

## Interaction Between Sea Turtles and Artisan Fisheries Phra Thong Island, Thailand

### Final Report

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# Interaction Between Sea Turtles and Artisan Fisheries Phra Thong Island, Thailand

## 1. Introduction

The sea turtle project on Phra Thong Island, Phang Nga, was set up in 1996 and since then has been focusing on sea turtle nesting behaviour and conservation. During the last ten nesting seasons (with the exception of 2004/05 when the tsunami affected the project), a monitoring programme has been conducted on a daily basis by a team of researchers and volunteers.

A comparison of the results from the ten years of the project with the data available in published literature results in the conclusion that there has been a drastic decline in the number of olive ridley turtle nests (83%) being laid on the island (Aureggi and Chantrapornsyl, 2003). This decrease is probably a consequence of a large egg harvest which occurred about 20 years ago in the area (Aureggi and Chantrapornsyl, 2003).

As a result of regular beach surveying and an intense education programme aimed at the local community, egg poaching became a rare practise (Aureggi and Chantrapornsyl, 2003), until last season (2005/06; the first after the tsunami) when two poached nest were discovered on Ko Ra. Some local fishermen of the island have been working together to save nests and turtles for the project.

Conservation strategies are applied in order to protect as many eggs as possible and maintain the status of the population, with a possible increase in numbers in future generations (Aureggi and Chantrapornsyl, 2006). In parallel, an education programme is carried out in local schools and conservation awareness is conducted amongst tourists. The number of nesting individuals is still unknown but the low number of nests most likely indicates an alarming situation (Aureggi and Chantrapornsyl, 2006) and extinction could be reached soon if protection is not achieved.

Having established a research/conservation project based on the island (approved by the National Research Council of Thailand) the nesting turtle population is carefully monitored and protected. Over the last few years, the need to focus on the mortality rate at sea due to fishing activities has emerged.

The main activity of local communities is fishing with different artisan methods (such as traps, gill nets, etc) being utilized around the island. As part of our post tsunami evaluation, it was noticed that a considerable amount of fishing gear has been given to local fishermen and is being used without regulation, probably affecting the natural resources of the area.

The impact of accidental catch on sea turtles populations is one of the most urgent problems which need to be solved in order to ensure the survival of all these species globally. Available information on sea turtle population dynamics has shown that the bigger (older) a specimen is, the greater its contribution is to the demographic growth of the population to which it belongs (Crouse *et al.*, 1987). Therefore, the main priority would be to direct the conservation efforts to the adult and large juvenile stages, when natural conditions on nesting beaches are preserved (Gerosa and Casale, 1999).

The aim of this project is to evaluate the interaction between artisan fisheries and sea turtles (*Lepidochelys olivacea*, *Chelonia mydas*, *Eretmochelys imbricata* and *Dermochelys coriacea*) through a programme which involves the fishing community, local authorities, local organizations, Phuket Marine Biological Center, Department of Marine and Coastal Resources, Department of Fisheries and Naucrates researchers. This report focuses on the results obtained during the first phase of the project which consisted of an assessment of mortality rate (direct and indirect) caused by fishing activities and an educational and awareness programme. Recommendations are also made with respect to the continuation of the project.

## 2. Research Team

Project leader and principal scientist: Monica Aureggi

Naucrates researcher in the field: Paul Tsaros

Mangrove Action Project researcher in the field: Jaruwan Kaewmahanin

Volunteer (Mangrove Action Project): Sharna

Thai/English translator: Jaruwan Kaewmahanin

Local helpers: Pin (Thung Dap), Puyai Jok (Tapayoi headman).

## 3. Study Area

The project was carried out on Phra Thong island, a 100 km<sup>2</sup> island (15 km long x 7 km wide), located about 5 km from the western coast of Thailand in the Andaman Sea (9.03-9.17°N, 98.25-98.33°E). It is located 200 km north of Phuket, in Kura Buri District, Phang Nga province and is part of a group of three islands near the mainland; from north to south: Koh Kho Khao, Koh Phra Tong and Koh Ra (Fig.1).

Phra Thong Island has a tropical climate with rain falling intermittently throughout the year. There are two main seasons: the rainy season (April to November) and the dry season (December to March) with an average temperature of 28.7 C°. For the islanders, the latter is the main fishing season.

Three sites (villages) have been selected for the study: Tapayoi (TA), Thung Dap (TD) and Pad Chok (Fig. 1). The sites were selected according to the intensity of fishing activity in the region and the population of the villages.

