

Community Perspectives and Conservation Needs for Dugongs (*Dugong dugon*) Along the Andaman Coast of Thailand

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ABSTRACT / The dugong is classified as vulnerable to extinction by the World Conservation Union on the basis of

declines in area or extent of occupancy, habitat quality, and actual or potential levels of exploitation. In Thailand, the largest groups of dugongs are found near islands off the Andaman coast. The authors conducted a 2-year project that included dugong population and habitat assessment as well as interviews with local fishers. The results indicate declining populations of dugongs. The largest threat to dugongs is incidental catch in fishing nets. The numbers of deaths reported place the dugong population along the Andaman Sea in danger of extirpation. Other threats include seagrass destruction both from fishing and coastal development and the use of dugong parts for medicinal purposes. Villagers still show strong ties with dugongs, and the majority favor establishing more large protected areas for the species. These should arise from an integrated national dugong and seagrass conservation strategy formulated by concerned stakeholders from government, nongovernmental organizations, scientists, and local communities. The strategy needs to be both top down and bottom up in its formation to balance existing and potential uses as well as conflicts between artisanal and commercial fishers. The strategy should include the development of educational materials and enforceable regulations, as well as the designation of community-protected seagrass beds and a system of dugong sanctuaries along the Andaman coast. An integrated management plan is needed urgently, with the continued input of concerned scientists, to monitor and increase knowledge of dugong behavior and distribution.

Dugongs are one of four surviving species in the *Sirenia* order, and the only living member of the *Dugongidae* family (Marsh and others 1997). They once were common along tropical coasts from East Africa to Australia, but now are rare over most of this range (Marsh and others 1999) and classified as vulnerable to extinction (IUCN 2004). The Convention on Interna-

tional Trade in Endangered Species of Wild Flora and Fauna (CITES) has banned international trade in dugong products (UNEP-WCMC 2004).

The dugongs' dependence on specific species of seagrass combined with its low birth rate makes the species especially vulnerable to disturbance (Boyd and others 1999). Depending on seagrass availability, dugongs, which have an approximate gestation period of 14.5 months, do not reach sexual maturity until the age of 6 to 13 years, and give birth only every 28 to 39 months (Kwan 2002). Estimates suggest that a dugong population can afford to lose only 1% to 2% of its breeding females in 1 year if it is to maintain its population numbers (Marsh and Lefebvre 1994).

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Little is known about the status, distribution, and conservation needs of dugongs in most of Southeast Asia (Marsh and others 2002). To rectify this lack of information, researchers interviewed a sample of 145 villagers along the Andaman Sea coast of Thailand in 2000 and 2001 regarding their experiences with and attitudes toward dugongs. The purpose of this article is to illustrate the use of interviews to assess the status of the dugong and ongoing threats to its survival, to describe the relationship of the dugong with the local population, and to develop recommendations for a workable conservation plan.

Background

Dugongs Along the Andaman Coast

In the past, dugongs were seen regularly along the coasts of the Andaman Sea and the Gulf of Thailand, but they now are confined largely to isolated population groups off the Andaman coast. On the basis of aerial surveys, interviews, and stranding records, we estimate that 200 dugongs now live in this area (Hines 2002, Hines and others 2005).

There are three major threats to dugongs along the Andaman coast. The first threat is the incidental catch of dugongs in fishing nets. Both illegal fishing practices (using dynamite, cyanide fishing, or push-nets) and legal fishing (using small mesh seines and gill nets) can harm dugongs directly and damage seagrass beds. A major problem on the Andaman coast is the encroachment of large commercial fishing trawlers and push-netters into shallow coastal waters. These boats damage seagrass beds and catch dugongs incidentally.

The second threat is the valuing and selling of dugong body parts, including tusks and tears, as amulets and medicine (Hines 2002). The third threat is the increase in coastal populations and development that is destroying seagrass beds and leaving the dugong vulnerable to the effects of increasing habitat fragmentation (Roberts and Hawkins 1999). The re-colonizing ability of dugongs and the extent of their movement in this region are unknown, and the increasingly patchy distribution of seagrass beds may place the remaining animals at added risk of extinction from environmental and demographic stochasticity. Attempts to mitigate these threats and devise an effective conservation plan are hampered by insufficient knowledge of the locations and numbers of dugongs as well as the varieties and amounts of seagrass. If officials cannot estimate how habitat loss or change, incidental mortality, or stochastic environmental events will affect the dugong, they cannot determine how best to protect the animals.

