 2004.

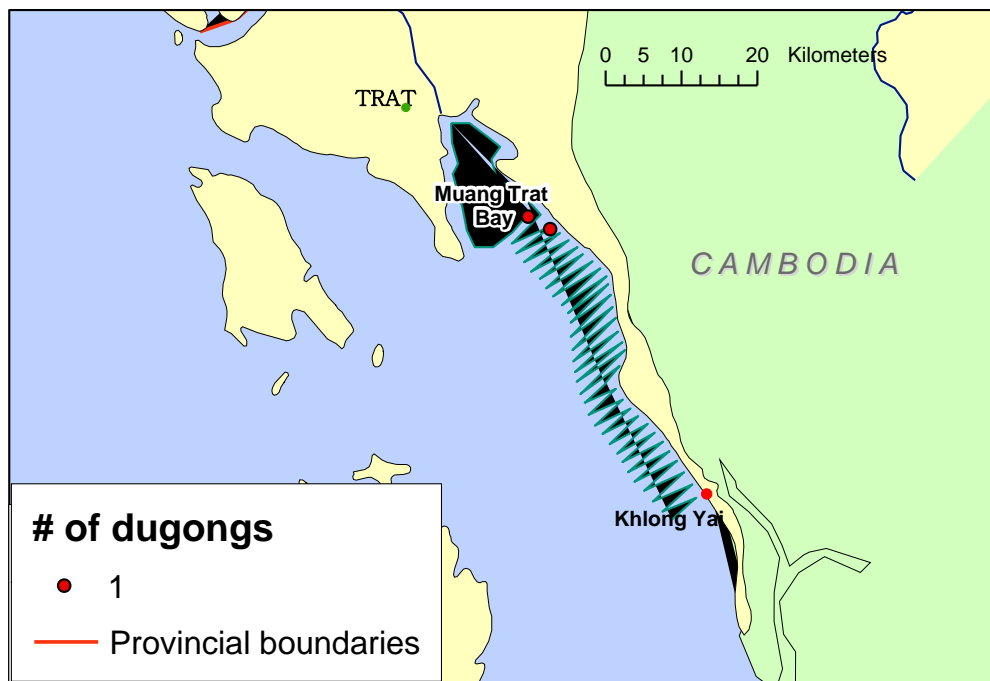


Figure 9. Sightings of locations and group numbers of dugongs seen in Trat province on January 8, 2004.

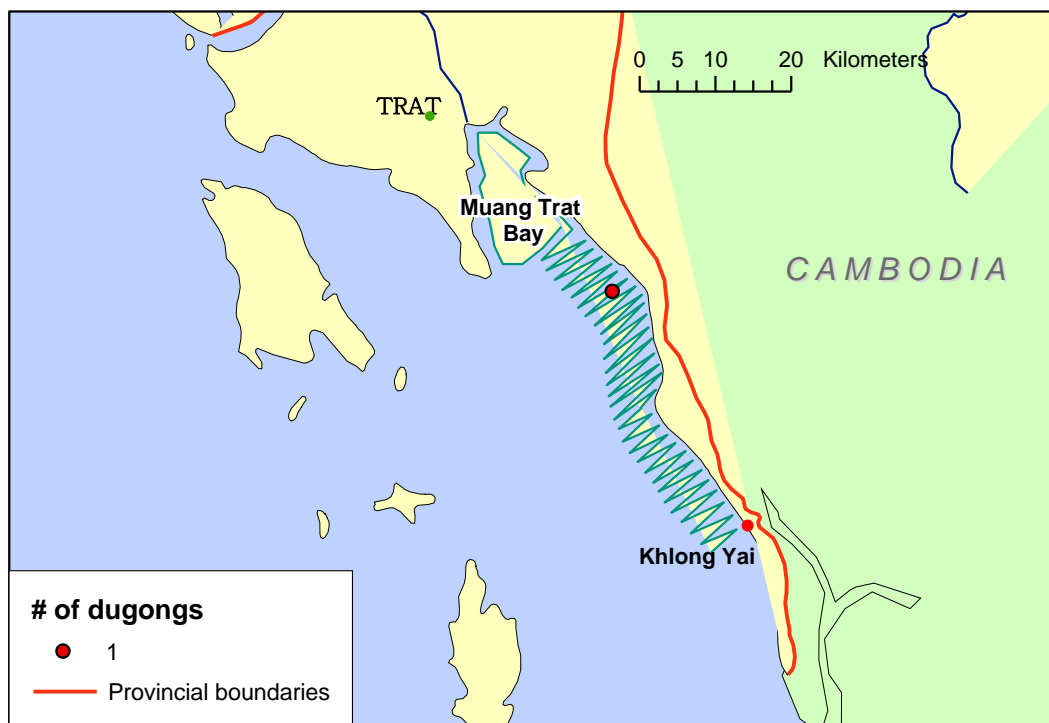


Figure 10. Sightings of locations and group numbers of dugongs seen in Trat province on January 9, 2004.

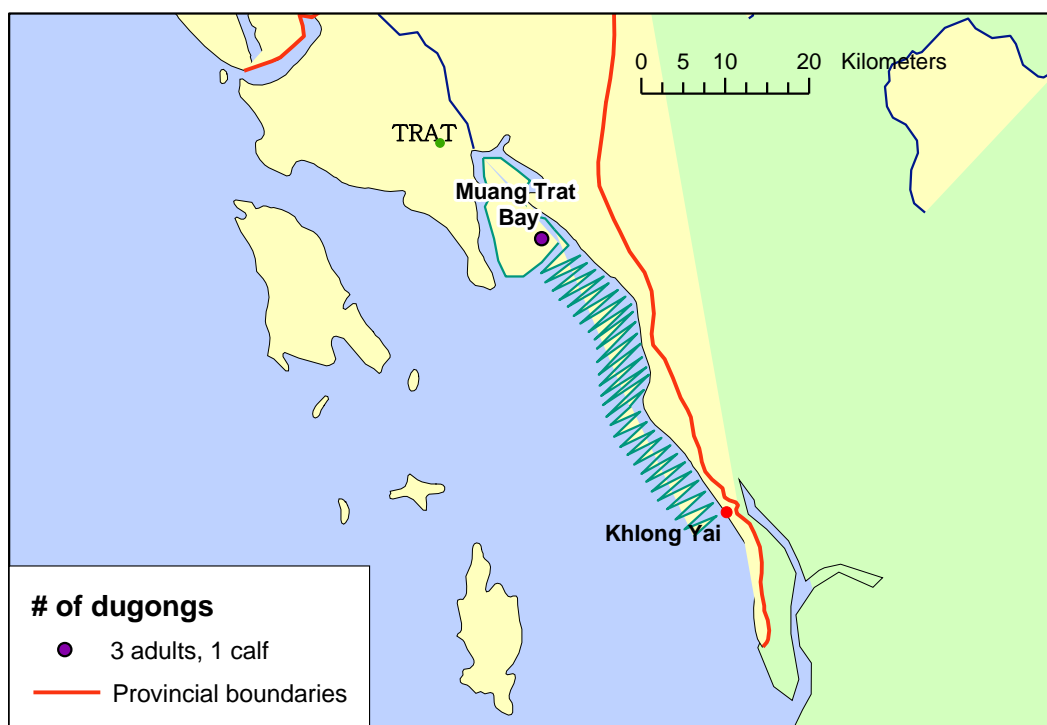


Figure 11. Sightings of locations and group numbers of dugongs seen in Trat province on January 11, 2004.

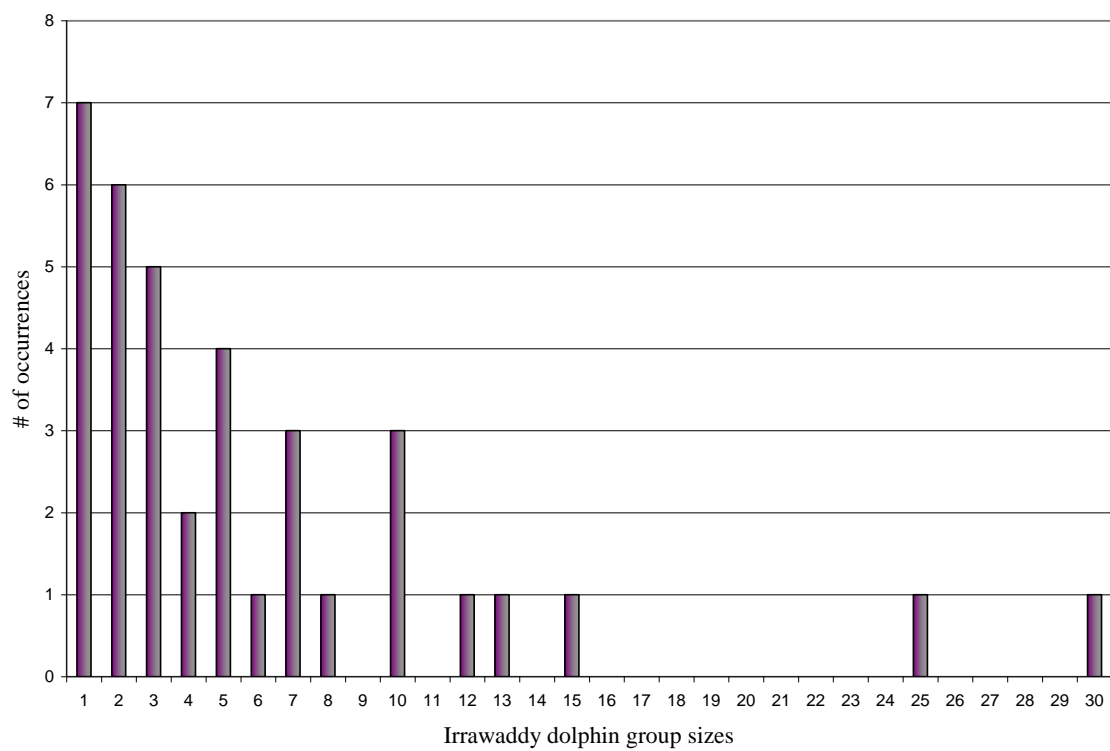


Figure 12. The distribution of Irrawaddy dolphin group sizes seen during aerial surveys in the eastern Gulf of Thailand in January of 2004.

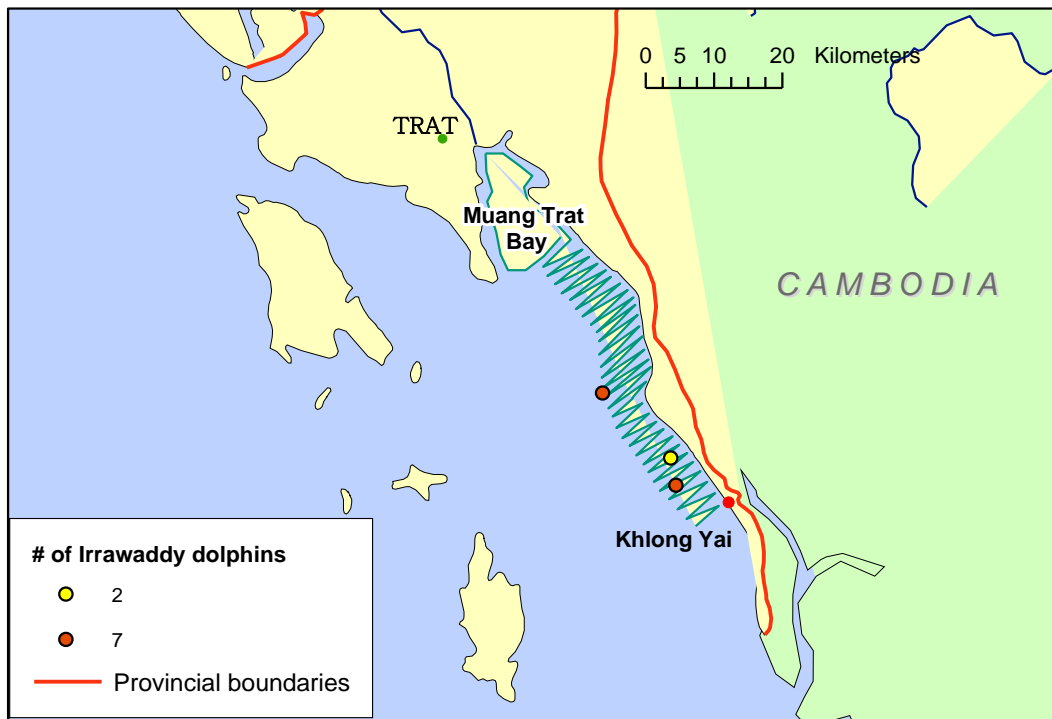


Figure 13. Sightings of locations and group numbers of Irrawaddy dolphins seen in Trat province on January 7, 2004.