Before the tsunami about 1064 people were resident on the island split between 49 families in TD, 87 families in Pad Chok and 123 in TA (Ferrari *et al*, 2006). At the beginning of this study, two years after the devastating event, only the villages of TA and TD are present on the island.

Pad Chok had been completely destroyed (Table 1) and was still being rebuilt at the start of this study by the Lion Club. Its location has been changed making it more protected from natural disasters. The village was opened on 25 February 2007 and therefore it will take some time for the fishing activities to restart and the population to move back.

## 4. Objectives

1. Evaluate the fishing effort in the area: detailed description of common fishing gear and estimation of the size of the local fishing fleets through interviews conducted with fishermen and local people (non-fishermen).
2. Estimate sea turtle mortality (direct and indirect) by assessing the causes of mortality to juvenile and adult sea turtles looking at the range of fishing methods in shallow waters of the continental shelf.
3. Estimate the number of big boats (trawlers and squid boats) fishing off the west coast of the island.
4. Recommend possible mitigation measures to reduce sea turtle by-catch by artisan fisheries.
5. Determine why sea turtle conservation can reduce mortality and benefit the fishermen.
6. Carry on the environmental educational programme amongst local communities.

## 5. Methodology

The fieldwork was conducted between January and March 2007, as part of the Naucrates Conservation project. The study focuses mainly on the dry season which is also the sea turtle nesting season and therefore experiences the main interaction between fishing and turtle activity.

In order to assess the sea turtle mortality (number of captures) two different methods were applied:

- indirect method: through questionnaires and estimation of “big boats”

- direct method: through a researcher/observer going on board and checking the by-catch and use of fishing gear. Using GPS (Global Positioning System) the fishing grounds mostly used could be identified.

Direct interviews with local stakeholders, i.e. fishermen and local people, were conducted. A technique of stratified random sampling was employed, where the stakeholders were divided according to their age group and occupation. Thirteen fishermen were interviewed in TA and six in TD, including young fishermen below the age of 25 years, a middle age group of between 25 and 50 years and an older age group of 50 years and above. Local persons (non-fishermen) were interviewed at each site, eight in TA and four in TD consisting of people from different occupations. Different questionnaires were used for the fishermen (Appendix 1-2) and the non-fishermen (Appendix 3 - 4).

The data was collected through individual interviews.

The questionnaire was designed as a guideline to ensure all the necessary information was collected. After a discussion, it was agreed to have an informal conversation with the fishermen, rather than asking set questions, to make them feel more comfortable and therefore express their opinion more easily. This proved successful; the results show that some topics would have been avoided by the fishermen and conversations continued beyond the questionnaire and enlightened us about the fishermen's concerns and livelihoods.

During the interviews visual information material was utilized, such as identification sheets for turtle species and drawings of fishing gear, etc. Interviews conducted in two villages, TA and TD, are taken into consideration in this report. Both fishermen and "non-fishermen" have been analysed separately to outline their differing knowledge and interest in conservation issues.

The research team worked together with local fishing communities and local people in order to achieve the objectives of the project. Meetings were periodically organized to enable interviews to be carried out in the villages. An initial visit to all three villages was scheduled to introduce the project to the villagers and the fishermen and to prepare the field work. Fishermen were interviewed late in the afternoon when they had returned from work. Non fishermen were interviewed when available during the day.

A T-shirt and a little compensation was given to the fishermen who took the researcher on board

Every evening from January to March, the Naucrates team counted the number of lights on the horizon off the west coast of the island, estimating the number of fishing boats every day.

An educational programme was set up at the school of TA. The programme included general information about mangrove and sea turtle biology and conservation taught by way of a mangrove drawing competition.

## 6. Results

According to the rapid assessment conducted by IUCN after the tsunami (IUCN, 2005), the villages of Phra Thong were affected by the tsunami in different ways (Table 1). It must be highlighted that the table does not include human loss and damages reported on the west coast of the island, where tourist facilities and the Naucrates Conservation Project were based.

Village	Households	Women	Men	Human loss	Houses lost	Vessels lost
Ban Thung Dab	49	135	137	19	22	19
Ban Tha Pae Yoi	123	203	206	0	0	5
Ban Pak Chok	87	134	140	28	85	50
Ban Koh Ra	19	54	55	2	10	7
<b>TOTAL</b>	<b>278</b>	<b>526</b>	<b>538</b>	<b>49</b>	<b>117</b>	<b>81</b>

**Table 1.** Summary of households, population and losses in the four villages. Source: Seub Foundation, 2005 (IUCN 2005).