Study Area

The six coastal provinces along the western coast of Thailand—Ranong, Phang-nga, Phuket, Krabi, Trang, and Satun (Figure 1)—contain 621 fishing villages and an estimated 15,742 small-scale fishing households with an average of five members per household (Sielert and Sangchan 2001). Trang province has the largest population of dugongs remaining in Thailand, estimated at a minimum population of 123 dugongs (Hines 2002, Hines and others 2005).

Methods

Interviews were conducted in 13 villages in Phang-nga province; 7 villages in Kuraburi and Thap Lamu on the western Andaman coast, and 6 villages on the Yao Islands in Phang-nga Bay. Moving south, researchers conducted interviews in six villages on a group of islands in Krabi province, seven coastal villages in Trang province, and six villages in Satun province (Figure 1). Villages were selected as interview sites because of dugong sightings or strandings that fishers and scientists had reported to the Phuket Marine Biological Center over the previous 5 years. The objectives of the interviews were to ascertain whether dugongs had been observed by local fishers either in the past or recently, to discuss the influence of the dugong in the lives of villagers, and to seek local opinions about the importance of dugong and seagrass conservation.

Several methods were used to select interview subjects within villages. In some areas, we contacted people recommended by local nongovernmental organizations (NGOs). We interviewed heads of villages, considering them key informants, and other villagers whose role in the community made them knowledgeable (Tremblay 1982). They in turn recommended additional interview subjects. We also sought subjects at houses with nets hung outside and at stores and restaurants where people gathered. When possible, we tried to achieve a mix of ages and genders in each group.

Thai-speaking researchers conducted 86 interviews with a total of 145 individuals in 2000 and 2001. Because most people did not feel comfortable speaking alone, most of the interviews were conducted with groups of people who all felt free to comment at any time. Often groups agreed on joint responses to questions.

The average age of the 110 men and 35 women we interviewed was 40.9 ± 14.6 years (range, 7–100 years). Most of the men were fishers (87%). The remaining men were boat drivers, shrimp farmers, rubber plantation workers, and store workers (each 3%), and