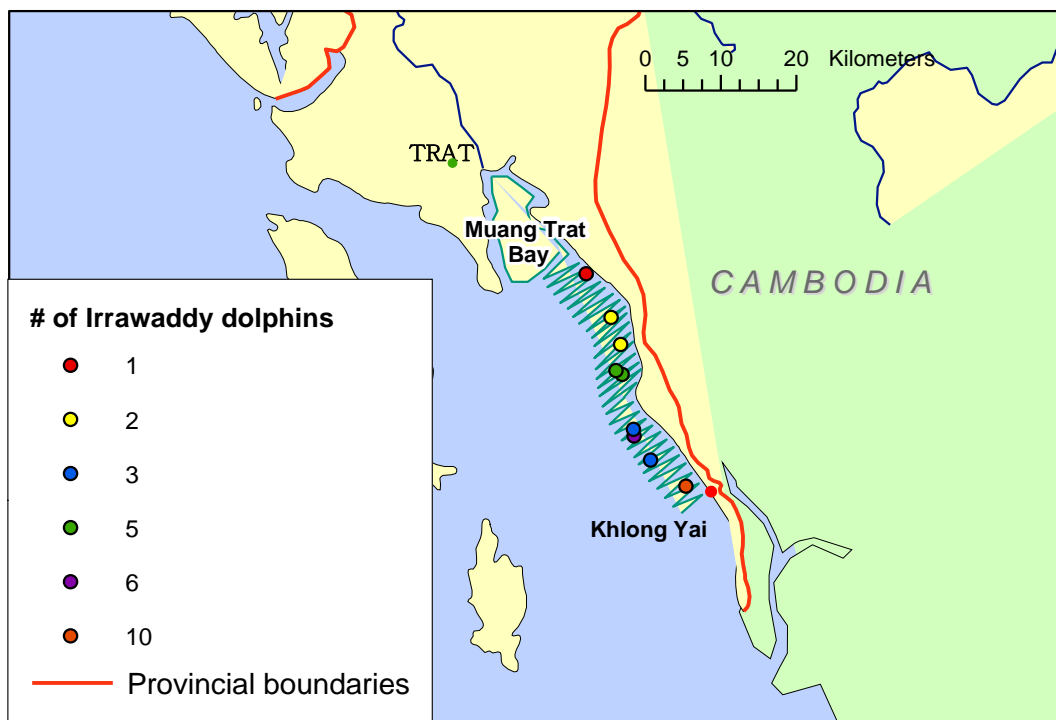


Figure 14. Sightings of locations and group numbers of Irrawaddy dolphins seen in Trat province on January 8, 2004.

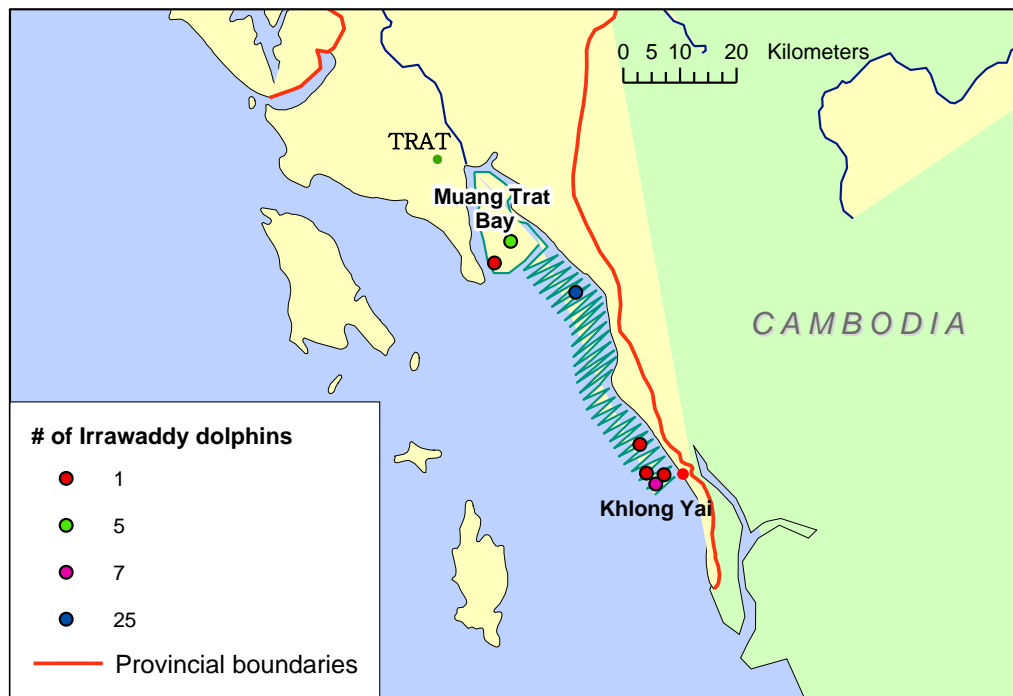


Figure 15. Sightings of locations and group numbers of Irrawaddy dolphins seen in Trat province on January 9, 2004.



Figure 16. Sightings of locations and group numbers of Irrawaddy dolphins seen in Trat province on January 10, 2004.



Figure 17. Sightings of locations and group numbers of Irrawaddy dolphins seen in Trat province on January 11, 2004.

### Seagrass Surveys

Figure 18 contains a map of the general locations of seagrass beds in Rayong, Chanthaburi, and Trat based on information gathered during the aerial surveys in 2003, and delineates the locations of spot sampling in Trat in 2004. Table 2 shows the results of the spot samples.

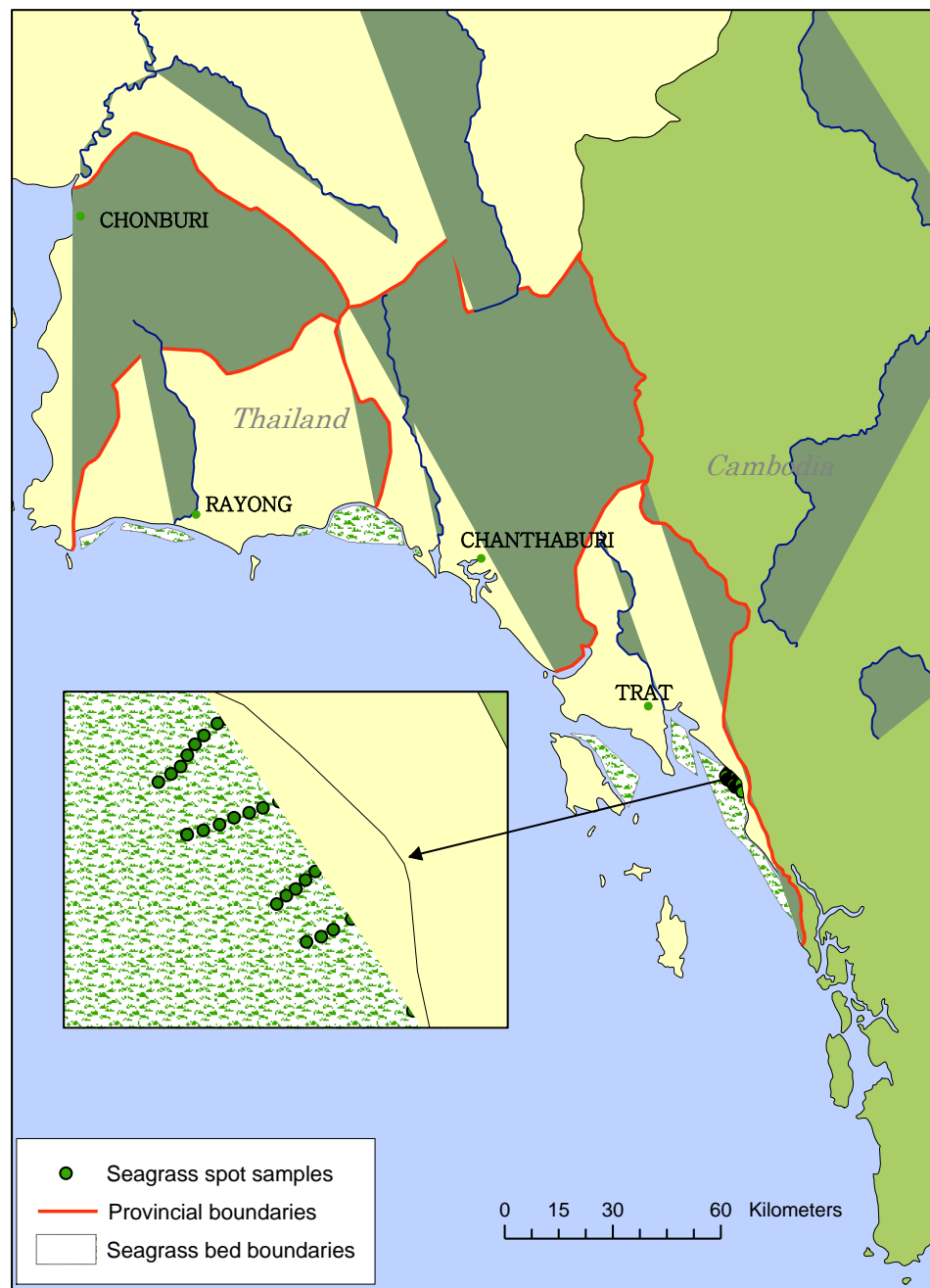


Figure 18. Generalized seagrass bed boundaries from 2003 & 2004, and spot survey locations in Trat province from 2004.



Table 2. Results of seagrass spot sampling in Trat province, February 2004

Waypoint	Lat	Long	Depth (m)	Salinity	DO	Bottom type	Seagrass species	%coverage
234	12.05535	102.73498	2.2	30	5.44	mud	none	0
235	12.05557	102.73506	2.2	30.5		mud	none	0
236	12.05380	102.73222	3.5	30	5.26	sand	<i>Halophila minor</i>	<0.1*
237	12.05300	102.73080	3.7	30		sand	<i>Halophila decipiens</i>	20*
238	12.05100	102.72852	4.1	30	5.05	sand with shells, mud on top	<i>Halophila decipiens</i> with flowers	25
239	12.04952	102.72700	4.2	30		sand with shells	<i>Halophila decipiens</i>	15
240	12.04770	102.72573	4.4	30	5.46	sand with shells	<i>Halophila decipiens</i>	20
241	12.04578	102.72460	4.4	30		sand with shells	<i>Halophila minor</i> with <i>Caulerpa</i> algae	20
242	12.04453	102.72298	4.8	30	5.57	sand with shells	<i>Halophila decipiens</i> ; <i>Gracilaria</i> algae	10
243	12.04317	102.72085	5.2	30		sand with mud	<i>Halophila decipiens</i>	20
244	12.03435	102.72567	5.7	30		sand with mud	<i>Halophila decipiens</i>	50
245	12.03432	102.72570	6.1	30		mud, turbid water	no seagrass	0
246	12.03505	102.72842	5.7	30		mud with sand, turbid water	<i>Halophila decipiens</i>	5
247	12.03600	102.73115	5.1	30	5.57	sand, mud	<i>Halophila decipiens</i>	10-15
248	12.03717	102.73362	4.7	30		sand with shells	<i>Halophila decipiens</i>	5-15
249	12.03800	102.73617	4.7	30	5.46	sand with shells	<i>Halophila decipiens</i>	10
250	12.03882	102.73848	4.3	30		sand with shells, rock	<i>Halophila decipiens</i>	20
251	12.03988	102.74120	4.1	30	5.21	sand with shells	<i>Halophila decipiens</i>	5
252	12.04012	102.74388	4.1	30		mud with sand and shells	<i>Halophila decipiens</i> ; <i>Caulerpa</i> algae	30
253	12.04062	102.74607	3.7	30	5.57	sand on rock	<i>Halophila decipiens</i>	5
254	12.04138	102.74847	3.2	30		sand with shells	no seagrass	0
255	12.03432	102.75408	3.1	30	5.15	sand with mud on top	no seagrass	0
256	12.03313	102.75258	3.7	30		sand	<i>Halophila decipiens</i>	5
257	12.03138	102.75090	4.5	30		sand with mud on top	<i>Halophila decipiens</i>	5
258	12.02970	102.74915	4.8	30	5.31	sand	<i>Halophila decipiens</i>	15
259	12.02815	102.74732	5.1	30		mud with sand	<i>Halophila decipiens</i>	10
260	12.02670	102.74565	5.4	30		sand with mud and shells	<i>Halophila decipiens</i>	10
261	12.02517	102.74402	5.6	30	5.05	sand with mud	<i>Halophila decipiens</i>	<5
262	12.02407	102.74243	6.0	30		sand with mud	<i>Halophila decipiens</i>	<5
263	12.02265	102.74080	6.0	30		sand with shells	One <i>Halophila minor</i>	<0.01
264	12.01628	102.74582	6.2	30	5.51	sand with shells	no seagrass	0
265	12.01715	102.74830	5.9	30		sand, rock grains, mud	<i>Halophila decipiens</i>	2-3
266	12.01833	102.75035	5.4	30		rockbed	no seagrass	0
267	12.02012	102.75342	5.1	30	5.62	sand with mud	<i>Halophila decipiens</i>	5
268	12.02103	102.75595	4.8	30		sand with mud	<i>Halophila decipiens</i>	5
269	12.02175	102.75828	4.5	30		sand with mud	One <i>Halophila minor</i>	<0.01
270	12.02310	102.76050	3.9	30	5.46	sand, mud, shells, turbid water	no seagrass	0
271	12.00860	102.76320	4.1	30		sand with mud, rockbed	<i>Halophila decipiens</i>	5
272	12.00468	102.76375	4.5	30		sand with mud	<i>Halophila decipiens</i>	5

## Interviews

Two teams of researchers interviewed 160 villagers in fishing villages in Rayong, Chanthaburi, and Trat provinces (Figure 19). The age spread of respondents goes from a minimum age of 14 to a maximum of 80 (Figure 20). The average age of interview respondents is 46.8 years, the median age is 46.0, and the standard deviation 12.3. We interviewed 138 men and 22 women.