Since the tsunami, the geographical and demographic distribution has been altered. Many villagers from Phra Thong Island are still living in temporary houses or have been transferred to new villages on the mainland.

TA, due to its location on the east coast, was the least destroyed during the tsunami. It seems to have recovered most of its fishing activity and fishing efforts have been increased due to post tsunami support. Observations made last year seem to indicate a major increase in the number of squid traps. The number of Burmese people has also increased (reaching 45 persons); some are present for reconstruction and others as cheap labour for fishing activities (on board, trap making, etc). Some families have moved closer to Kura Buri.

TD was severely affected by the tsunami (Table 1). Many villagers moved to Tu Laon (Fig. 1) and are still residing there. The village now has a very small population living on site, mainly elders and young sea gipsies.

#### **a. Indirect method**

- fishermen analysis

##### **i. Age group & fishing history**

With respect to the age of the fishermen, 76,9 % of the TA fishermen interviewed were between 25 and 50 years, and only 66,7% were in that age group in TD. Also, TD has a younger group of fishermen (below 25 years) representing 16,7% whilst TA fishermen has an older group with 15,4% being 50 years or above.

This reflects on fishing history: 83,3 % of TD fishermen have been fishing for between 5 and 20 years, as opposed to 53,8% of TA fishermen. Experienced fishermen (over 20 years spent fishing) represent 30,8% in TA and only 16,7% for TD.

##### **ii. Time frame**

The time when the fishermen go out fishing is closely related to the target. All fishing activity is concentrated in the morning and the afternoon. The fishermen would generally leave early morning around 5-6 o'clock and return in the middle of the afternoon. The fishing gear can be complimentary and is used at different times of the year.

##### **iii. Fishing target**

As observed the main target is squid, representing 76,9% in TA and 100 % in TD (Photo 1), but it was noted that 46,2% of the TA and 50 % of TD also fished for crab. Crab fishing is a main activity for few fishermen. The areas were different for each target. The squid "season" ranges from December to April. From May to December the target changes to grouper and mangrove crab. Fishermen also fish for grouper during the dry season.

##### **iv. Boat type**

As expected most fishing boats are long tail boats (Photo 2). For TA they represent 92,3 % of all the fishing boats, with the remaining 7,7 % representing banana boats. The latter type of boat is used essentially on the east coast and in the canals. In TD 100% of the fishermen interviewed use long tail boats. In TA an estimated 30 boats go out every day, with about 100 traps per boat. A conversation with one of the villagers resulted in an estimate of 10 000 traps for the island.

##### **v. Gears**

Squid traps are used to catch squid. This equipment, identical for both villages, is used by 84,6% of TA fishermen and 83,3% of TD fishermen. The traps lie on the bottom of the sea over night and are checked in the morning. The depth varies from 10 to 40 meters. A

difference was noticed in TD where traps were laid at depths of up to 70 meters and sometimes in mid-water.

The bait used in both villages is squid eggs. The traps are covered with palm (*Phoenix paludosa*) leaves (Photo 3) to create a safe shelter. It seems that the female is attracted to the trap to lay her eggs and the male will go in to fertilize the eggs.

All squid traps (Photo 4) are relatively similar in size reaching 60x40x90 cm. The mesh size is 1,5 cm .

For crabs, a bottom gillnet is used (Photo 5). These are generally 200 meters long and 80 cm high. They lie on the bottom and are set on sandy to silty soils. The mesh size is 4,5 cm. They are laid overnight when crabs become active and checked in the morning. The main species of crab targeted is the swimming crab, but fish, shells, rays and anemones are also caught.

For mangrove crab, two distinctive traps are used. They are placed in the canal and collected daily. One is placed on the bottom whilst the other is on a stick in mid-water.

The method used to mark the traps was identical to both villages. Some used either a flag or a styrofoam float or sometimes both. From on board observation records, we can see that the traps are generally placed in lines. Styrofoam is also placed in the traps to ensure they lie flat on the bottom. Results from a necropsy conducted in 2006, concluded that the bait used (squid eggs) had attracted a turtle. Once caught in the trap, the turtle drowned.

#### **vi. Outcome of catch**

Observations made last year and this year from TA village, as well as within published literature (Ferrari *et al*, 2006) seems to highlight that the trade always includes a middle man. The archaic system operates around one or several men buying the catch from the fishermen either in the village or at various piers off the mainland.

The wholesalers provide gear, petrol and money (essential during the off season) to fishermen in advance and oblige the fishermen to sell their catches back to them. This system keeps the fishermen in debt for their whole lives. There can be up to seven intermediates between the fisherman and the final buyer.