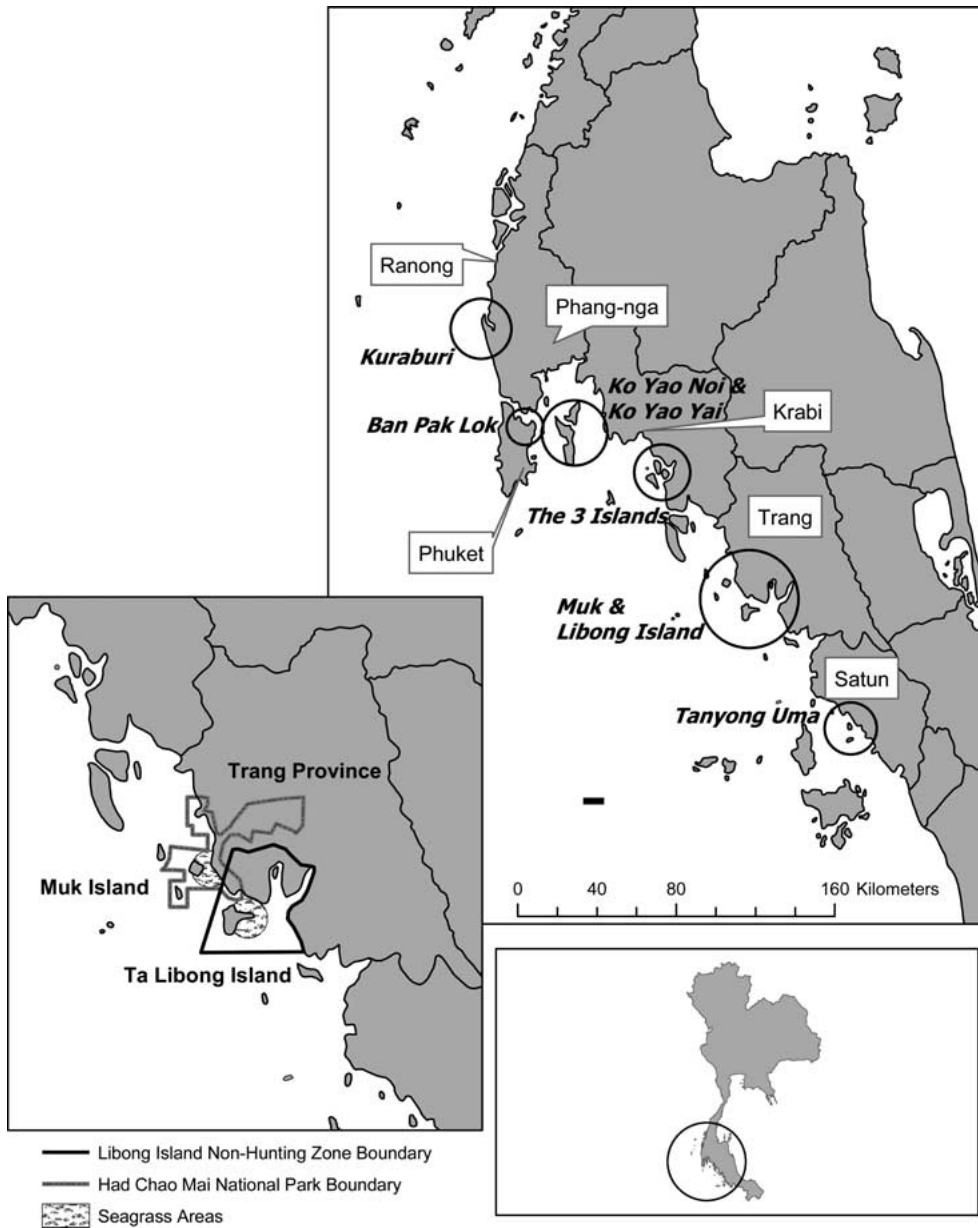


Figure 1. The circled areas are interview survey locations along the Andaman coast of Thailand in 2000 and 2001. The inset map shows boundaries of Had Chao Mai National Park and the Libong Island Nonhunting Zone in Trang Province.

teachers, fish packers, and retirees (each 1%). Fishers represented 45% of all the professions for women. Store worker and shell collector each represented 15%.

The questionnaire included a mixture of open- and closed-ended questions (Hines 2002). The interview process was unstructured and exploratory, designed to open a dialogue rather than undertake a formal empirical attitudinal survey. Several of the closed-ended questions were followed by a probe question (e.g. "Do you think this is important? Why or why not?"). The interviewers were encouraged to elicit discussion on related topics of interest, as recommended by White (1986).

The advantage of this approach is that it elicits unanticipated valuable information. Its disadvantage is the increased difficulty it poses for judging the reliability of responses (Broadfoot 2000). Any interview response can be fallible, but we are confident that respondents were sincere and considered the questions relevant because they were speaking about resources that affected their livelihood. Their reliability was further confirmed when the dugong sites they pointed out on bathymetric maps of the surrounding area (Figure 2) largely corresponded with those found in aerial surveys and seagrass field studies (Johannes and others 2000).