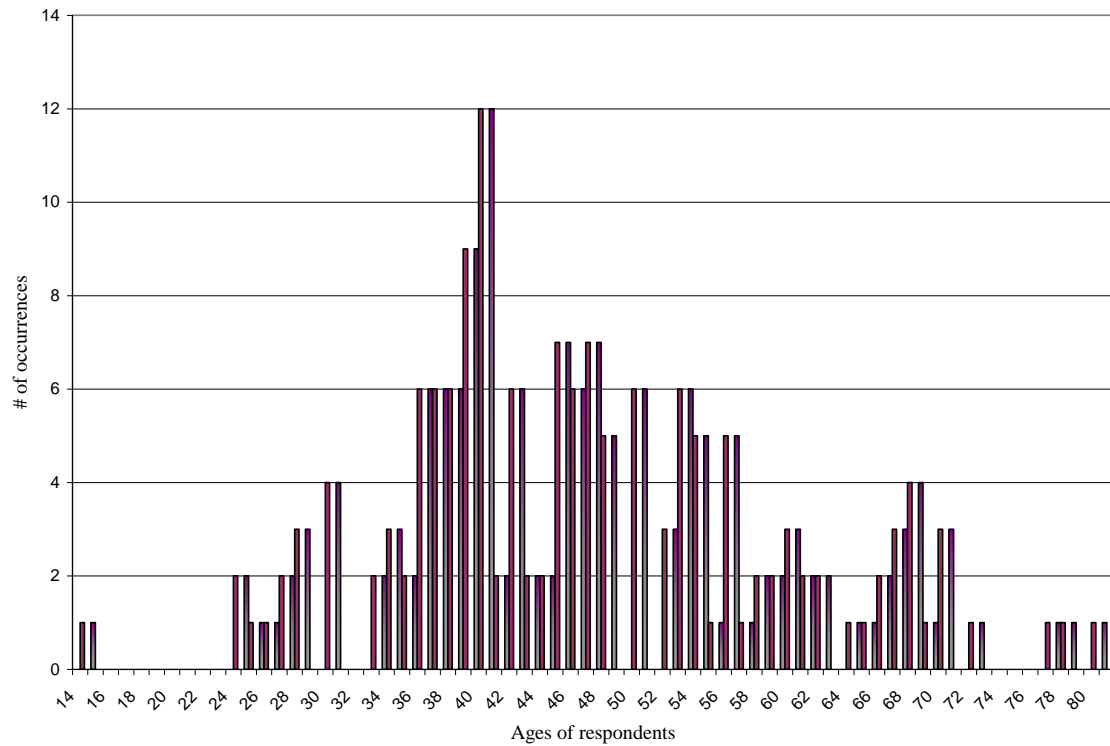


Figure 19. The distribution of ages of interview respondents for the Eastern Gulf interviews (2004).

In the following section, we have summarized the results descriptively using percentage distribution tables (Ember & Ember 2001, Alreck & Settle 1995). Each category of questions is grouped and each question is repeated within each category. Please refer to Appendices I and II for complete interview questionnaires. If a question is



Figure 20. Interview locations in Rayong, Chanthaburi, and Trat provinces in 2004.

not addressed in this section, less than 30% of respondents answered. Therefore, we believe that each table shows the frequency of each answer as well as the adjusted percentage for that answer out of the number of respondents. In this way, the sample percentage can be interpreted as an estimate of the percentage of the respondents that answered each question (Alreck & Settle 1995).

### *History*

#### 1. How long have dugongs been seen in this area?

Forty-two villagers answered this question, with extremely variable answers in terms of years. However, a general consensus from the responses was that many more animals were seen 20 years ago or more than recently.

#### 2. Have dugongs ever been hunted in this area?

Out of the 160 responses, 5 people answered yes, between the ages of 59 and 80, from the provinces of Rayong and Trat. Three of the villagers said that dugongs were hunted 30 years ago, one 40 years ago, and one 50.

#### 3. Are there any legends or rituals or stories about dugongs?

There was only one 'yes' answer here. A 53 year old man from Trat province mentioned that dugongs come from mermaids.

### *Patterns*

#### 1. Where do dugongs occur?

The amount of time that small-scale fishers along the coast spend on the water is unconstrained by the limited field season and airtime of these surveys. News of sightings is spread throughout the villages. Respondents pointed out dugong sighting points on

bathymetric maps of the surrounding area. Eighty-two, or half of the interview respondents, from every province and varying ages had never seen a dugong. Several respondents noted that they had not seen dugongs for 30 years. Figures 21 through 23 show areas where dugongs were stated to occur in each of the three provinces.

2. What seasons do you see dugongs?

The answers to this question varied quite a bit, with every season mentioned several times. Some respondents mentioned instead the last time they saw a dugong. Eleven of those answers included dugong sightings since 2000. Whether these sightings were stranded animals or sightings at sea were not specified.

3. Are they in big or small groups?

Out of 65 respondents, most of the dugongs (53 or 82%) were reported to occur in small groups of less than 3 animals in all provinces. Nine or 14% of respondents had seen groups of between 3 and 5 dugongs, and three (4%) had seen larger groups. These latter respondents were from Chanthaburi and Trat provinces.

4. Do you notice calves?

Out of 128 respondents, 120 or 94% reported they have never seen dugong calves. Six percent have. One of the eight positive responses was from Rayong, two from Chanthaburi, and five from Trat provinces.

5. How many dugongs have you seen in the past five years?

Table 2 shows the distribution of answers. Out of 65 responses, 14 were from Rayong, 22 from Chanthaburi, and 29 from Trat.

Table 2. Number of dugongs seen in the past five years by interview respondents.

# OF ANIMALS	NUMBERS OF REPORTS	% OF TOTAL REPORTS
1	48	74
2 to 3	14	22
4 to 5	3	4
Total # of responses	65	100



Figure 21. Areas where dugongs have been seen in the past 5 years, as mentioned by interview respondents in Rayong and Chanthaburi provinces in 2004.



Figure 22. Areas where dugongs have been seen in the past 5 years, as mentioned by interview respondents in Trat province in 2003.



6. What other species of sea mammals or sea turtles have you seen?

The fifteen respondents in Rayong had seen 11 dolphins and 7 sea turtles. Four of the dolphins were identified as bottlenose (*Tursiops spp.*), and 3 as hump-backed (*Sousa Chinensis*). Fifty respondents in Chanthaburi saw 47 dolphins and 19 turtles. Two respondents had not seen any other species of marine mammal or sea turtle. Of the dolphins, 13 were identified as bottlenose, 14 as hump-backed, and 2 as Irrawaddy (*Orcaella brevirostris*). Two of the turtles were identified as hawksbill and 1 as leatherback. In Trat province, out of 95 respondents, 2 had not seen animals, 90 had seen dolphins, 1 had seen a whale, and 49 had seen turtles. Of the dolphins, 38 were identified as bottlenose, 9 as hump-backed, and 41 as Irrawaddy. Six hawksbill turtles, 3 leatherback, and 1 green turtle were identified. In Table 3, all species seen in the research area are summarized.

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Table 3. Other sea mammals or sea turtles seen by interview respondents.

SPECIES	NUMBERS
Bottlenose Dolphins	55
Irrawaddy Dolphins	43
Hump-backed Dolphin	26
Hawksbill Turtle	8
Leatherback Turtle	4
Green Turtle	1

### *Threats*

1. Are dugong numbers declining, increasing, staying the same? Table 4 shows the distribution of answers, and Table 5 outlines the various comments made in response to this question.

Table 4. How dugong numbers are declining, increasing, or staying the same.

Declining (%)	111 (69)
Increasing (%)	24 (15)
Staying the same (%)	2 (1)
No Comment (%)	23 (15)
Total # of responses	160 (100)

Table 5. Comments to the question: Are dugongs declining, increasing, or staying the same?

Comment	Where heard (Province)	Numbers of Respondents
Seagrass killed by illegal trawlers	Rayong/Chanthaburi/Trat	24
Nobody harms or catches dugongs	Rayong/Trat	6
Local people see more dugongs lately	Trat	5
Seagrass killed by wastewater	Chanthaburi/Trat	3
Increase because of conservation	Rayong	1
Dugongs are already extinct	Rayong	1
Never seen dugong	Rayong/Chanthaburi/Trat	20
Totals		60

2. Do dugongs interfere with fishing or boating activities?

All 160 respondents answered no to this question.

3. Have you or anyone in the village caught dugongs in fishing nets?

Out of 160 respondents, 141 (88%) have either not caught, or know of a dugong in caught in a village net. Sixteen villagers answered yes to this question, and of these respondents 1 was in Rayong, and 15 in Trat.

4. What would you do if you found one stranded? (report, kill, let go)

Out of 155 respondents, 111 (72%) would let the animal go, 34 (22%) would report the incident to local government officials, 3 (2%) would eat the dugong, and 2 (1%) did not know. Six (3%) respondents specifically stated that if the animal was alive they would let go, and if dead they would report the stranding.

### *Conservation*

The following questions (1-4) ask respondents to rank the importance of conservation, as represented by dugongs, other endangered species, as well as coastal mangroves and seagrass beds (1= Very important, 2= Important, 3= Neutral, 4=Moderate, 5=Very negative). Tables 6 through 10 summarize responses and comments to these questions. Other endangered species were explained as being whales, dolphins, and marine turtles. The next question (5) asks for a choice on a continuum of positive and negative feelings about an area being designated off-limits to fishing in order to conserve an endangered animal or system. Tables 11 and 12 chart those opinions and comments.

Table 6. Opinions of interview respondents on the importance of conserving dugongs, other endangered species, seagrass, and mangroves, as reported in the interviews. Comments are summarized below in Table 7 for dugongs, Table 8 for other endangered species, Table 9 for seagrass, and Table 10 for mangroves.

	<b>DUGONGS (%)</b>	<b>ENDANGERED SPECIES (%)</b>	<b>SEAGRASS (%)</b>	<b>MANGROVES (%)</b>
Very important	26 (16)	25 (17)	15 (10)	37 (23)
Important	106 (68)	112 (70)	100 (65)	99 (62)
Neutral	24 (15)	14 (8)	36 (23)	20 (13)
Moderately negative	0	7 (4)	2 (1)	0
Very negative	1(<1)	1 (<1)	2 (1)	3 (2)
Total # of responses	157	159	155	159

Table 7. Comments on the importance of conserving dugongs.

<b>DUGONG CONSERVATION COMMENTS</b>	<b>NUMBER OF TIMES MENTIONED (%)</b>
Would like children to see in future/rare in nature	29 (55)
For the diversity of the ecosystem	1 (2)
Dugongs are a good/lovely animal	3 (6)
Because they are endangered	10 (14)
Fishers need more information/education	2 (4)
There should not be trawlers by the coast	5 (9)
Have never seen so we need to see	3 (9)
Total # of responses	53 (~100)

Table 8. Comments on the importance of conserving endangered species.

ENDANGERED SPECIES CONSERVATION COMMENTS	NUMBER OF TIMES MENTIONED
So that children can see in the future	5
They are rare in nature/nearly extinct	3
Part of the biodiversity of the ecosystem	1
Dolphins bite my nets (Rayong & Trat)	2
Total # of responses	11

Table 9. Comments on conserving seagrass.

SEAGRASS CONSERVATION COMMENTS	NUMBER OF TIMES MENTIONED
Food for dugongs	6
Must control trawlers fishing in seagrass	2
For the food chain	1
Habitat/breeding ground for marine animals	7
There is no seagrass here ( from all provinces)	16
Total # of responses	32

Table 10. Comments on conserving coastal mangroves.

MANGROVE CONSERVATION COMMENTS	NUMBER OF TIMES MENTIONED (%)
Nursery ground for marine animals	25
Mangroves clean the water	1
Habitat for fishes	1
For the food chain	1
No mangroves here (Chanthaburi)	1
Total # of responses	29

Table 11. Opinions on a local area being designated off-limits to fishing in order to conserve an endangered animal or system.

	<b>OFF-LIMITS AREA (%)</b>
Extremely positive	21 (13)
Moderately positive	103 (64)
Neutral	21 (13)
Moderately negative	13 (8)
Extremely negative	0
No Comments	2 (1)
Total # of responses	160 (~100)

Table 12. A summary of comments on a local area being designated off-limits to fishing in order to conserve an endangered animal or system.

<b>OFF-LIMITS AREA COMMENTS</b>	<b>NUMBER OF TIMES MENTIONED (%)</b>
So aquatic animal populations can grow	19 (32)
So small fishing boats can fish in this area, not illegal trawlers	16 (28)
Might effect local fishers	7 (12)
Close the whole Gulf to protect it from trawlers	6 (10)
It might help to control trawlers & pushnets	5 (8)
Because it is dugong habitat	1 (2)
There are no dugongs here (Chanthaburi)	1 (2)
Must control fishing gear as it damages the dugong	1 (2)
Protect local fishing gear from trawlers	1 (2)
Doesn't matter to him	1 (2)
Total # of responses	58 (100)

### *Locations and History of Strandings*

The first question in this section asked if respondents had ever found any dugongs or dolphins stranded. One hundred and sixty villagers answered with 62 positive and 98 negative responses. Table 13 summarizes comments. Out of these 60 comments, 14 respondents reported the strandings to local or regional authorities, and 46 did not. Nine respondents (6 dugongs, 3 dolphins) ate the animal, and 1 person from Chanthaburi kept dugong bone for medicine.