This is clearly outlined in TD where 100% of the catch is sold to the middlemen and TA where it is 92,3%. This essentially applies to squid. Two fishermen in TA sell some of their catch directly to customers (15,4 %).

#### **vii. Area and duration of fishing**

The areas where the fishermen fish are closely correlated with the village location.

In TA 69,2 % of the fishermen stated that they went to the west coast, generally setting out from Koh Pring (Fig 1). Their primary aim was to put their traps where there is an abundance of squid (38,5%). One mentioned the law that bans fishing within 3 miles of the shore. They were also concerned about avoiding trawler routes. They blame the trawlers for destroying their traps and over fishing. For 92,3 % of them, the duration of a fishing day is around 10 hours (ranging from 8 to 12).

For 83,3 % of the TD fishermen, the fishing grounds are located offshore of their village. They go further off the coast, between 10 and 20 kms, which equates to between one and two hours travelling time. Most of them (66,7%) responded that their main aim was to put their traps away from trawler routes. In this respect, they agreed with TA fishermen in the sense that trawlers represent the main threat to their livelihood. The length of their fishing day was generally 9 to 10 hours (83,3%).

#### **viii. Changes since tsunami**

Since the tsunami the fishing areas have not changed in either village.

In TA 69,2% of fishermen responded that they had received new fishing equipment since the tsunami. This comprised new boats (53,8%) and new fishing gear (38,5%).

In the case of TD 66,7 % received new equipment, which consisted of boats for 50%. One of them received equipment for setting up a garden, shifting activity away from fishing.

#### **ix. Turtles**

In TA, 46,2 % of the interviewed fishermen confirmed that they had seen turtles during the last couple of months. Another 15,4% of them said they see them daily. Only one fisherman said he had caught a turtle with a squid trap, but 76,9% said they had seen turtles while fishing. In TA the main species (69,2%) they observed was the hawksbill turtle, followed by the green turtle (30,8 %), the olive ridley (15,4 %) and the leatherback (15,4%).

These results were obtained through visual identification with assistance from the identification sheets. However, some confusion still remains between green and hawksbill turtles and therefore accurate identification is not certain. With respect to the time of year, 30,8% have seen turtles all year round, 38,5% said they are more likely to see turtles during the dry season, and one fisherman had noted them during the rainy season.

In TD, all fishermen answered that they have seen turtles but have never caught them in their traps. In TA, one fisherman mentioned a turtle entering a trap. A further two fishermen in TA mentioned turtles getting their flippers caught in the rope between the trap and the float.

The opening of a trap is between 35 and 40 cm, wide enough for a juvenile turtle, although there was only one case of this in TA.

Turtles have been seen by 83,3% of the fishermen whilst out fishing. The sightings were not as regular as TA, ranging from often to two to three times a year. The species, however, were the same with olive ridleys and leatherbacks seen by 50% of the fishermen. Hawksbill turtles were seen by 33,3% of the fishermen. This last figure is questionable since visual identification was not positive.

Regarding what they would do if they caught a turtle, 15,4% (TA) and 16,7% (TD) answered that they would release it. Another 16,7 % of TD would cut the net to set the turtle free. 46,2% of TA and 50% of TD answered that they did not know since they had never caught a turtle.

#### **x. Trade**

In TA 76,9% of the fishermen knew about the turtle trade and 92,3% answered that they did not take part in it. In TD 66,7% knew about it and 100% declared not taking part in it.

When asked about the outcome of a nest found on the beach, 61,5% of TA fishermen said people would leave it on the beach, 15,4% thought people would collect the eggs to sell them, and another 15,4% would collect them to eat them.

In TD, 16,7% of fishermen answered that people would leave the nest on the beach. Another 16,7% thought people would take it for household consumption and 33,3% thought people would inform the Phuket Marine Biological Center.

Regarding the reason why people consume turtle products, in TA 53,8% declared they had never tried them, which seems unlikely given that 46,2% said they were tasty. 50% of TD fishermen responded that they are nutritious and 33% declared they had never tried them.

#### **xi. Knowledge about turtles**

92,3% of TA fishermen and 100% of TD fishermen knew that sea turtles visit the island of Koh Phra Thong. This is through personal knowledge ranging from 10 to 50 years depending on their ages, but this knowledge has definitely been with them for most of their fishing lives.