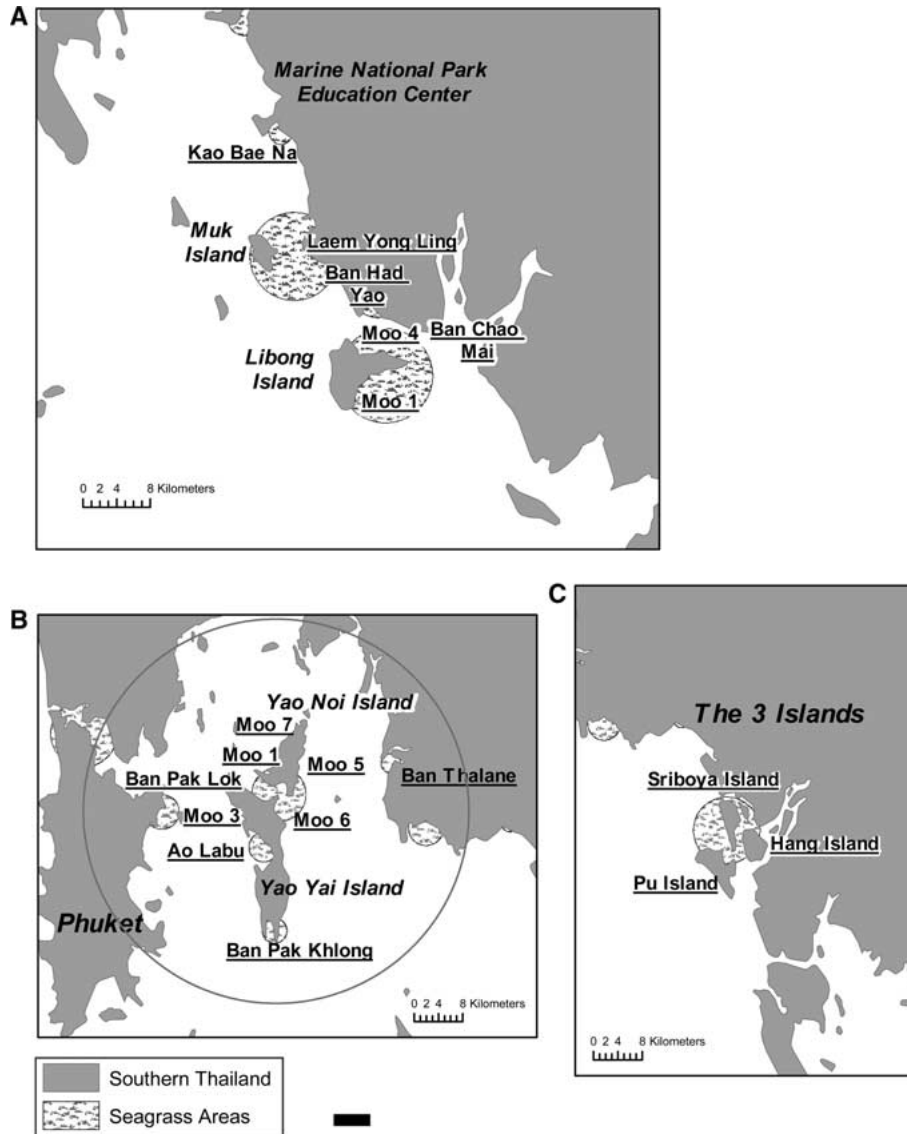


Figure 2. The underlined place names denote locations where interview respondents have seen dugongs in (A) Trang province, (B) the Yao Islands in Phang-nga province, and (C) the Three Islands in Krabi province.

The questionnaire was based on an earlier dugong survey in Vanuatu by Chambers and others (1989). We asked about past interactions with dugongs, current and former hunting practices, patterns of dugong sightings, current and former use of dugong body parts as amulets or medicine, sources and levels of dugong mortality, and dugong legends, stories, and beliefs. We also asked villagers their opinions on threats to dugongs, the importance of conserving dugongs and seagrass, and the value of designating areas off-limits to fishing to conserve dugongs, seagrass, and mangroves (Marsh and Lefebvre 1994). Mangroves, although not used directly by dugongs, were included as a measure of environmental knowledge.

Results

The interviews showed that the numbers and patterns of dugongs sighted, conservation awareness, and current and former use of dugong body parts as food, medicine, and amulets vary among sites. This article focuses on results from Trang, the Yao Islands in Phang-nga Bay, and Krabi because they illustrate and explain these differences most clearly. Complete interview results can be found in Hines (2002).

History and Sightings

In Trang province, during 2000 and 2001, we interviewed 55 people ages 16 to 100 years in 35

interviews. All but one of the villagers (who was not a fisher) had seen dugongs (Figure 2A). In their lifetimes, 16 villagers said they had seen hundreds of dugongs, 15 villagers claimed to have seen 2 or 3 dugongs every time they fished, and 3 villagers saw 1 or 2 animals a year. Villagers said the hunting of dugongs had stopped 2 to 26 years earlier.

In Phang-nga province, on the Ko Yao Noi and Ko Yao Yai Islands in Phang-nga Bay (Figure 1), we conducted 15 interviews with 38 people ages 11 to 54 years. Most of the interviews were conducted with groups of five to seven villagers who gathered specifically to speak with us about dugongs and conservation issues. In these areas, illegal commercial trawling and push-netting are major concerns.

In two of the interviews, we were told that dugongs are seen all the time, and once that local fishers see at least one dugong a day (Figure 2B). Eight respondents said they had seen between one and eight dugongs in the past 3 years, and between one and four dugongs in the current year. One respondent had never seen a dugong, but had heard that other fishers see them occasionally swimming in pairs. All respondents agreed that dugongs had never been hunted in this area, but that they did get caught in fishing nets.

In Krabi province, we interviewed 14 people in 8 interviews in villages directly adjacent to seagrass beds on the islands of Pu, Hang, and Sriboya (Figure 2C). Three of the respondents reported seeing many dugongs. Two respondents had seen none lately; two had seen only one in the previous year; and one commented that he saw more dead than living dugongs.

Five of the eight respondents had heard of dugong hunting in the past. One villager said hunting had stopped in 1980. Another informed us that the NGO Yadfon had come into the area in 1994 and had educated villagers about not hunting dugongs.