Table 13. Animals found stranded as related by interview respondents.

	NUMBER OF TIMES MENTIONED
Dugongs	21
Dolphins (no species)	20
Bottlenose	8
Irrawaddy	5
Hump-backed	1
Whales (no species)	4
Calf (no species)	1
Total # of responses	60

### 3. Where were dugongs strandings found?

Out of the 21 positive responses where the villager had found a dugong, 4 of the strandings were found in Rayong province, 8 in Chanthaburi, and 9 in Trat.

4. When were these animals found?

Table 14 summarizes those answers. In 2002 and 2003, the dugongs reported stranded were reported found in different places with one exception (in 2003).

Table 14. Years during which respondents found stranded dugongs.

Year	Number
1984	1
1994	2
1997	2
1999	1
2000	1
2001	1
2002	4
2003	7
2004	1

Table 15 summarizes the answers to the following 4 questions asking for details about dugong strandings:

5. What size were these animals?
6. Were they dead?
7. Did you notify any officials, who?
8. What happened to the animal or the body?



Table 15. Answers to questions 5-8 for each respondent who found a stranded dugong.

<b>Respondent</b>	<b>Size estimation</b>	<b>Dead or alive</b>	<b>Notify officials?</b>	<b>What happened to the body?</b>
<b>1 (Rayong'03) Ban Sar Kaeo Beach)</b>	nc	alive	no	Let go
<b>2 (Rayong'02) Hat Mai Ram Phung</b>	nc	dead	yes (municipal)	Turned in
<b>3 (Rayong'97) Ao Makhom Pom</b>	50-60kg	dead	Yes (DOF)	Turned in
<b>4 (Rayong'00) Pak Nam Prasae</b>	2m, 150kg	dead (rotten)	no	Let go
<b>5 (Chanthaburi'03)</b>	100kg	dead	Village head & local government	Let go
<b>6 (Chanthaburi'04) Pak Khlong Prasae</b>	100kg	dead	no	Let go
<b>7 (Chanthaburi'02) Ao Khung Kraben</b>	80kg	dead	no	Ate
<b>8 (Chanthaburi'97) Chong Samae San</b>	80kg	dead	no	Let go
<b>9 (Chanthaburi'03) Ao Mu</b>	2m, 20kg	dead (rotten calf)	no	Kept bone for medicine
<b>10 same as above</b>				
<b>11 (Chanthaburi'99) Ao Khung Kraben</b>	200kg	dead	no	Let go
<b>12 (Chanthaburi'01) Ko Khwang</b>	skeleton	dead	villagers	Let go
<b>13 (Trat'94) Ao Thammachat</b>	2m	dead	no	Ate
<b>14 (Trat'84) Hat Ban Yai Mom</b>	100kg	dead	no	Ate
<b>15 (Trat'03) Ban Mai Rut</b>	80kg	dead	villagers	Turned in
<b>16 (Trat'03) Laem Klat</b>	60kg	dead	villagers	Buried
<b>17 (Trat'03) Pak Khlong Ao Rawa</b>	1m, 100kg	dead	officials	Buried
<b>18 (Trat'94) Ao Mai Rut</b>	1.5m	dead	no	Ate
<b>19 (Trat'02) Khao Lan</b>	80kg	dead	no	Ate
<b>20 (Trat'02) Ko Kong</b>	130kg	dead	Notified observer	Cambodian soldier took to Cambodia
<b>21 (Trat'00) Laem Sok</b>	80kg	dead	no	Ate

### *Medicinal Use*

#### 1. Have you used any parts of a dugong's body as medicine or amulet or aphrodisiac?

Two people in Chanthaburi province of 160 respondents said that they had used at least some part of the body of the dugong for some sort of medicinal or amulet use.

Ninety-nine percent (158 people) had never used dugong body parts as medicine or amulets.

#### 2. Have you heard of using any parts of a dugong's body as medicine?

Out of 160 responses to this question, 138 respondents, or 86%, said that they had never heard of using any parts of a dugong's body. Twenty-two or 14%, answered positively. The specific comments are summarized in Table 16. Note: some respondents mentioned more than 1 use.

Table 16. As reported in interviews; what dugong body part was used, for what purpose, and how it was prepared.

	NUMBER OF TIMES MENTIONED
Use the bones as medicine	10
Use the tusks as medicine	8
Use the tusks as amulets	3
Amulet from either bone or tusk	3
Grind bone until powder & drink with water for fever	2
Walking stick made from the skin	1
Medicine from dugong 'fat'	1
Makes a penis amulet from the bone	1
	29

### CONCLUSIONS AND RECOMMENDATIONS IN THAILAND

This year's research raises questions. Last year we saw significantly more dugongs in this area. This year we also saw significantly more Irrawaddy dolphins. What patterns are responsible for these changes? The first thought for dugongs is a

change in seagrass coverage and distribution. Seagrass is susceptible, especially in a more exposed coast like Trat, to damage by yearly monsoonal storms. Kwan (2002) talks about seagrasses of the genera *Halophila* and *Halodule* as species well adapted to disturbance. These variations can be both from natural and anthropogenic events. We also saw large numbers of fishing boats, more fixed nets than in 2003, and more crab nets this year in the coastal waters around Trat. These should be further documented in future research and if necessary, regulated, by the Eastern Marine and Coastal Resources Center in Rayong.

In Table 2, we see that the % of coverage of the seagrass found at this time off the coast of Trat is low (maximum of 30 percent coverage occurring once, mostly less than 20%), and the species found is mainly *Halophila decipiens*. Our basis for comparison is results from seagrass surveys from Hines (2002) along the Andaman coast, where the most plentiful species is *Halophila ovalis*, at an average of 50% along the coast, and up to 90% in Trang province. Repeating seagrass sampling along the coast in the next several years is the best way to determine the patterns of seagrass growth in this area.

One of the survey days we flew along the coast to look for seagrass around the coastal islands in Trat (Kut and Chang Islands and smaller islands in between, see Figure 22). We found no seagrass, but rapid tourism development on Chang Island, and agricultural plantations on Kut and other islands. From the proximity of the Cambodian border, and the substantial seagrass that we saw in the Koh Kong area, perhaps the dugongs move to this area to graze, following the ‘bet-hedging’ strategy mentioned by Kwan (2002) in response to fluctuations of seagrass conditions.

In the Rayong/Chanthaburi area, we saw the same approximate number of dugongs in similar areas as in 2003. While we saw a significant fluctuation of dugong numbers in Trat, we did see dugongs and document the presence of some seagrass beds in the area. *Halophila decipiens* has been found in the stomachs of stranded dugongs from this area (Adulyanukosol pers comm.). From the additional interviews we also have further evidence of recent strandings and sightings along the coast.

Based on the interviews from both years (a total of 285 respondents), we can again say that while few people see dugongs at sea, local people are aware of dugongs, and concerned about their conservation. Eighty four percent of respondents in 2004 answered that dugong conservation is important. In 2003, that number was 94%. The major differences in interview results between the 2 years were in the results for the conservation questions. For dugongs, endangered species, seagrass, and mangroves, the majority of people thought that conservation was important, but the numbers of neutral answers were larger. For the question of having an area of seagrass off-limits to fishing, 77% of the responses were positive, ostensibly for dugong conservation, versus 91% in 2003. While there were no negative responses last year, 8% were negative in 2004. This could be coincidental; however the issues of overfishing in the Gulf and the conflict between small-scale and commercial and illegal fishers are very present in the respondents' comments. Similarly to the Andaman coast, dugongs and dolphins are caught in the conflict between small-scale fishers and destructive commercial trawlers that fish illegally close to shore, damaging not only seagrass, but destroying the nets of the small-scale fishers. The main point that came out of discussions around the conservation question had to do more with restricting destructive trawlers, and letting

fishing areas recover from overfishing. Six respondents even suggested closing the entire Gulf of Thailand to commercial trawling!

In comparison to the results of dugong research on the Andaman coast (Hines 2002), there are fewer dugongs in fewer places, less trade in dugong body parts, and while the practice of medicinal and amulet use for dugong body parts is comparatively less, the knowledge of these practices is common.

After our research found dugongs in the Rayong/Chanthaburi and Trat areas in 2003, and the ensuing radio, TV, and newspaper publicity, communities in each area formed village-based groups to ‘welcome the dugong’ back to their areas. This year as well, both TV and newspaper reporters came to our field site (in Trat), and interviewed us and a Ministry of Sustainable Resources official (short video and pictures enclosed).

At this time, we can say that the minimum number of dugongs seen along the coast of Rayong and Chanthaburi between Laem Thain Bay and Khao Bo Toei (Figure 4) is 8. Between Muang Trat Bay and Khlong Yai in Trat province (Figure 5) we would have to call the population variable: last year we saw groups of 36 animals, and this year the largest group of dugongs we saw was four. Further research is needed to ascertain patterns of dugong distribution in Trat.

In 2003, we saw Irrawaddy dolphins on 3 survey days, with a maximum of 15. In 2004, dolphins were seen every survey day in Trat province, with a maximum sighting of 63-73 animals in one day. We would like to do aerial surveys in Trat in January of 2005, to see if the dugong sightings are still less, and the dolphin sightings still more, than in 2003. One goal for 2005 is a pilot study to research possible short-term patterns of relative abundance for both dugongs and dolphins, and compare them to fishing efforts

(as noted from the air), and further studies of seagrass presence or absence. Dolphins are commonly seen by all but seven interview respondents.

The presence of such large numbers of Irrawaddy dolphins could lead to an unprecedented research opportunity to assess relative population and distribution, habitat parameters, presence/absence of fish, and foraging patterns of marine Irrawaddy dolphins in SE Asia. If such regular sightings of Irrawaddy dolphins occur again, we plan to propose a major study of Irrawaddy dolphins in Trat province, and in Cambodia (if logistics and permissions can be worked out) for the following years. In the 2002-2010 Conservation Action Plan for the World's Cetaceans, by the IUCN/SSC Cetacean Specialist Group, one of the recommended research initiatives concerning the status of coastal cetaceans in Thailand addresses a need to identify special areas of "cetacean abundance for special conservation attention", as well as to document fishing intensity in these areas (Reeves et al. 2003, pg. 60).

At this time, the Thai Ministry of Sustainable Resource Management is considering the creation of an Environmental Protection Area along eastern Gulf Coast of Thailand. At this writing we have not received specific information about this plan. We recommend continuing this research, doing further aerial surveys, more detailed seagrass surveys, and follow-up interviews. We also believe it important to continue to include Cambodia in further research as we found the majority of animals close to the border. In Trat especially, we look forward to further information on coastal management strategies to protect what we believe to be a hot-spot of coastal bio-diversity.

From our research, GIS databases and maps have been created (as shown in figures in this report) and are available to the Ministry of Sustainable Resource

Management and the Phuket Marine Biological Center as a basis for immediate management recommendations and ongoing monitoring. Bringing this scientific and traditional knowledge to the Dugong and Seagrass Conservation Project of Wildlife Fund Thailand, local NGO's, and Small-Scale Fisheries Networks is an important step towards an integrated coastal zone management process to conserve the critical and often overlooked seagrass ecosystem. The inclusion of this information into educational materials is a crucial step to stop the belief that dugong body parts can be used for amulets and medicine. In the long-term, we hope to create a working collaboration that can continue to increase our knowledge of these animals and their habitats, and their conservation needs in Thailand and bordering countries.

## RESEARCH METHODS IN CAMBODIA

### **Aerial Surveys**

Our aerial surveys in Cambodia were flown using a Cessna 206 aircraft. We based the surveys in two locations: the first, the Koh Kong airport along the western coast of Cambodia, for the eastern coast, the only airport available was the Phnom Penh International airport.

As described earlier, we chose strip, or fixed-width transect surveys. We planned our survey and transect areas based on:

1. Interviews conducted by Hines, Adulyanukosol, Cox, Somany, and Sam Ath in 2002.
2. Previous survey experience of Phay Somany and Isabel Beasley (Beasley *et al.* 2002)
3. Consultations with researchers at the Department of Fisheries in Phnom Penh, and Koh Kong.

We designed a zigzag pattern in order to equalize the effort on all parts of the transect line (Dahlheim *et al.* 2000, Buckland *et al.* 1993). Transects were flown at a predefined interval of between 400 and 500 meters, at aspects perpendicular to shore. Tide tables were not available; however, the tidal amplitude is negligible along this coast and did not influence the timing of our surveys. Instead, we generally flew surveys in the morning to avoid afternoon winds and glare. The airplane flew at an average height of 152.4 meters, and an average speed of 74 knots. Figures 23 through 26 show global positioning system (GPS) tracks of the four surveys.

On January 16<sup>th</sup> and 17<sup>th</sup>, we flew over the western coast of Cambodia, south of the Thai border, with flights originating out of Koh Kong (Figures 23 and 24) (Please see Figure 2 for reference). On January 16<sup>th</sup>, we flew south to the island of Koh Rung. On the 17<sup>th</sup>, we flew southeast to the eastern shore of Kampong Som Bay, and the southern coast of Thma Sa.