In TA, 61,5% of them had not noticed a difference since the tsunami, although they did mention that marine resources were generally decreasing. In TD 66,7% had noticed a difference and reported a decreasing number of turtle sightings at sea than in previous years.

The reasons why turtles visit the area was a reflection of their good knowledge of sea turtles. Nesting represented 84,6 % of TA fishermen responses and 100% of TD responses. 76,9% of TA fishermen and 50% of TD fishermen believed that they also use the area as a feeding ground.

When asked if they had seen turtles on the beaches of Phra Thong Island recently, 76,9% of TA fishermen answered negatively. 83,3% of TD fishermen have not seen any.

In TA 69,2 % of the fishermen stated that they had seen turtles in the sea on the west coast off Golden Buddha Beach resort and Koh Pring. Some fishermen (53,8%) have also seen turtles in the canal leading to the open sea, as well as near Pad Chok and Ra Island. 83,3% of the TD fishermen have seen sea turtles out at sea, often offshore in the fishing areas.

Two fishermen from TA has seen some juvenile turtles that had been killed (opened up)(15,4%). In TD one fisherman (16,7%) made the same comment. All three fishermen pointed out that the trawlers were to be blamed. They added that people seemed to like the organs.

## **xii. Conservation**

TA fishermen knew about the Naucrates Conservation Project (84,6%). 76,9% of them knew what the project does to protect the sea turtles. They believe (92,3%) that sea turtles can be saved. Conservation is seen as a solution (69,2%). Some (46,2%) thought that education is the key. Trawlers are believed to be an issue for sea turtles and also for the fishermen's livelihoods.

TD fishermen (83,3%) knew about the Naucrates Conservation Project. They all knew of the project's activities (100%). They thought sea turtles can be saved (83,3%). They also believed in conservation as a solution (83,3%). Some (50%) also thought that education is the key. The issue with the trawlers was expressed both for sea turtles and for fishermen. Some expressed the need to involve the community to find a solution.

### **• non-fishermen analysis**

#### **i. Age and occupation**

In TA 62,5% of the interviewed villagers were between 25 and 50 years old and 37,5% where over 50 years old. In TD, the older villagers (50 and over) represented 75% and the 25 to 50 age group represented 25%.

In TA, 62,5% are or were involved in the fishing industry. None of the TD villagers have a job related with the sea.

#### **ii. Observation**

In TA, 87,5% of the people spoken to and 50% of the TD interviewees have visited the coast. Respectively 87,5% of TA interviewees and 50% of TD interviewees have seen an increase in fishing activity. 37,5 % of TA interviewees and up to 75% of TD interviewees have noticed an increase in the number of houses and other construction.

Other changes have been noticed in both villages since the tsunami such as a decrease in resources, more conflicts and an increase in projects.

#### **iii. Turtles**

Within both villages, 100% of interviewees knew about sea turtles visiting the island. TA people stated that 47,5% of the turtles encountered were green turtles, 25% were leatherbacks and 27,5% were hawksbills. This was in contrast with the TD reports where people noted that 50% of the turtles visiting the island are olive ridleys, 25% are greens and 25% are hawksbills. All the interviewed (TA and TD) villagers indicated that nesting was the main reason why turtles visited the island. In TA, 37% thought they also came to the area to feed.

Whilst 100% of the TA villagers have not seen any turtles recently, half of the TD villagers (50 %) have seen turtles between 2 and 6 years ago. TD interviewees reported sightings close to their village.

#### **iv. Trade**

Both TA and TD villagers acknowledged the trade in sea turtle (75%). When asked who was involved in it, 50% of TA interviewees answered the local people. TD interviewees said they believed the fishermen were responsible for the trade (50%). They emphasized again the role of the trawlers in this trade.

About the need for conservation, they all agreed (100% of both villages) that sea turtles should be conserved.

The need to save the turtles for the next generation seemed to be a strong feeling amongst TA interviewees representing 75% of the answers. For TD interviewees, the fact that they are rare and endangered species made conservation necessary.

#### **v. Actions**

A variety of actions was noted from both communities. The main two were regarding the future. One was to continue environmental education so that the future generation is aware and the second is to limit or ban the trawlers, responsible for turtle by-catch and diminishing marine resources.

### **b. Direct method**

As indicated in the methodology section above, the fishermen were asked to take the researcher on board for a day. This second method allowed for the collection of other data relating to fishing activity. This included observation of fishing techniques, other types of by-catch and identification of fishing zones using GPS mapping.

Three fishermen agreed to take the researcher on board; two from TA and one from TD.