Legends

We asked respondents about dugong legends on the assumption that these legends are a measure of the current and long-term inclusion of the animal in local culture. In Trang, legends were related in 27 interviews. The stories told most often (13 interviews) were variations on a legend about a pregnant woman who began craving seagrass. When she stood in the sea as the tide rose, different parts of her body turned into those of a dugong. Six people asserted that the tears and hands of the dugongs and the fact that they nurse their young proved that they once were human. Four people said their human ancestry explained why dugong tears were aphrodisiacs.

In Phang-nga province, no legends or stories about dugongs were reported in 5 of the 15 interviews. The most common story (four occurrences) was that dugong tears were used as an aphrodisiac. Two villagers said old people knew stories. Others said the dugong was a mermaid and people loved mermaids, that dugongs love their mates and always travel in pairs, and that dugongs breastfeed their young like humans. We also heard another version of the woman-turning-into-a-dugong story.

Three respondents in the Three Islands area (Krabi province) had heard of legends about the dugong. One person told us about using dugong tears as a love potion. Another told us that dugongs once were human, and two individuals related the woman-becoming-a-dugong story.

Mortality and Threats

When asked about threats to the dugong, 26 respondents from Trang said their numbers were declining. Six said their numbers were increasing as a result of rising conservation awareness, the proximity of the Had Chao Mai National Park and the Libong Island Non-Hunting Zone (Figure 1), and decreases in the number of push-nets.

Ten groups of respondents in Phang-nga agreed that dugong numbers were decreasing. However, three interviewees said that dugongs were increasing thanks to villagers' conservation and patrol efforts that had resulted in fewer push-nets. In Krabi, all respondents agreed that dugong numbers were decreasing because of increased illegal push-nets that catch the dugongs and destroy the seagrass.

A stranded dugong is a dead animal found on land or a live one unable to swim out to sea, either because of natural causes or because it was caught in a fishing net and released. In Trang, 26 people commented on stranded dugongs, with 13 saying they had never seen one and the other 13 saying they had. Seven of the latter group said they had found dugongs alive within the last 7 years and had let them go. Six of the dugongs found dead had been eaten, or the teeth, bones, tusks, or skin had been kept. All of these last six dugongs had been taken within the past 7 years except for one animal caught 30 years ago. One respondent mentioned that several dugongs are found stranded every year.

When asked what they would do if they found an animal stranded, 16 respondents answered that they would help the animal if it were alive. Three added that they would eat the dugong if it was dead. Seven respondents said they would tell local government officials. Three respondents said everyone in the village knew when a dugong was found, and that they would

Table 1. Opinions of interview respondents in Trang, Phang-nga, and Krabi provinces on the importance of conserving dugongs, other endangered species, seagrass, and mangroves

	Dugongs n (%)	Endangered species n (%)	Seagrass n (%)	Mangroves n (%)
Trang Province				
Very important	18 (64)	15 (54)	12 (41)	12 (43)
Important	10 (36)	13 (46)	15 (51)	14 (50)
Neutral	0	0	2 (8)	2 (7)
Moderately negative	0	0	0	0
Very negative	0	0	0	0
Phang-Nga Province				
Very important	10 (77)	10		
Important	2 (22)	3		
Neutral	1 (1)	0		
Moderately negative	0	0		
Very negative	0	0		
Krabi Province				
Very important	6 (100)	5		
Important	0	1		
Neutral	0	0		
Moderately negative	0	0		
Very negative	0	0		

ostracize anyone who tried to kill an animal to sell its body parts.

Eight respondents in Phang-nga had found stranded dugongs, one just 10 days before the interview. All the respondents said that if a stranded dugong were found alive, they would help it back into the water. If it was dead, four groups agreed they would notify the Phuket Marine Biological Center. One person in these groups said he would show the animal to his children first. A second individual said that the dugong was too like humans to eat, and a third person said that his people, as Muslims, would not eat the dugong. One respondent said he would talk to other fishers to decide what to do. Another would take the tusks and teeth to show children and throw the body into the ocean. A single respondent said he would eat the meat and collect the bones, tusks, and teeth for medicine.

Every respondent in Krabi except one had seen stranded dugongs. One had found three dugongs in 3 months. One person commented that in the preceding 4 years, four dugongs had been found dead in the area, and no one knew why they had died. If they found a stranded dugong alive, six villagers said they would help it into the water, and one said he would leave it where it was. On finding a dead dugong, four fishers said they would take the bones and tusks for medicine. Two would take the meat, and one would report it to the local government.