On January 19<sup>th</sup> and 20<sup>th</sup>, we flew out of Phnom Penh, and surveyed the eastern Cambodian coast, to the Vietnamese border, concentrating on the coast and near-shore islands in the provinces of Kampot and Kep (Figures 2, 25 and 26).





Figure 23. The track of the aerial survey over the western coast of Cambodia on January 16<sup>th</sup>, 2004.

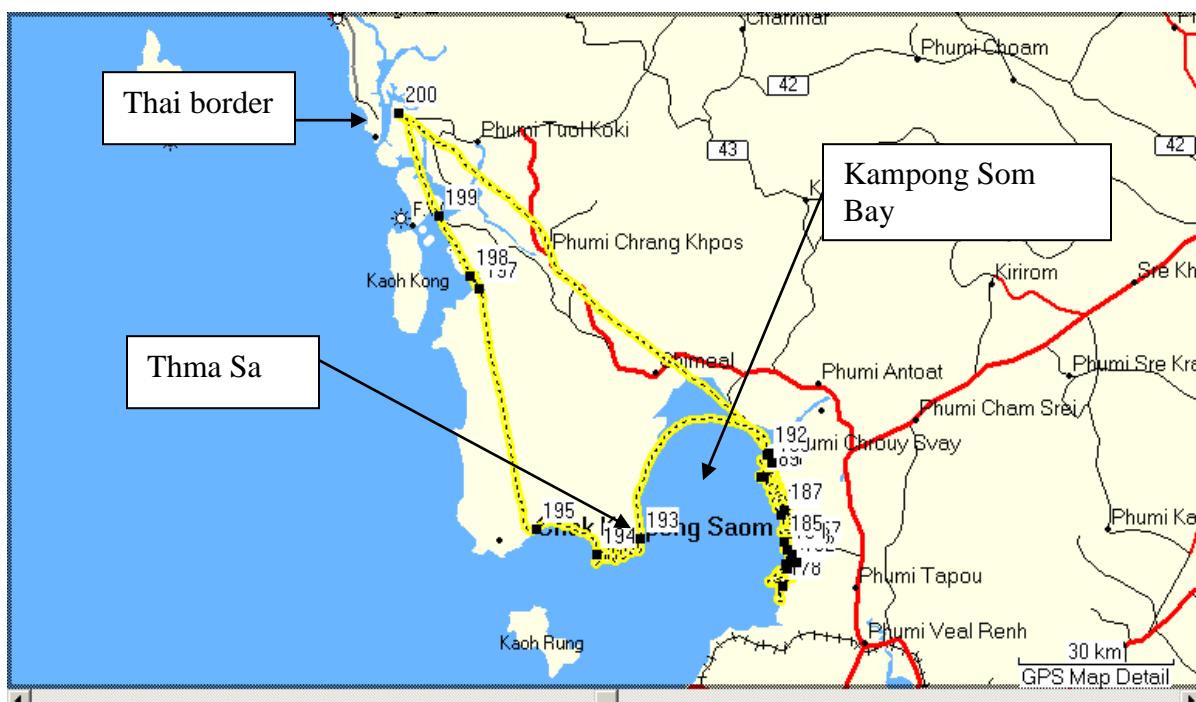


Figure 24. The track of the aerial survey over the western coast of Cambodia on January 17<sup>th</sup>, 2004.

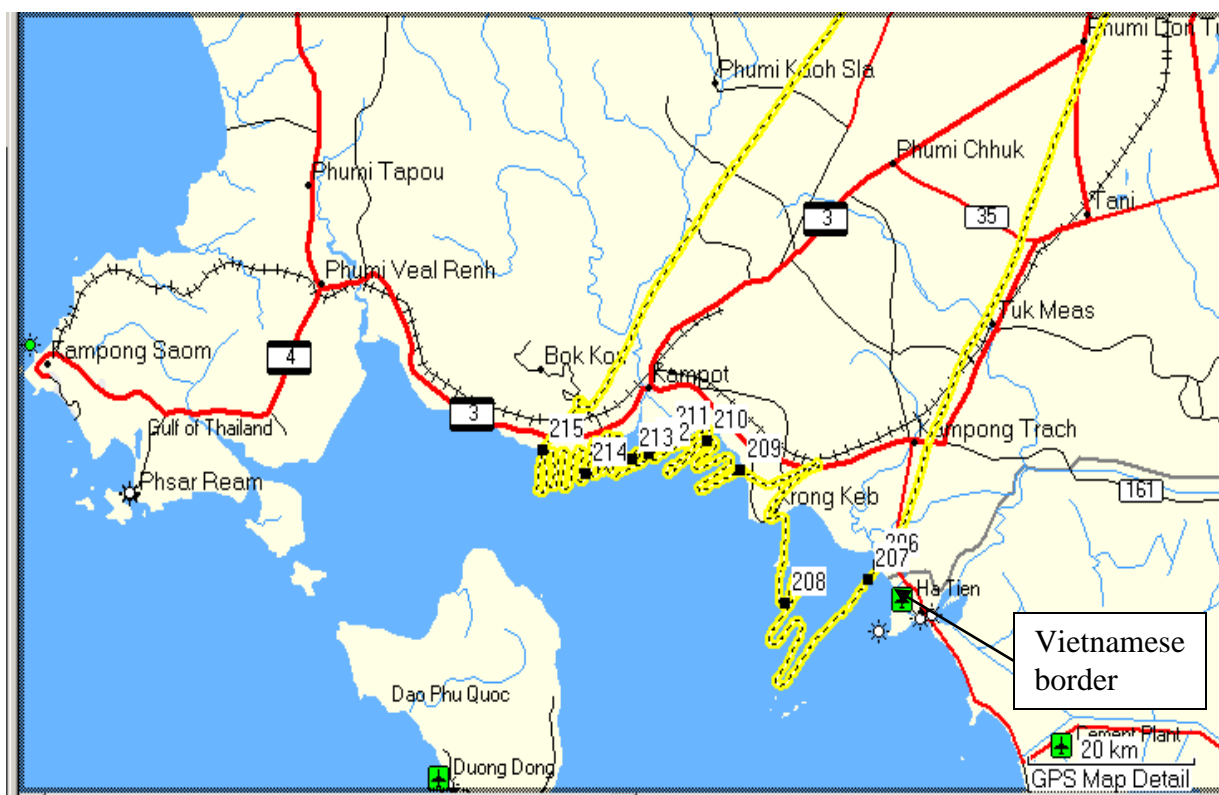


Figure 25. The track of the aerial survey over the eastern coast of Cambodia on January 19<sup>th</sup>, 2004.



Figure 26. The track of the aerial survey over the eastern coast of Cambodia on January 20<sup>th</sup>, 2004.

### **Seagrass Surveys**

The second objective of this study was to determine the distribution and species of seagrass beds considered to be suitable habitat for dugongs. We consulted with seagrass scientists at the Department of Fisheries in Phnom Penh about the locations of seagrass beds along the coast. While these researchers feel that much of the seagrass along the coast is known, their research is ongoing, and they had not been able to do aerial surveys. Mr. Potchana Boonyanate, a seagrass scientist from the Eastern Marine and Coastal Resources Center in Rayong, accompanied us to Cambodia and on the aerial

surveys to sight seagrass areas from the airplane. He also gave a training lecture on seagrass species identification and survey methods to scientists from the Cambodian Department of Fisheries.

### **Interview Surveys**

The third objective was to determine the cultural and economic importance of the dugong both currently and historically in the fishing villages that border dugong populations. We divided ourselves into two teams in each village. The first person we contacted in each village was the village ‘chief’ as a key informant. Sometimes the chiefs of villages also recommended people to talk with. As in Thailand, we went to stores and restaurants where people gather, and also walked through villages and stopped at houses with nets outside. We purposely tried to mix ages and genders in choosing interview respondents whenever possible. While a more random sample of interview respondents would have been optimal, we were dependent on the limited availability of the villagers.

The interview questionnaires themselves were adapted from Hines (2002), and are in Appendix I of this report in English. The interview questions were translated into Khmer by Mr. Phay Somany.

## **RESEARCH RESULTS IN CAMBODIA**

### **Aerial Surveys**

We conducted aerial surveys on four days. Sighting sheets for all four days are included in Appendix IV.

Along the western coast of Cambodia, on January 16, we saw between 55 and 65 Irrawaddy dolphins (including 2 calves), 4 hump-backed dolphins, 9 finless porpoises (*Neophocaena phocaenoides*), 11 dolphins with species unclear, and 1 sea turtle. We had a total of 24 separate sightings of dolphins. The largest group size was of 15 Irrawaddy dolphins. Once we saw a mixed group of Irrawaddy dolphins and hump-backed dolphins. We did not see dugongs on either the 16<sup>th</sup> or 17<sup>th</sup>. On January 17<sup>th</sup>, we had a total of 11 sightings of dolphins. Within those sightings we saw 10 Irrawaddy dolphins, and 7 sightings with the species unclear. Maps of sightings for January 16<sup>th</sup> and 17<sup>th</sup> are in Figures 27 and 28.

On January 17<sup>th</sup>, while on our way from Koh Kong town to do boat-based seagrass surveys, we saw a mixed group of 4-6 hump-backed and 4 Irrawaddy dolphins, including one Irrawaddy calf. The hump-backed dolphins ranged from spotted pink to one almost totally pink animal.

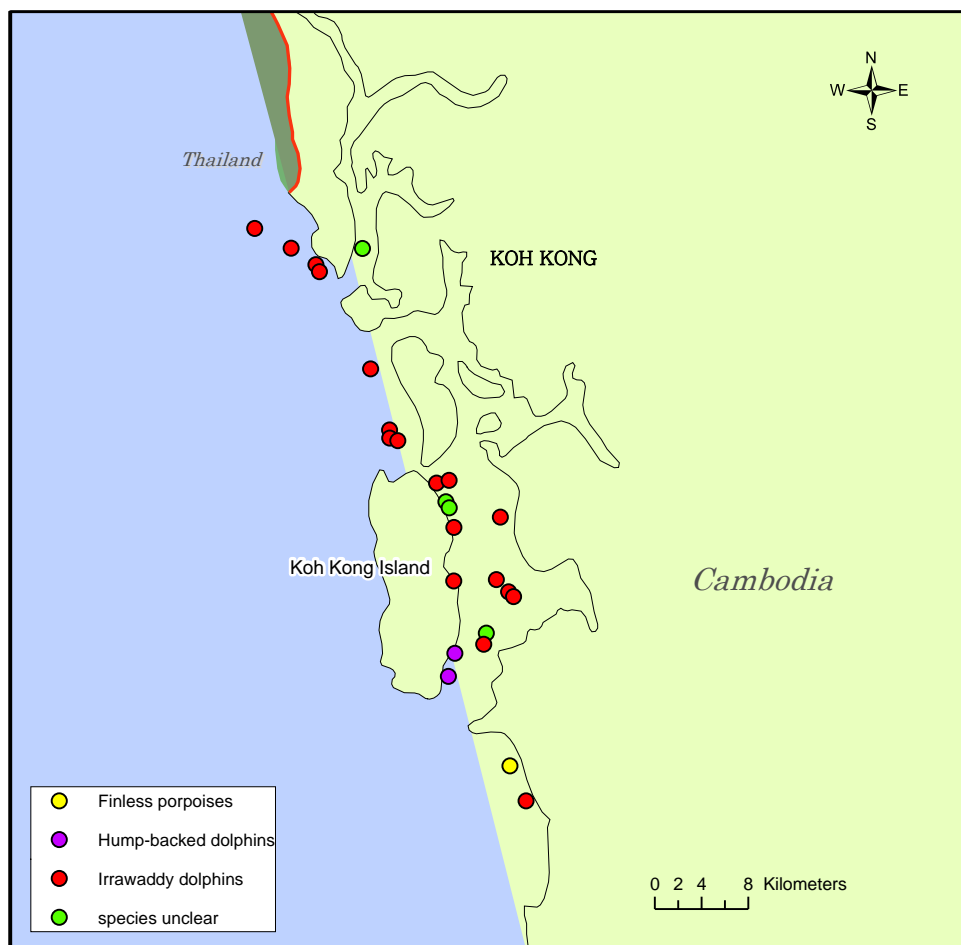


Figure 27. Sightings of dolphins in western Cambodia from January 16th, 2004.

