

# JAPAN-THAILAND CO-OPERATIVE STUDY ON THE SEA TURTLE TRACKING USING THE ARGOS SATELLITE SYSTEM

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## Introduction

Shrimp trawls are important fisheries in the coastal waters in Thailand. Some parts of shrimp catch were exported to many countries including the USA and Japan. Recently, the US officials notified the Thailand government not to bycatch sea turtles by the shrimp trawls or a ban of the export to the USA. The Thailand government and SEAFDEC (Southeast Asian Fisheries Development Center) took measures not to bycatch the sea turtles using TEDs (turtle excluder devices) that the US government recommended to install in the fishing gear. Although the TEDs were not good at for the shrimp trawl since the TEDs were too large to operate for the Thailand shrimp boats those were smaller than those in the USA. Therefore, the Department of Fisheries, the government of Thailand requested Professor W. Sakamoto of Kyoto University to support the sea turtle researches including satellite tracks and molecular markers. Then Japan-Thailand co-operative study on the sea turtle tracking was started in 2000 to investigate the migration paths of the sea turtles in order to prove that the paths did not overlap the shrimp fishing ground in the Thailand waters. The study was performed both in the Gulf of Thailand and the Andaman Sea.

Migration patterns are known as an important tool for conservation and management of the sea turtles. Several studies employing satellite transmitters revealed that the turtles migrated for very long distance between their feeding and nesting grounds (Balazs 1994; Balazs *et al.* 1995; Luschi *et al.* 1996). The result of having such long migrations leads to collaboration among countries for efficient conservation of sea turtles in each region (Liew *et al.* 1995). Studies employing molecular markers revealed that there was a great separation between green turtles *Chelonia mydas* living in Atlantic Ocean and Pacific Ocean (Bowen *et al.* 1992; Bowen & Karl 1997). Unfortunately, most recent studies neglected an important nesting area, Indian Ocean since we have no channel of collaborate study with Indian researchers now.

In order to add a piece of jigsaw to the migration patterns of the green turtles, we employed platform transmitter terminals (PTT) to the green turtles living in the Gulf of Thailand and in the Andaman Sea. The major aim of this study is to determine the migration routes of nesting green turtles. The results of the sea turtle track are open on the WWW, <http://bg66.soc.i.kyoto-u.ac.jp/shiba/seastar2000/index.htm>.

# 1. The Gulf of Thailand

## Materials and methods

Two models of PTTs, ST-18 and Kiwisat101 were used (Figs. 1 and 2). The PTTs were attached to six green turtles. They were 4 post nesting females from Khram Island and one incidental capture female from Sriracha, Chonburi Province and one post nesting female from Mannai Island (Table 1).

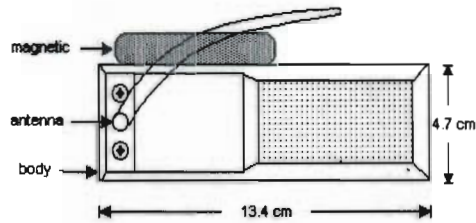


Fig. 1. ST-18 manufactured by Telonics Ltd., weighs 200g with 0.5 w power.



Fig. 2. Kiwisat101 manufactured by Sirtrack Ltd., weighs 600g with 1.0 w power.

Table 1. Name, body weight (BW), type of PTT, release date and place in the Gulf of Thailand.

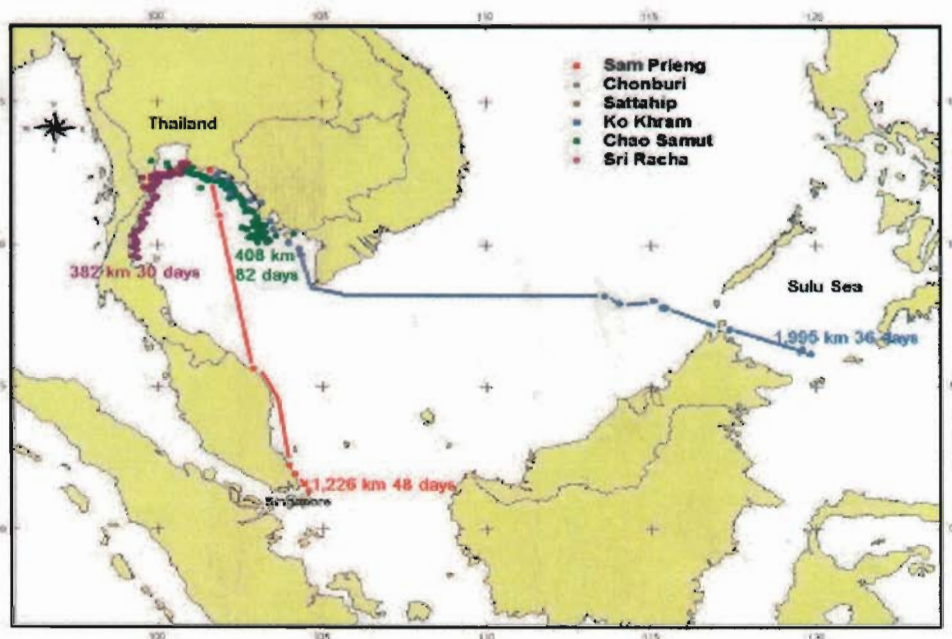
Name*	BW(kg)	Type of PTT	Release date	Release place
<i>Sampreang</i>	125	ST18	18/5/2000	Mannai Island
<i>Sri Koa Khram</i>	115	ST18	29/6/2000	Khram Island
<i>Sri Sattahip</i>	90	ST18	29/6/2000	Khram Island
<i>Sri Chonburi</i>	130	ST18	29/6/20/00	Khram Island
<i>Chao Samut</i>	110	Kiwisat101	12/9/2000	Khram Island
<i>Sri Racha</i>	59	Kiwisat101	3/11/2000	Sri Racha