Two trips with the researcher on board were carried out with a TA fisherman who had already been cooperating with Naucrates since the previous year. The fishing target was squid. The fishing areas were located on the west coast off Pring Island toward the south end near TD. For squid traps, the by-catch was composed of puffer fish and some other fish (banner fish, groupers, etc). The fisherman declared that he had never caught any turtle with his squid traps. He has seen turtles while checking his traps, very likely to be juvenile due to the small size described. On the first trip, he was near the 3 km limit with about 50 traps. On the second trip he was closer to shore (1 or 2 km) with about 40 traps. Both times the departure from the village was between 05:30 and 06:00. The duration of the fishing varied with the distance and the catch. It usually takes two hours to travel too and from the fishing zone. Traps are checked once, if the catch is good. If not, then a second round is scheduled. Generally about eight hours are dedicated to trap checking.

On most boats the crew is made up of two people. However, some fishermen go out alone.

A trip with the researcher on board was made with a fisherman using bottom gillnets and small fish traps. About four gillnets were set the night before, each 200 meters long, one side lying in the sand and raised to about 80 cm from the bottom. The by-catch was composed of fish, rays, anemones and various shells. The fishing area was in the canal in front of TA and between Phra Thong Island and Ra Island. He said he had seen turtles but this was before the tsunami. He noted that the sea grass bed had diminished, decreasing his crab catch and possibly the feeding grounds for turtles.

This fisherman also had about 15 small fish traps essentially for grouper. Both grouper and crab are farmed for about three months before sale (Photo 6 & 7). The fisherman left

around 06:00 and returned at about 11:00. He goes out with his wife who shares the workload.

A trip with the researcher on board was made with a fisherman from TD using squid traps. The fishing zone was a lot farther than for the TA fishermen. They went up the canal between Phra Thong and Kho Khao Island, clear off the coast into deeper water, about 17 km off shore.

Their squid traps were placed at a depth between 20 and 40 meters. They had very little by-catch, just a few fish. Sightings of turtles were not recorded although they said they saw small turtles regularly. The fisherman left around 06:00 and returned about 11:00. He goes out with his wife who shares the workload.

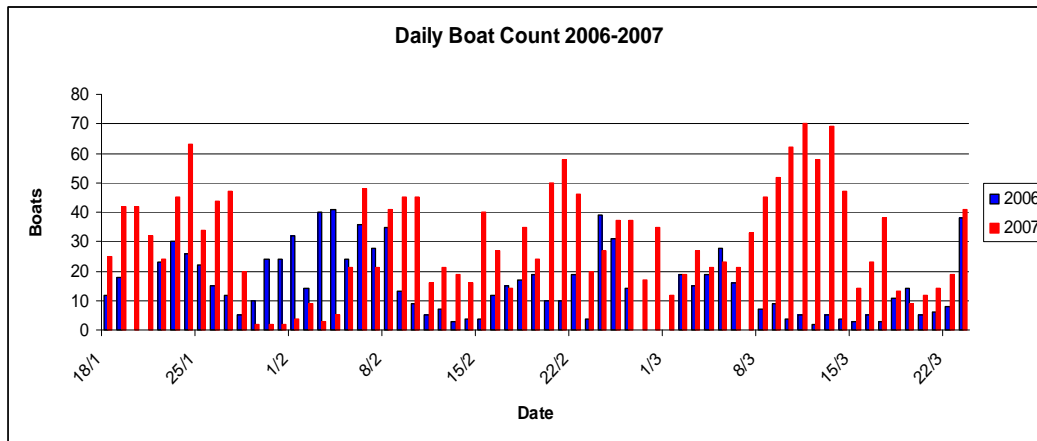
- Fishing boat estimates

The number of large fishing boats coming from the mainland (mainly trawlers and squid boats) has increased since the tsunami. The results (Table 2) show that over a two year period, the number has been doubled. In 2006 an average of 15 boats was recorded daily in 2006. In 2007 this figure rose to 30 boats per day on average.

	Maximum	Minimum	Average	Total
<b>2006</b>	41	0	15	932
<b>2007</b>	70	2	30	1947

Table 2: Boat Count from shore line near Golden Buddha Beach resort. Number of boats recorded daily from 18/1 to 23/03 in 2006 and 2007.

As observed and recorded, these numbers fluctuate throughout the month (Graph 1). The moon cycle seems to influence the effect of the strong lights used by the squid boats resulting in an increase around the new moon and a decrease around the full moon. Also the sea conditions have an influence on the mainland fishing activity (trawlers, bigger squid boats, long line), as they do on the local fishing effort.