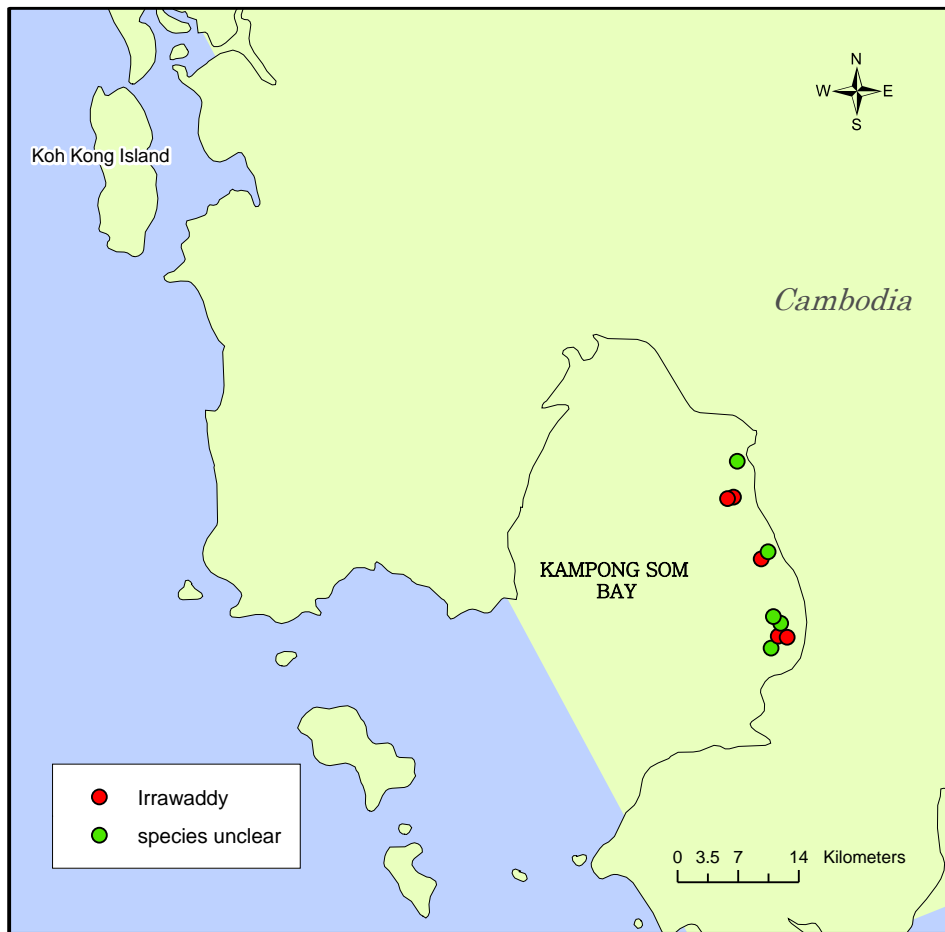


Figure 28. Sightings of dolphins in western Cambodia from January 17th, 2004.

In eastern Cambodia, on January 19<sup>th</sup> and 20<sup>th</sup>, we followed zig-zag transects starting from the eastern border of Cambodia, concentrating on both coastal areas and near-shore islands in the provinces of Kampot and Kep. We did not see any marine animals either day.

### **Seagrass Surveys**

Figures 29 (western Cambodia) and 30 (eastern Cambodia) show the seagrass beds mapped by the Cambodian seagrass scientists, and the extensions to those seagrass bed boundaries that we were able to delineate from the aerial surveys. Figure 29 also shows the locations of a boat-based survey for seagrass in the Koh Kong area. Table 17



has the results of that survey. The areas we surveyed were also in use by villagers with small pushnets catching small crabs. (Pictures of this are included with the report).

In both eastern and western Cambodia, the seagrass that we saw was plush and healthy looking. We saw no dugong feeding tracks. In eastern Cambodia, along the coast of Kampot province, we saw extensive seaweed farming in the seagrass (Figure 30), and, similar to what we saw in 2002, are of seagrass floating in the water and on the beach (see pictures). Villagers in Preak Amphil in Kampot province (Figure 31) grow seaweed and export it to Taiwan.

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Table 17. Results of boat-based seagrass surveys east of Koh Kong Island, Cambodia, on January 17<sup>th</sup>, 2004.

Point ID	Latitude	Longitude	Depth	Bottom type	Seagrass species
22	11.41895	103.03894	<1m	Sand w mud	<i>Halodule pinifolia</i>
23	11.40353	103.05094	<1m	Sand w mud	<i>Halodule pinifolia</i>
24	11.39828	103.04582	1.3m	mud	<i>Halodule pinifolia</i> (dead)
25	11.38262	103.08648	negligible	mud	No seagrass

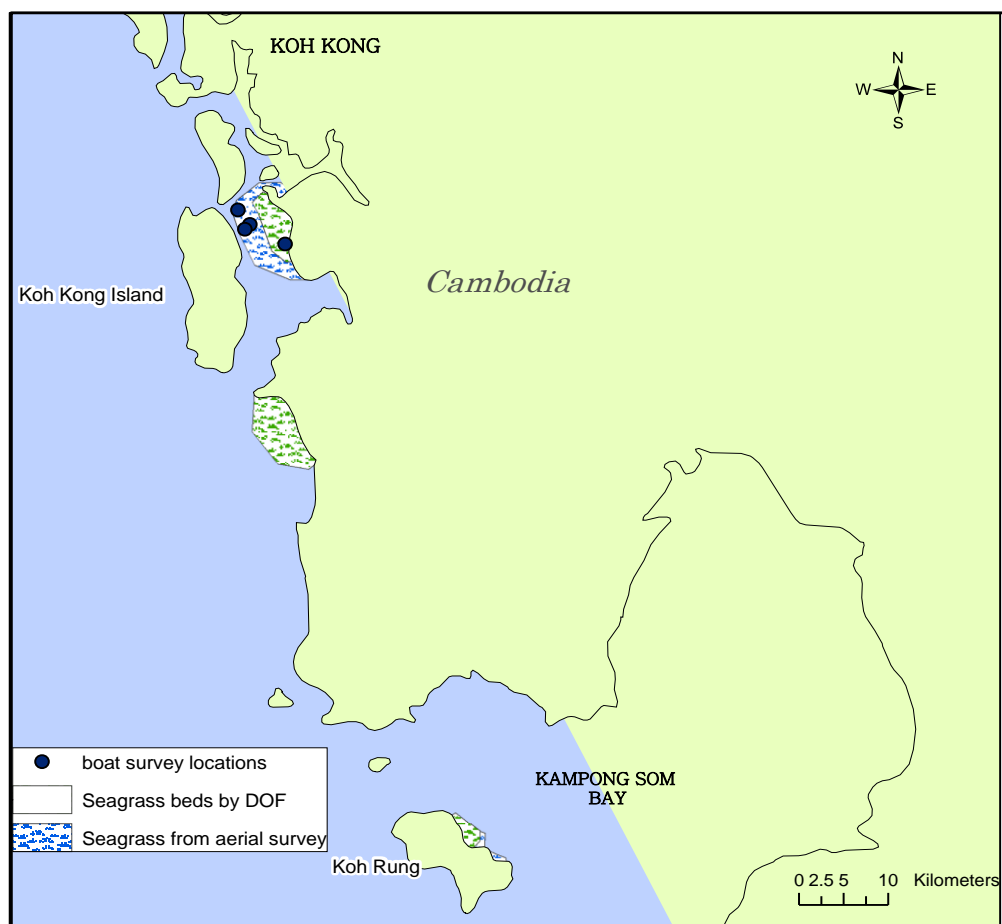


Figure 29. Seagrass bed boundaries from Dept. of Fisheries scientists and from aerial surveys in western Cambodia from January 16th and 17th, 2004.

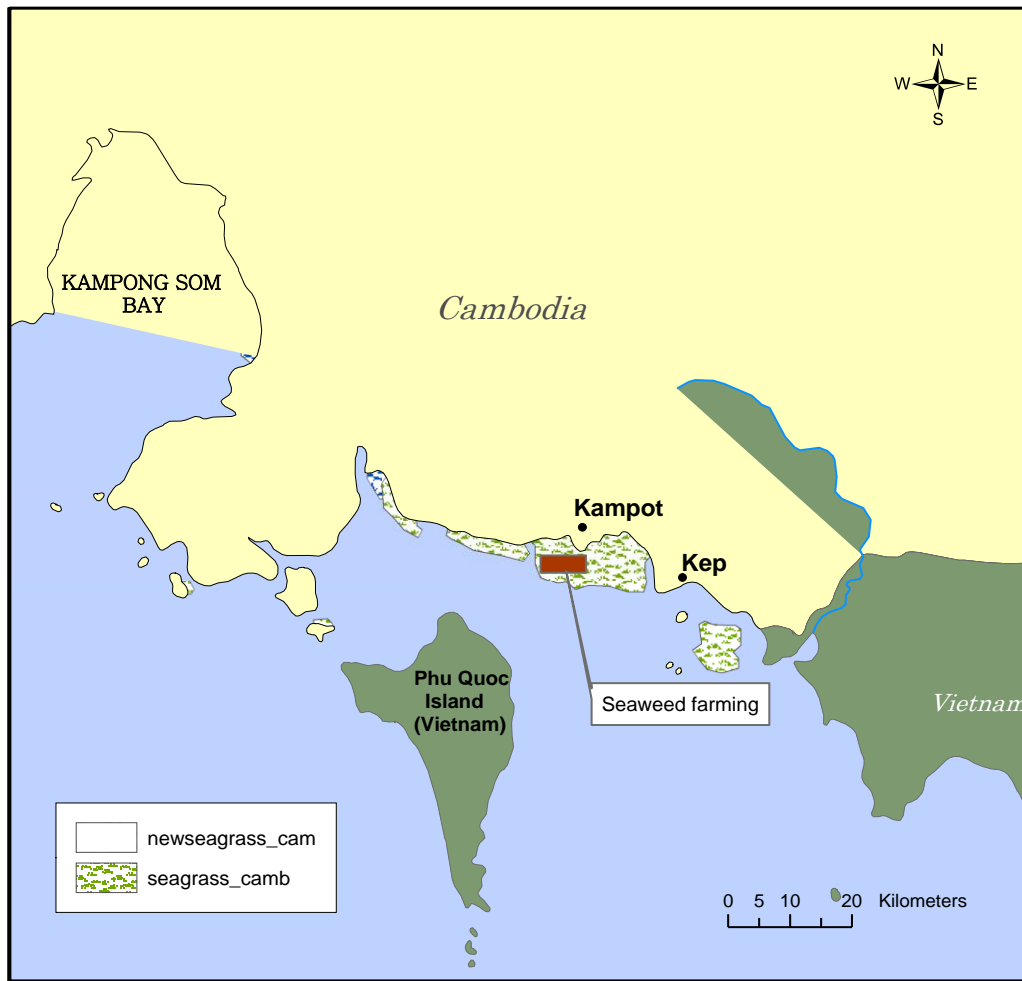


Figure 30. Seagrass boundaries from Dept. of Fisheries scientists and from aerial surveys in eastern Cambodia from January 19th and 20th, 2004.

## Interviews

Two teams of researchers interviewed 42 villagers in fishing villages in around Koh Kong Island, Kampot, and Kep provinces (Figure 31). The age spread of respondents goes from a minimum age of 19 to a maximum of 62 (Figure 32). The average age of interview respondents is 43.4 years; the median age is 42.0, and the standard deviation 10.9. We interviewed 32 men and 10 women.



Figure 31. Towns where interviews were conducted in Cambodia in 2004.

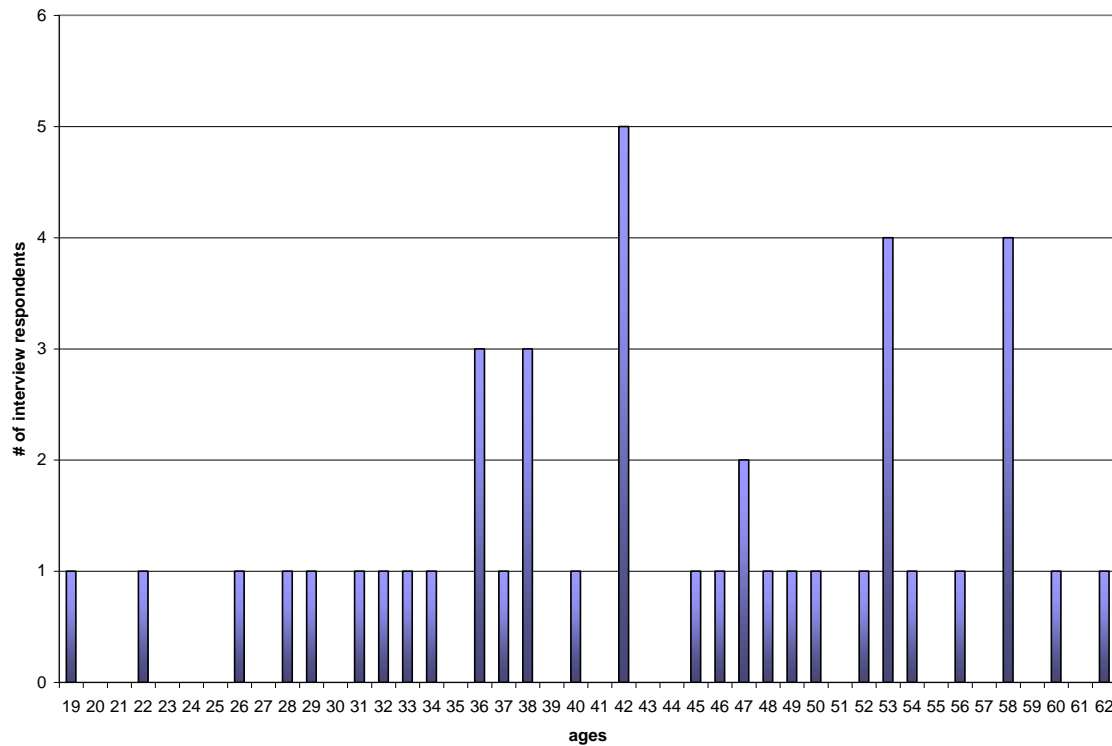


Figure 32. The distribution of ages of interview respondents for the interviews in Cambodia (2004).