Use of Dugong Body Parts

In 20 of 35 interviews in Trang, respondents reported using (either currently or in the past) dugong

Table 2. Summary of comments made by interview respondents from Trang, Phang-nga, and Krabi provinces on conserving dugongs

	No. of responses
Trang	
Important species for a healthy ecosystem	10
Wants children or grandchildren to see in future	7
So that tourists will come and see dugongs	3
Dugongs are like humans	2
Not many places left for the dugong; here is one of the few	1
Phang-Nga	
Wants to help preserve endangered species	6
Wants children or grandchildren to see in future	3
Important species for a healthy ecosystem	3
Dugongs are found dead because people with money can use push-nets	1
Fishermen are now more cautious about catching them in their nets	1
Krabi	
Wants children or grandchildren to see in future	2
Wants to help preserve endangered species	1
No comment	3

body parts as amulets or medicine or had heard of such use. Throughout the three provinces, the majority of uses mentioned were medicinal (74% of 50 responses). The respondents stated that dugong bones, tusks, oil, and skin are useful as tonics and for skin problems, arthritis, and acute fevers and colds. As mentioned by

14% of the respondents, dugong tusks especially can be used as protection against evil, impotence, and stinging sea animals. The use of tears as an aphrodisiac was mentioned by three respondents.

In Phang-nga, all the respondents except one had heard about the use of dugong body parts. All the remaining respondents had heard of using dugong tears for amulets. Four groups specified that they had heard about the use of dugong parts from older people, but had never used dugong parts themselves. Two groups said they had heard that pairs of tusks could be sold for 10,000 baht (\$240 US).

Only one respondent in Krabi province spoke about specific uses for dugong oil and tusks. However, all the respondents mentioned that there was a profitable market for selling bones and tusks through a middleman to shops in Krabi city, where they were made into rings and necklaces to protect the wearer from evil. The middleman turned out to be one of the village leaders on Sriboya Island.

Conservation

In answer to conservation questions, all the Trang respondents said they considered the conservation of dugongs, endangered species, seagrass, and mangroves to be important (Tables 1 and 2). A total of 15 respondents were moderately or extremely positive about designating an area as off-limits for fishing to conserve dugongs. Seven people were neutral, and six felt either moderately or extremely negative. According to their comments, seven respondents were concerned about the subsequent availability of resources, six believed that an off-limits area would be good for local conservation, and five were unsure if the protected area could be enforced sufficiently.

Whereas 12 groups in Phang-nga province considered dugong conservation important, 1 group was neutral (Tables 1 and 2). Seven interview groups were either extremely or moderately positive about designating an area as off-limits to fishing. Three groups were neutral, and three were either extremely or moderately negative. Individual comments included concern over availability of resources ($n = 4$), a feeling that this area might not be an appropriate selection for conservation ($n = 6$), uncertainty about enforcement ($n = 2$), belief that local people already know what is needed ($n = 1$), and insistence that locals have to designate so they know the boundaries ($n = 1$).

In Krabi, all the respondents considered dugong conservation very important (Tables 1 and 2). Opinions about an area declared off-limits to fishing varied from one extremely positive and three moderately positive to one mildly negative and one extremely

negative. The Krabi respondents were concerned about resources ($n = 2$) and enforcement ($n = 2$). One person commented that the area would be good for conservation, and one said that locals already know where not to fish.

In Trang, Phang-nga Bay, and Krabi, 80% of those interviewed thought that the number of dugongs was shrinking, and all believed that the conservation of dugong and other endangered species was important. Most also believed it important to conserve mangroves and seagrass beds. From the three provinces, only 20% of the respondents responded negatively to the idea of establishing protected areas for conservation. Whereas 41% of those who answered were worried that protected areas would reduce their income, food, and fishing space, 15% said that enforcement against illegal and destructive fishing and creation of conservation areas were needed.

Discussion

According to the interview results, respondents saw the status of the dugongs along the Andaman coast to be declining on the basis of habitat loss and disturbance, incidental catch, and the value of body parts as medicine and amulets. The interviews were informative about the conservation issues affecting the coastal villagers, and their awareness of the role the dugong plays within local culture and the nearshore environment. These results will be useful contributions to educational and co-management planning.

History, Sightings, and Legends

In all three provinces, respondents had heard stories about dugongs. The incidence of the common legend about the woman turning into a dugong along the coast indicates that there is an inherent and traditional knowledge in villagers about dugongs that speaks to a long-term awareness of the animals. The dugong is still an important presence in the lives of the villagers, a significant part of their immediate surroundings. Few interview respondents had never seen a dugong, and all were aware of them. Half of the interview respondents had personally seen dugongs within the preceding year. When a dugong is seen, alive or dead, the entire village hears about it.