Following conversations with fishermen from two trawlers, they said they spend five to six days out at a time, travelling from Ranong to Namkem. They noted turtles daily and all year round. One of the fishermen reported that his boat uses a drop net to catch squid which is brought up regularly. The other man's boat uses a trawler net set between two boats. They both declared catching turtles but releasing them. This would need further investigation since young turtles are often found dead by local fishermen.

## 7. Conclusions

Local people are aware that turtles were a lot more common in the past, some mentioning that there were 200 nests per year on Phra Thong island 20 years ago. Turtle meat and eggs used to be part of the villagers' diet.

Given that sea turtles are protected by Thai law and that there is a turtle conservation project working on the island, this is probably why most of the fishermen from both villages (55,1%) declared that they are aware of the turtle trade but that they do not take part in it (96,2%). However, they do know they are tasty (46,2% in TA). This demonstrates that a combination of Thai regulation and long term-conservation effort has made them aware of the problem. Even though the sea turtle is close to extinction, the local people do seem to be ready to apply simple sea turtle conservation rules. The fact that TA villagers mentioned that conservation should be applied for future generations is important. It shows that they have a clear idea of the necessity to protect rare species like sea turtles. They also seem to have a fair idea of what Naucrates is trying to achieve.

The results obtained from the questionnaire have drawn attention to turtle population depletion; partly as a result of past activities, partly has a consequence of the tsunami.

The tsunami which occurred on 26 December 2004 devastated the area has significantly impacted on the local people and their communities. From the unfamiliarity with an outsider about ten years ago, many villagers now welcome foreigners (NGOs, government officials, media, etc.) (Ferrari *et al*, 2006). Without doubt, the traditional local fishing effort has increased since the tsunami. Many NGOs have not only helped fishermen to rebuild their livelihoods but the addition of financial support has artificially increased the number of squid traps and other fishing gear. Even though it was with good intention that support was given to the communities, it has not been controlled and is not sustainable.

During the survey, differences emerged between the villages of TA and TD both in attitudes and communities. Although all the villagers have not yet returned to live on the island, TD seems to possess a younger fishing community.

This younger group has probably participated in the environmental education programme carried out by Naucrates over the last ten years. The positive effect of this education is now reflected in their greater conservation knowledge and their stronger attitude towards conservation than TA fishermen. The fishing population in TA is older and will probably require more time to accommodate new values.

In TA there is still a minority (15%) of fishermen that would eat eggs if they found them on the beach, whereas in TD they would help or leave them. This indicates a need for more education and awareness in the villages. However TA does have an unofficial conservation committee which shows some hope for conservation. This group comprises five people who have decided to protect their rich and rare species. They aim to prevent endangered animals like sea turtles being caught and eaten in the village. One person caught two to three years ago was threatened with jail and a few turtles have been released back into the sea. An ongoing consultation between the authorities has resulted in the scheduled creation of a National Park including the island of Phra Thong due to in the next few years.

Similar boats are used in both TA and TD. Banana boats do not generally go out into the open sea but do go near sea grass beds and in canals where juvenile green turtles were spotted before the tsunami. The sea grass beds have been damaged or displaced probably causing a change in the location of the feeding grounds. Fishermen who frequently go to sea could prove to be useful observers of these changes and could help to identify new feeding grounds.

Long tail boats constitute the main fleet (94,7% of both villages) on the island. They are usually used to access the open sea. Their range as shown through the questionnaire can vary greatly.

The impact of an increase in the number of bigger boats, such as trawlers, has forced the local fishermen to modify their fishing areas as well as productivity. As mentioned in the

results, fishermen blame the trawlers for destroying a lot of their cages and they also have to place their cages away from big boats. The increase of this bigger fleet has obviously decreased the local fishermen's catches.

More research should be conducted on boats using trawls and long line using both direct and indirect methods to evaluate their impact on the sea turtle population nesting or feeding near the study area. In parallel an information leaflet should be printed to educate them about general turtle conservation issues and to show them how to deal with a turtle caught accidentally.

Observations made last year and this year have also shown that one fisherman had doubled his traps within a year. But this does not seem (according to the indirect method) to have increased the sea turtle by-catch. The turtle by-catch should be studied in more detail by going out regularly on fishing boats over a season to clarify this assumption.

In the past, the capture of juvenile turtles in squid or fish traps was rarely reported. However, since the tsunami, there has been a case of a green juvenile being caught in a fish trap which was reported by the Naucrates team in 2006 (Aureggi, 2006). Both types of traps should be studied and modified to allow fish to enter but not turtles. Because of the limited number of cases of onboard observation, we cannot draw any firm conclusions but continued investigation is required in this area.