In the following section, the interview results are reported in the same format as in the earlier results from Thailand. Please refer to Appendix I for complete interview questionnaires. Only three of the interview respondents had been born in the villages in which they were interviewed. Two of the other respondents had lived in their villages before 1975, left, and returned after Pol Pot was deposed; one in 1980, and another in 1992. Everyone else moved to the coast after 1979, 19 in the 1980's, 13 in the 1990's, and 5 since 2000.

We conducted two more prolonged interviews with village chiefs in fishing villages in Koh Kong province. Some of the responses outside the more formal questions give further valuable information. The chief of Peam Krasoap was interviewed on January 15<sup>th</sup>. The first topic we spoke about was the capture of dolphins from his

village. In 1993 11 Irrawaddy dolphins were captured easily by villagers using surrounding nets about 20 to 30 meters from shore. Seven were released eventually, 4 were sold to Safari World in Bangkok for 6000 baht apiece (about \$150US), and 2 of those animals were sent to Japan. In 2002, a nearby casino (near the Thai border) hired villagers to catch dolphins and paid them with rice. The dolphins caught were both Irrawaddy and hump-backed. Mr. Somany got the casino to release most of them, but the casino ended up keeping 4 dolphins.

This chief was born here, left between 1975 and 1979, and returned. He thinks there are between 100 and 200 dolphins in the Koh Kong area, and has seen mostly Irrawaddys, but also hump-backed dolphins and finless porpoises. Half the people think that catching dolphins is bad luck so they will leave a stranded animal, and if they catch a dolphin in their net, will stop fishing, release the animal and pray. The other half will not eat the dolphin, but will release it, keep fishing, and not pray. He sees more dolphins around the Chinese New Years when they come closer to shore. Every month people come from different agencies and do education and awareness programs so he hopes that the people will not catch any more dolphins.

In the village of Peam Krasoap, there are 200 families. Sixty percent of the families use crab nets and traps, 20% small set nets, 18% use gill nets to catch catfish, and 1% use small trawl nets. Fishers here average about 3000 baht a month (~\$75US). During the Pol Pot years (1975-1979) no one was here. After 1979 about 17 or 18 families came here, but around 1985-87, 70 more families came. The fishing now is declining because of the number of fishers both here and the fact that there are too many people along the coast. There is a conflict here between the local fishers and the big

trawlers that destroy the nets of the small-scale fishers. He does not think there have been dugongs here now, but he has heard that dugongs are near Chrouy Pras. Before 1975 when he was young he saw up to 10 dugongs, mostly which were caught and eaten.

We then spoke to the representative of the chief of Chrouy Pras. He moved to the village in 1987. Now there are 300 families here, last year there were 80. Before 1975 there were about 100 families here. The fishers here use crab nets and traps, gill nets, prawn nets, mostly trawlers and surrounding nets. A lot of the fishers use illegal push nets here. Local authorities want them to stop but each group of users wants the other group to change first. He has not seen dugongs near his village.

### *History*

#### 4. How long have dugongs been seen in this area?

Forty-one villagers answered this question. None of the 21 respondents from western Cambodia said that they had seen dugongs. The 20 respondents from Kampot and Kep gave answers varying from 7 to 24 years..

#### 5. Have dugongs ever been hunted in this area?

Out of the 41 responses, all of the respondents from western Cambodia said no, and 20 from Kampot and Kep said yes. Three of the villagers said that dugongs were hunted 30 years ago, one 40 years ago, and one 50. These villagers also mentioned that the dugongs were caught accidentally, but fetch a good price in the market. They also mentioned that since there is a new Fisheries law prohibiting catching or selling dugongs, they will release the animal. Note that the main interviewers were from the Dept. of Fisheries.

#### 6. Are there any legends or rituals or stories about dugongs?

There were no positive answers here.

### *Patterns*

#### 1. Where do dugongs occur?

In western Cambodia, 4 respondents mentioned that dugongs can be found in Chrouy Pras (see Figure 31), 13 said they didn't know, and 4 said dugongs are not found here. In eastern Cambodia, 20 respondents pointed out different areas. Figure 33 shows approximate areas where dugongs were mentioned near Kampot and Kep towards the Vietnamese border.

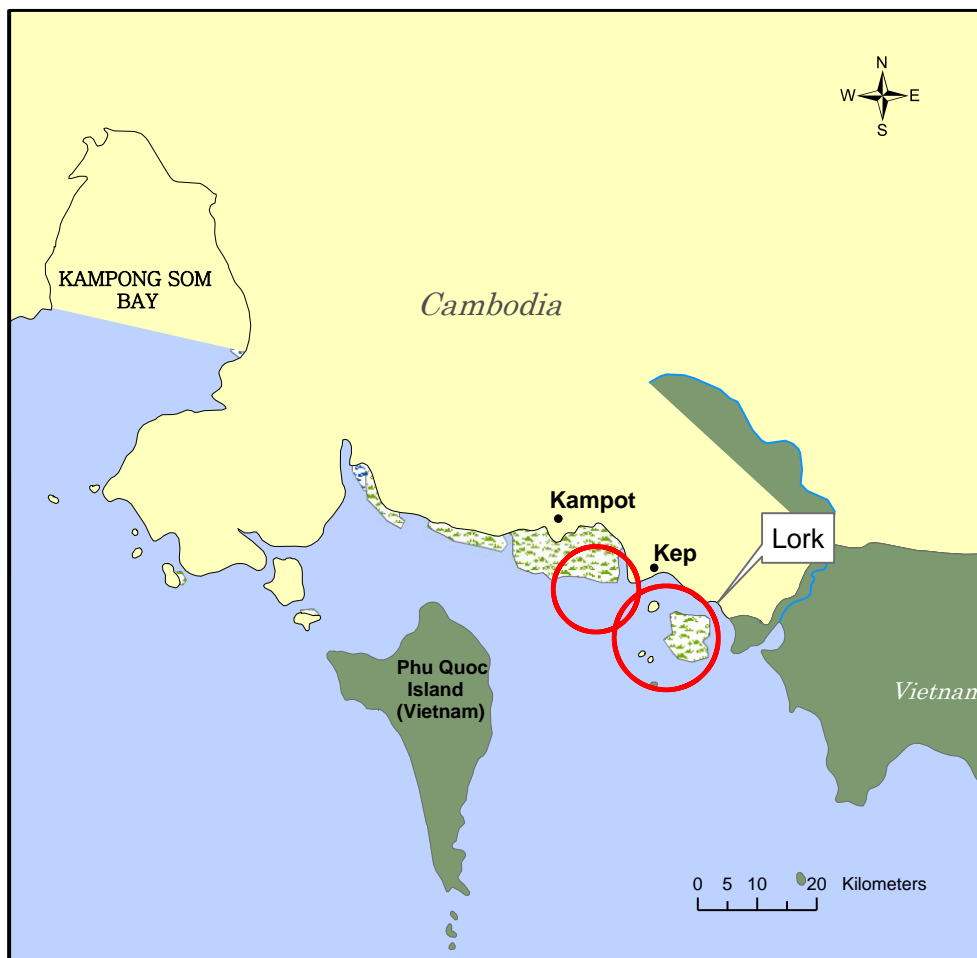


Figure 33. Areas where dugongs had been seen or caught in nets according to interview respondents in Cambodia, 2004



2. What seasons do you see dugongs?

In western Cambodia, 17 respondents said they had never seen dugongs, and 4 mentioned that they appear in dry seasons. Four respondents mentioned that they had seen dugongs at the market at Peam Krasoap (Figure 31) that had been caught at Chrouy Pras. In eastern Cambodia, all respondents mentioned seeing dugongs at the market at Kbal Romeas (Figure 31) at least once a year. The meat is sold for around \$2US/kg, and the tusks for between \$100 & \$150US. Several fishers mentioned that dugongs get injured from fighting together, then move to shallow water and get caught in nets.

3. Are they in big or small groups?

In western Cambodia, 17 of the respondents had not seen dugongs, 4 mentioned having seen single animals. In eastern Cambodia, 20 respondents had seen small groups and 1 had no comment.

4. Do you notice calves?

No calves were seen by respondents.

5. How many dugongs have you seen in the past five years?

Twenty-one respondents in eastern Cambodia had seen one dugong. In western Cambodia, 2 respondents mentioned that they had seen 1 to 2 dugongs per year before 1970, and 2 had seen dugongs before 1975. Neither respondent have seen dugongs since then.

6. What other species of sea mammals or sea turtles have you seen?

In both western and eastern Cambodia, 21 respondents had seen coastal cetaceans, and 20 of had seen turtles. In western Thailand, of the dolphins, 21 were identified as Irrawaddy

dolphins, 16 as hump-backed, and 2 as finless porpoises. Respondents had seen 4 whales; one mentioned the whale was probably a Brydes whale. Several respondents mentioned that finless porpoises are occasionally caught in fish and prawn gillnets near Pak Khlong. The turtles were identified as green (14), hawksbill (5), and leatherback (2). These villagers had seen turtles caught in hook & lines, crab nets, fish gillnets, and pushnets.

In eastern Cambodia, 21 Irrawaddy dolphins, and 4 hump-backed dolphins were seen. Villagers had seen 17 green, 2 hawksbill, and 1 leatherback turtles. In Table 18, all species seen in the research area are summarized.

Table 18. Other sea mammals or sea turtles seen by interview respondents.

SPECIES	NUMBERS
Irrawaddy Dolphins	42
Hump-backed Dolphin	20
Finless porpoises	2
Hawksbill Turtle	7
Leatherback Turtle	3
Green Turtle	31

### *Threats*

1. Are dugong numbers declining, increasing, staying the same? Table 19 shows the distribution of answers, and Table 20 outlines the various comments made in response to this question.

Table 19. How dugong numbers are declining, increasing, or staying the same.

Declining (%)	31 (74)
Increasing (%)	0
Staying the same (%)	1 (2)
No Comment (%)	5 (12)
Do Not Know (%)	5 (12)
Total # of responses	42 (100)

Table 20. Comments to the question: Are dugongs declining, increasing, or staying the same?

Comment	Where heard (Province)	Numbers of Respondents
Seagrass killed by illegal trawlers	Western Cambodia, Eastern Cambodia	24
Lots of fishing activities in the seagrass	Western Cambodia	11
Dugongs get caught every year	Eastern Cambodia	11
Enforcement of illegal fishing is poor	Western Cambodia	5
Lots of surrounding nets in the seagrass	Western Cambodia	5
The fisher population is growing	Western Cambodia	3
No more seagrass here	Western Cambodia (Pak Long)	3
Dugongs get caught in the nets of local people	Western Cambodia	1
Modern fishing gears catch dugongs	Western Cambodia	1
There is lots of seagrass	Eastern Cambodia	1
Education on dugong conservation has recently started	Eastern Cambodia	1
Totals		60

2. Do dugongs interfere with fishing or boating activities?

All 42 respondents answered no to this question.

3. Have you or anyone in the village caught dugongs in fishing nets?

In western Cambodia, all 21 respondents answered no to this question. In eastern Cambodia, one person said yes and 20 said no.

4. What would you do if you found one stranded? (report, kill, let go)

All respondents in western Cambodia mentioned that they would return a stranded animal to the sea if alive. Twenty out of 21 respondents gave the reason that dugongs were rare animals. One respondent said that he would return the dugong to sea as an example to other villagers as he is the head of the village. Four respondents gave the new fisheries law (prohibited to catch, kill, or sell dugongs) as the reason. One respondent stated that if the dugong was dead but fresh he would eat the meat, if decomposed he would take the flippers, tusks, and bones, and if alive he would kill it because he could get a high price in the market. In eastern Cambodia, all 21 respondents would return the dugong to the sea.

### *Conservation*

The following four questions asked respondents to rank the importance of conservation, as represented by dugongs, other endangered species, as well as coastal mangroves and seagrass beds (1= Very important, 2= Important, 3= Neutral, 4=Moderate, 5=Very negative). Tables 21 through 25 summarize responses and comments to these questions. Other endangered species were explained as being whales, dolphins, and marine turtles. The next question (5) asks for a choice on a continuum of positive and negative feelings about an area being designated off-limits to fishing in order to conserve

an endangered animal or system. Tables 26 and 27 chart opinions and comments on all of these questions. Table 28 summarizes answers to a question added by Mr. Somany:

“How do you want the government to help you?” Please note that some villagers made more than one comment in response to the questions.

Table 21. Opinions of interview respondents on the importance of conserving dugongs, other endangered species, seagrass, and mangroves, as reported in the interviews. Comments are summarized below in Table 22 for dugongs, Table 23 for other endangered species, Table 24 for seagrass, and Table 25 for mangroves.

	<b>DUGONGS (%)</b>	<b>ENDANGERED SPECIES (%)</b>	<b>SEAGRASS (%)</b>	<b>MANGROVES (%)</b>
Very important	37 (88)	20 (48)	42 (100)	42 (100)
Important	2 (5)	16 (38)	0	0
Neutral	2 (5)	6 (14)	0	0
Moderately negative	0	0	0	0
Very negative	1(2)	0	0	0
Total # of responses	42	42	42	42

Table 22. Comments on the importance of conserving dugongs.