Mortality and Threats

Marsh and Lefebvre (1994) have stated that many of the countries within the range of the dugong report incidental catches in gill nets. One of the largest problems for the dugong along the Andaman coast is certainly that of being caught in stationary nets, gill

nets, and push-net trawlers. The villagers interviewed were aware of this problem and concerned about it, especially because the illegal fishing was destructive to their fishing beds and depleted fish in nearby waters (Nickerson 1998, Sielert and Sangchang 2001).

Because almost 90% of the commercially harvested fish in Southeast Asia is found on the shallow continental shelf within 5 km of the coast (Chua and Garces 1994), the commercial trawler fleets compete with increasing numbers of small-scale fishers for the diminishing fish resources. Findings show that 5% of the commercial trawlers catch 95% of the total catch (Sielert and Sangchan 2001). As a result, small-scale fishers earn an estimated 41,253 baht (approximately \$994 US) per year, which is only one-fourth to one-ninth of Thailand's average household income (Sielert and Sangchan 2001). The growing population and increased development along the coast also causes degradation and destruction of seagrass beds (Chua and Garces 1994), although there has been little quantitative assessment of these impacts. Preliminary reports after the tsunami of December 26, 2004, suggest that seagrass beds did not suffer extensive damage in the key areas where dugong populations are highest.

However, dugongs are being negatively affected by many of the previously described pressures. They are trapped in the nets of large illegal commercial gill-net and push-net trawlers, and both commercial and small-scale fishers who find dugongs trapped or stranded are apt to be tempted by the money they can receive by selling dugong tusks, which are then used as amulets or medicine. A fisher may receive 10,000 Thai baht (\$240 US) for a set of tusks, 24% of their average yearly salary. Circumstances work against enforcement of environmental regulations. Large commercial fishing trawlers and push-netters have been illegal within 3 km of the coast since 1979 (Seilert and Sangchan 2001). If commercial fishers were to report an incidental catch, they would also have to admit to fishing within the 3-km shoreline limit. Furthermore, under current Thai legislation, fishers who accidentally capture a dugong or find one stranded must put it back. If it is hurt or dead, they must hand it over or report it to local government officials. Reporting the incident wastes time that could be spent fishing, and fishers face the risk of being fined. Under the 1992 Wildlife Conservation and Protection Act, anyone found with a dead dugong could face a 4-year jail term or a fine of 40,000 baht (\$963 US).

Use of Dugong Body Parts

The use or sale of dugong body parts is commonly known in the three provinces, but that knowledge is

more widespread among older villagers, and the current practice is limited. In Phang-nga province, the presence of a local conservation organization, the Small Scale Fisheries Network, which has members in every village, led to the reporting of most stranding incidents and to the giving of most carcasses to government authorities.

The effect of role models on environmental attitudes was seen in Krabi province. There, village officials openly take part in the amulet industry, and the use of dugong-based medicine is prevalent. Belief in the protective powers of bones and tusks and the ready market nearby in Krabi city have made profits too tempting to ignore.

In Trang, due to the presence of Had Chao Mai National Park, Libong Island Non-Hunting Area, local NGOs, and the activities of researchers in recent years, villagers are very aware of dugong conservation issues. The sale of dugong body parts has lessened as conservation and peer pressure from fellow villagers has increased.

Conservation

The interviews showed that villagers whose livelihoods depend on understanding the near-shore and ocean environment were aware of the conservation issues affecting those livelihoods. Results suggest that the dugong decline and the shrinking small-scale fishery income share some underlying causes: poor law enforcement, economic instability, lack of alternative sources of income, and poverty. The most often-cited reasons for the importance of endangered species conservation were the wish for future generations to see dugongs and fear for their extinction, which can be interpreted as a hope that the environment will continue to function and support not only this species, but also the fish that grow in the seagrass and mangroves.

Recommendations

The Andaman coast needs a regional dugong and seagrass conservation-based management strategy. Although a dugong conservation area has been proposed by the Department of Fisheries and the National Park Service for the Trang/Satun area, it is unclear at this writing whether this is an integrated management plan. Coastal villages as well as local and national governments need to play a role in developing and enforcing regulations against illegal commercial fishing and push-nets to make conservation planning effective.

The first step toward formulation of such a strategy should include the creation of an institutional framework that brings together concerned stakeholders from government, the scientific community, NGOs, and

community organizations in an integrated coastal zone management process. These committees then will work toward a regional dugong and seagrass conservation strategy and oversee the coordination and funding of ongoing management and research.