Squid traps, the most common type of fishing gear (68,8% of fishermen interviewed), can also potentially catch turtles. Whilst only three interviewees mentioned the interaction between traps and turtles, there are several factors which contribute to this concern. The trap stays at sea over night, with fresh bait, which can attract turtles. The opening (35-40 cm) could allow a young turtle to enter and become trapped. This opening should be reduced to minimize by-catch without reducing the amount of squid caught in trap.

It is important to determine possible changes in juvenile green turtle feeding grounds, especially since the tsunami. The pre-tsunami previous feeding grounds might need time to rebuild or new feeding grounds will be identified.

The west coast fishermen want to avoid trawlers and this means they place some of their traps closer to the shore or further out at sea near Pring island, which correspond with the feeding areas of juvenile turtles. Fishermen have reported many turtle sightings during their fishing activity, showing that the areas where they fish correspond to areas where turtles come to feed, probably to a larger than previously established.

The fact that most (68% of both villages) of the members of the community know that it is forbidden to kill turtles could encourage them to report any dead turtles caught in their traps or seen. A sighting notebook has been left with one member of each community in order to improve the network between the project and local people.

At the same time, the fact that we are a conservation group may discourage them to admit if they do catch a turtle accidentally in their fishing equipment. It is necessary to pursue this issue further in order to discover if mitigation measures could be applied.

Gillnets used in the canal and on the east coast of the island should also be investigated. Even though fewer fishermen use them, the fact that they are used on sea grass bed and in areas of previous juvenile turtle sightings is concerning.

Even though a new positive collaboration has begun between Naucrates and the fishermen, more observation on boats should be conducted to see if any turtles get seen or are caught in those areas.

On the other hand this study has brought forward another worrying factor. Although the estimate of big boats undertaken every season has always shown a relatively large number of big squid boats and trawlers, a notable increase has been seen this year, probably due to post tsunami aid. This increase brings a serious threat to the juvenile population which is the future of a sea turtle population currently struggling to survive.

The brighter side of this study comes from the villagers of Koh Phra Thong. The attitudes of the younger fishermen can be attributed to the Naucrates' environmental education programme over the last decade. The children previously taught in the local schools are now the new generation of fishermen. They are concerned about environmental issues and have the will to help. They should and will be actively involved in the conservation effort.

During the survey the need emerged for an education programme about how to handle turtles in case they are caught in fishing equipment. In fact about half of the fishermen (46.2% TA and 50% TD) do not know what to do if they accidentally catch a turtle. The introduction of a simple manual (Gerosa and Aureggi, 2001) and the organization of a workshop on handling techniques would help to decrease the direct mortality of those animals. This would be complimentary to the sea turtle sighting booklet that was given to both villages which would provide us with precious information on the situation at sea.

## **8. Recommendations**

- To continue the collaboration with local fishermen and involve them in any conservation strategies.
- To conduct the survey among fishermen of Pak Chok.
- To choose a key fisherman in each village to train to take over some of Naucrates' activities.
- To do on board surveys on squid boats and trawlers to evaluate sea turtle mortality.
- To conduct interviews at the local fishing port of Kura Buri.
- To set up an environmental education program for fishermen on Phra Thong Island and Kura Buri regarding sustainable fishing practices and how to handle turtles.
- To set up an environmental education programme in local schools: on Phra Thong island and Kura Buri.
- To investigate proper mitigation measures.
- To introduce sustainable methods of using *Phoenix paludosa* as a local resource of the mangrove forest.
- To prepare a scientific report in Thai and English to give to local authorities and officials.

## **9. Mitigation measures**

One of the main needs that emerged from the project is an investigation into effective, simple mitigation measures to reduce sea turtle by-catch by artisan fisheries while simultaneously maintaining viable fishing operations.

In order to decrease the accidental capture of sea turtles in the area, the following possibilities should be investigated:

- The opening of the squid trap could be reduced or modified to allow squid to enter but to prevent turtles entering.
- Bait modification: dyeing bait (turtles are more or less sensitive to different colours) or a change in the type of bait (different bait is more or less attractive to turtles)
- Enforcement of the 3 km limit of fishing for trawlers.
- Reinforcement of the cement block barrier in the sea, in front of the island.
- Implementation of an awareness campaign

- Identification of new fishing zones that would not affect turtle feeding and nesting behaviour and would not affect the daily catch of fishermen.

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