DUGONG CONSERVATION COMMENTS	NUMBER OF TIMES MENTIONED (%)
Conserve for the next generation	11 (42)
Because they are facing a lot of threats	4 (15)
Dugongs are a good/lovely animal	3 (11)
Because they eat a lot of seagrass	1 (4)
For the diversity of the ecosystem	1 (4)
Education on dugong in communities would help to save the dugong	1(4)
They get caught in nets every year	1(4)
Dugong conservation would help to increase fishes in seagrass beds	1 (4)
Have never seen	1 (4)
Cannot see in Koh Kong	1 (4)
No comment	1 (4)
Total # of responses	26 (100)

Table 23. Comments on the importance of conserving endangered species.

ENDANGERED SPECIES CONSERVATION COMMENTS	NUMBER OF TIMES MENTIONED
Afraid that they will become extinct	14
Ecotourism possibilities	14
There are still lots of dolphins & turtles	12
We find a lot of dolphins stranded on the beach	7
No comment	7
Fishers catch sea turtles every month	5
Not as abundant (in Kep & Kampot) as in Sihanoukville and Koh Kong	3
Dolphins are facing threats from live capture for display	1
Dolphins help to save people from drowning	1
Total # of responses	64

Table 24. Comments on conserving seagrass.

SEAGRASS CONSERVATION COMMENTS	NUMBER OF TIMES MENTIONED
Habitat/breeding ground for marine animals	37
Food for dugongs	31
Fishing ground for small-scale traditional fishers	14
Must control illegal trawlers and other gear fishing in seagrass	13
Seagrass is a good fishing area	4
Part of the ecosystem	1
Total # of responses	32

Table 25. Comments on conserving coastal mangroves.

MANGROVE CONSERVATION COMMENTS	NUMBER OF TIMES MENTIONED
Nursery ground for marine animals	29
Protection from storms and wind	29
Seabird habitat	17
Fishing ground for communities	12
Ecotourism	10
Not as many here (Kep & Kampot) as in Sihanoukville and Koh Kong	3
Total # of responses	100

Table 26. Opinions on a local area being designated off-limits to fishing in order to conserve an endangered animal or system.

	OFF-LIMITS AREA (%)
Extremely positive	39 (13)
Moderately positive	0
Neutral	0
Moderately negative	0
Extremely negative	0
No Comments	3 (1)
Total # of responses	42 (100)

Table 27. A summary of comments on a local area being designated off-limits to fishing in order to conserve an endangered animal or system.

OFF-LIMITS AREA COMMENTS	NUMBER OF TIMES MENTIONED
The government should leave fishing areas for fishers	19
This will help increase the fish stock	13
The fishing grounds are already too small	9
There should be 2 areas in the seagrass: 1 (30%) for dugongs, one (70%) for fishing	4
This would save marine animals for local fishers	4
Trawlers should only be allowed at greater than 20m depth	3
Traditional fishing gear should be allowed	2
Would protect local fishing gear from trawlers	2
The areas should not be on the fishing grounds of local communities	2
Nursery ground for larvae	1
No comment	2
Total # of responses	58



Table 28. Summarized comments on how the government can help villagers.

COMMENTS	NUMBER OF TIMES MENTIONED
Force trawlers and electric boats away from shore	28
Strengthen fisheries law to ban trawlers from shallow waters	22
Conflicts between trawlers & traditional fishing gear (6 mentioned Vietnamese boats in their area)	21
Provide land for rice fields	17
Limit the exact distance from shore each boat can go	12
Ban local fishing activities of neighboring boats	10
Help them to replace fishing with a new career	9
Ban electric fishing gear	2
Need provincial & municipal workshops on these problems sponsored by the Dept. of Fisheries	1
Reduce fishery exploitation tax	1
Conflicts between fishers & seaweed growers	1
Do not allow fishing in seaweed areas*	1
Total # of comments	105

\*in Preak Amphil in Kampot province. This respondent mentioned conflicts between fishers and seaweed growers. He spoke as follows: “All people in Preak Amphil village do not want to do fishing any more; they have changed their fishing career from fishing to go grow seaweed. They do not allow the fishermen who live in nearby villages to operate nets near their seaweed areas. They can make the money from 30000 to 40000 riels per day. This amount of money is really bigger than the money which they got from their fishing career.”

### *Locations and History of Strandings*

The first question in this section asked if respondents had ever found any dugongs or dolphins stranded. Forty-two villagers answered with 38 positive and 3 negative responses. Table 29 summarizes comments.

Table 29. Animals found stranded as related by interview respondents.

	NUMBER OF TIMES MENTIONED
Irrawaddy	22
Hump-backed	2
Dolphins (no species)	1
Whales (no species)	1

Where were strandings found?

Table 30 shows the areas mentioned by villagers in response to this question.

Table 30. Areas where villagers have heard of dolphins being stranded.

Area	# of times mentioned
Peam Krasoap	9
Pak Long	9
Koh Kong	4
Koh Kape	7
Kep	8
Kampot	13
Sihanoukville	1
Do not know	1

When were these animals found?

- All 38 respondents who responded positively mentioned that since they have lived by the coast they have seen a few dolphins found stranded each year.

The following 4 questions asked for details about dolphin strandings:

1. What size were these animals?

- All animals seen were adults.

2. Were they dead?

- All animals seen were dead.

3. Did you notify any officials, who?

- Out of 38 responses, only 3 villagers reported the strandings to provincial Fisheries officials.

4. What happened to the animal or the body?

- Table 31 summarizes comments.

Table 31. Comments on what respondents did with stranded dolphins.

Comment	# of times respondents mentioned
Buried	29
Left	7
Bury and have monk do ceremony/bad luck to kill or catch	21
Leave on beach: do not want to touch and stay by	6
Bury to protect the environment from the smell	8
Usually leave, but last time told provincial Dept. of Fisheries	4

### *Medicinal Use*

1. Have you used any parts of a dugong's body as medicine or amulet or aphrodisiac?

All of the 42 respondents said no to this question.

2. Have you heard of using any parts of a dugong's body as medicine?

All respondents answered yes. The specific comments are summarized in Table

32. Note: some respondents mentioned more than 1 use.

Table 32. As reported in interviews; what dugong body part was used, for what purpose, and how it was prepared.

	NUMBER OF TIMES MENTIONED
Use the oil as a rub for rheumatism	38
Use the bone as medicine for fever for children	21
Use the tusks as amulets	19
Meat for consumption	7
Dugong hair as medicine for tooth pain	5
Hangs tusks on the wall of house to protect against ghosts	4
Hangs the flipper on the gate to protect against ghosts	1

## CONCLUSIONS AND RECOMMENDATIONS IN CAMBODIA

Cambodia is a complicated situation, dugong-wise. We did not see any, but we did see quite a bit of seagrass. The seagrass was plentiful, however we also saw quite a bit of activity in the seagrass, such as people fishing in the seagrass both with motorized and human-driven pushnets. We also saw seaweed farming in the seagrass beds. The seaweed farming is supported by the Dept. of Fisheries and brings in a better living for villagers, other fishers see it as taking fishing area, and this activity, while we do not believe it is harmful to the seagrass, is a fixed structure in the seagrass which could discourage dugongs from or trap dugongs while foraging.

People, especially those in eastern Cambodia, had not seen dugongs themselves, but in western Cambodia had heard of dugongs being caught and taken to market to be sold. Respondents in Peam Krasoap heard of dugongs in Chrouy Pras, but in Chrouy Pras no one had seen them.

Further research on dugongs in Cambodia is definitely needed, as is further research on coastal seagrass. In western Cambodia, the amount of seagrass that we found, plus proximity to the Thai coast brings the possibility of the same animals using

both areas for foraging. As most of the fishers here use crab nets and traps, they fish only when the tide is at its lowest, and very close to the shore, and might not see the animals. Here, with the proximity of the small airport at Koh Kong, aerial surveys are feasible, and it might be possible to get permission to use the ultralite in the area for both dugong and dolphin surveys. The pilot told me it would take at least a year for the permits. The Cessna was quite expensive to use, and we were not able to circle in time to see the animals clearly in many instances.

In eastern Cambodia, the seagrass was plentiful as well, but again very used by locals. While no one had seen dugongs while fishing, or stranded dugongs along the beaches, respondents mentioned areas where they thought dugongs were, and knew about using dugong body parts. This area is also close to Phu Quoc Island in Vietnam (Figure 33), where we found dugong hunting and reports of commonly finding dugongs in our interviews in 2002. Respondents in Phu Quoc also told us that dugongs and seagrass were between their island and the Cambodian coast. This point was also made by Vietnamese scientists at a 2002 workshop on the status of dugongs in Vietnam (Hoa, in Cox and Hines 2003). Further aerial surveys here are prohibitive mainly because of the expense and the fact that the closest airport is in Phnom Penh. There is a possibility that a small airport in Kampot might be restored.

Most respondents had heard of dugong body parts being used as medicine or tusks used as amulets, but only one person admitted to having done so! There is a new fisheries law that prohibits catching dugongs or using body parts and our interviewers were Fisheries officials so that is not surprising.

In summary, threats to dugongs along the Cambodian coast include incidental catch from both small-scale and illegal commercial fishers, some direct catch when an animal is seen, the common knowledge of and large profit from the sale of dugong body parts as medicine or amulets, and probably the most insidious, the increasing use and degradation of seagrass beds by an ever-increasing number of people living at the coast. The shrimp farms that are being started next to the coast will destroy the present seagrass beds as well. While there are similarities to Thailand (both the Andaman coast and the eastern Gulf coast) in the threats to dugongs, actually a threat to all marine life is the unrestrained growing number of people trying to make a living from rapidly depleting resources.

Dolphins are commonly seen along the Cambodian coast. Beasley *et al's* (2002) surveys along Cambodia's coast were the first systematic surveys in this area, finding 9 species of coastal cetaceans. While we only saw cetaceans (Irrawaddy and hump-backed dolphins, and finless porpoises) in western Cambodia, all respondents and Beasley *et al's* surveys all along the coast reported seeing dolphins, and all but one of our respondents have seen sea turtles. All respondents except for 4 have seen stranded dolphins, and most of those Irrawaddys. From the interview with the chief of Peam Krasoap, we also know that as lately as 2002, dolphins are being freely captured for oceanaria. Paradoxically, we also heard from the interviews that, mainly on the west coast, people have "strong beliefs" about dolphins, and hire a monk to have a ceremony if they find a stranded dolphin or trap on in their nets.

Since 1979 many people have moved to the coast and started fishing. One village we visited went from 80 people in 2002 to 300 now. The Cambodian coast is

impoverished and overfished, and the people commonly use either motorized or people-powered push nets in the seagrass. Seaweed farming in seagrass beds is being pushed by the Department of Fisheries as an alternative to fishing as well. There are serious conflicts, as in Thailand, between small-scale fishers and commercial trawlers (many from Vietnam) that fish illegally close to shore, and shrimp farming is starting right at the shoreline.

Any further research in Cambodia needs, in our opinion, to incorporate working with the Department of Fisheries and local and international NGO's such as the Wildlife Conservation Society and World Wildlife Fund Indochina to create educational programs, put up signage in areas where dugongs and dolphins are found (a request from the Dept. of Fisheries), and exploration of sustainable, non-destructive fishing alternatives, such as have been instigated by NGO's in Thailand by groups such as Yadfon and the Mangrove Action Project. Protected area designations without empowering and relieving the poverty and conditions of local fishers would not be effective. Most of the people we interviewed moved to the coast within a dozen years after leaving Pol Pot's camps in 1979, and have not had a history of long-term planning or sustainable solutions. While knowledge of the need for conservation is present, day to day hardship seems to place its own priorities.

The history of genocide and current poverty create an atmosphere for no easy answers. While all respondents agreed that conservation was important, their comments when asked about protecting an area of seagrass showed contradictions: on one hand, a protected area would allow fish to grow and make sure no illegal trawlers could fish there, on the other, there are already too many people fishing in too small an area. Mr.

Somany's question on how the government can help elicited requests for government regulations and enforcement to protect fishing grounds from illegal trawlers, fishers from neighboring villages, and seaweed growers. The seaweed grower we spoke to talked about keeping fishers away from the seaweed farms. Twenty-six (24.7%) of the respondents wanted alternative livelihoods, 17 of them wanted to farm rice.

Recommendations here in Cambodia come from several directions, which ideally would work together. The threat to the near-shore ecosystem, the marine mammals and its other fauna and flora from the people who live there, the poverty and the needs of those people, and their reliance on a quickly degrading environment are all intertwined, and no effective solution would address only part of these threats. Continuing research needs to be conducted by local researchers and supported if not by a government with little resources, then by concerned NGO's. Researchers and research cooperation from neighboring countries also needs to be encouraged and organized. International researchers and organizations need to focus on supporting local and regional research and training local researchers.

International organizations are also urgently needed to help fund and train health and sanitation workers, environmental educators, as well as to seek solutions and train villagers in alternative, non-destructive livelihoods. Legislation, if fairly conceived and well-enforced can form the backbone for change. But only if social conditions and the values perceived as a result of current social capital encourage self-regulation as well. Our respondents were aware of the new Fisheries laws and the need for conservation. Perhaps the dolphin, as a sacred animal to many villagers, could be the representative, or flagship, for a campaign to increase environmental awareness in conjunction with efforts



to improve living conditions and ensure that illegal and destructive fishing practices are effectively outlawed.

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