Recommending stronger laws, more and larger protected areas, and further restrictions alone is a narrow solution to a problem that requires a more integrated approach, as suggested elsewhere in Thailand (Dearden and others 1996). To confront the issues surrounding dugong conservation and fishing conflicts effectively, an integrated management approach is needed. Such an approach emphasizes the need for long-term cooperation and participation of local people. This integrated technique for coastal conservation has been advocated worldwide, and has focused primarily on fishing and coral reef issues (Alcala 1998, Elliot and others 2001; Gomez 1995, Pomeroy 1995, White and Vogt 2000, White and others 2002).

Small-scale fishers have been forced by circumstance and desperation into an awareness of the critical need for conservation action. To address this need, two NGOs in particular are actively working with small-scale fishery networks along the Andaman coast of Thailand: the Andaman Project and Yadfon. The involvement of NGOs in an integrated coastal zone management strategy is a crucial step toward the cooperation and participation of villagers in coastal conservation strategies. These NGOs can assist local fishers in establishing community-protected seagrass beds, with the support of local and national government officials. Then with the support of government and the establishment of more formal protected area systems, there is a stronger framework from which to sustain local community stewardship (Dearden 2002).

The best chance for survival of the dugong in Thailand lies in coastal villagers taking responsibility for their protection as partners with local government and researchers. Continued interviewing of fishers can both strengthen this partnership and ensure local input into management decisions (Kwan 2002). The interviews suggest that in areas where there has been a larger presence of government staff, as in Trang and Phang-nga provinces, there was a higher awareness of the importance of rescuing and reporting stranded animals. Staff visits to these villages were considered important occasions, and the posters the staff handed out were carefully displayed.

From the aerial surveys and interviews associated with this research, we have estimated primary dugong feeding areas along the Andaman coast and documented the most-used foraging sites during high tide

(Hines 2002). But without further knowledge of dugong movement and numbers, it is difficult to recommend specific areas for protection outside the seagrass beds themselves. Preen and Morissette (1997) point out that dugongs can utilize large home ranges averaging between 79 and 85 km² in North East Queensland and Moreton Bay in Australia. In Australia, dugongs make regular trips of 40 to 50 km, and sometimes travel between 200 and 500 km (Preen and Morissette 1997). In de Iongh's (1996) Indonesian study, the furthest distance tracked from a capture site was 60 km for an immature male. Groups of dugongs along the Andaman coast could possibly be mixed, with any number of animals migrating from one area to another. In all areas, in consultation with local fishers, areas of known dugong habitat should be zoned for restricted nondestructive fishing activities.

In Trang province, the site with the highest dugong population, we propose that the seagrass beds in the area be designated a wildlife sanctuary, and that this sanctuary be expanded to include at least the seagrass beds associated with primary dugong feeding areas along the Andaman coast as a whole (Hines 2002). Adequate protection for and education about seagrass and dugongs are crucial in Trang at this time due to both the planned influx of tourists and the increasing conflict between commercial and artisanal fishers. Tourism can be both a benefit and a cost to conservation. Several marine examples, such as whales (Duffus and Dearden 1993), sharks (Topelko and Dearden 2005), and turtles (Wilson and Tisdell, 2001) show that benefits can accrue with adequate planning and management. However, the dugongs in the study area are very easily disturbed by boat traffic and vulnerable to any development that has a negative impact on seagrass beds.

It is essential that regulations be developed from within the integrated coastal zone management process and enforced both within the areas specifically designated for the protection of dugongs and within the 3-km coastal area buffer where commercial fishing was outlawed by the Department of Fisheries in 1979. Both the Department of Fisheries and the Ministry of Natural Resources and Environment should publicly state that any fishing practices possibly resulting in seagrass damage or dugong mortality are not permitted in these regions (Preen and Morissette 1997). Enforcement of the Fisheries Act of 1947 and the Wildlife Conservation and Protection Act of 1992 concerning the possession and trade of dugong body parts also is essential at the local level.

It is critical that measures be initiated quickly to reduce dugong mortality. Destructive fishing, incident-

tal catch, and the use of dugong body parts as medicine and amulets are significantly endangering the dugongs and their habitats. For the difficult challenge of conserving the dugong along this coast, all stakeholders must be being willing to participate in efforts toward this goal. Conservation and management planning to conserve the dugong needs to be tied closely to issues that would sustain small-scale fisheries and local communities before this challenge can be met.

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