\* All turtles were female green turtles *Chelonia mydas*.

## Results and discussion

Fig. 3 shows migration paths of 6 green turtles. *Sampreang* was the first turtle we attached by ST-18 after the fourth nesting on 18 May 2000. She had not finished nesting for the season yet so she came to nest again. She started to migrate on 20 May 2000 heading to

the south. She went pass through the Gulf of Thailand in 27 days and reached Kuala Terengganu in Malaysia and then passed to Pahang heading to the Malaga strait. The last signal we received she stayed at Malaysian Peninsula, which closed to Singapore. The total distance was about 1,226 km within 48 days. *Sri Koa Khram* was attached with ST-18 on 29 June 2000 at Khram Island in Chonburi Province. After released she still stayed around Khram Island about 5 days and started heading to the southeast pass through Trat Province, Thailand and Cambodia waters, then she went down to the Vietnam Peninsula after that she traveled to the east crossing the South China Sea then to the north of the Sabah of East Malaysia and the Sulu Sea on 8 August within 36 days. The last signal on 17 August showed that she stayed around the islands in the Sulu Sea. The total distance of the further route was about 1,995 km. *Sri Sattahip* was attached with ST-18 on 29 June 2000



**Fig. 3.** Map of the migratory routes of adult female green turtles attached by satellite telemetry in the Gulf of Thailand

at Khram Island in Chonburi Province. The signal of this turtle could be received only 2 times in 9 days and she still stayed around Khram Island. *Sri Chonburi* was attached with ST-18 on the same day as *Sri Koa Khram* and *Sri Sattahip* on 29 June 2000. The signal could be detected only 11 times in 40 days. She still stayed around Khram Island. *Chao Samut* was attached with Kiwisat101 on 12 September 2000 at Khram Island, Chonburi Province. In the first 2 days she started to swim to the west and then she changed to come back to the releasing area. On 17 September she began to travel again but this time she went to the southeast passed Rayong, Chantaburi and Trat Province. She passed Thailand to Cambodia on 25 September and still went down not far from the shore. On 3 October she stayed around the Rong Island of Cambodia until 4 December. The total distance of the further route was about 408 km. *Sri Racha* was attached with Kiwisat101 on 3 November. This turtle was caught by incidental and rearing in the outdoor pool about 5 months at Sriracha District, Chonburi Province. After release she started to swim cross to the western

coast of the Gulf close to the shore of Prachaup Khiri Khun Province and then went down. The last signal on 18 December showed that she stayed around the islands of Chumporn Province. The total distance of the further route was about 382 km.

These results suggest that the adult female turtles coming to lay their eggs in the Gulf of Thailand were coming from different feeding grounds and habitats and the turtles migrated long distances from different places of their foraging habitats to the nesting ground in the Gulf of Thailand..

## 2. The Andaman Sea

### Materials and Methods

Three green turtles namely *Panwa*, *Sri Nuan* and *Kayano* were attached with PTT as shown in Table 2. *Panwa* was caught from the sea around Phuket and reared at Phuket Marine Biological Center for 6 years. *Sri Nuan* and *Kayano* were wild females came to lay eggs at Huyong, Similan Islands. At the time we tagged, *Sri Nuan* had laid eggs for the 6 times in that year. The record from the Third Fleet of Royal Thai Navy showed that *Sri Nuan* also came to lay eggs at the islands 3 years ago. While, *Kayano* was recorded as her first egg laying in that year and there was no record to lay eggs at the islands during past 4 years.

The position data were plotted with GIS program. The additional information on sea grass habitats in Thailand was obtained from Chansang & Poovachiranon 1994 and Poovachiranon & Chansang 1994. The minimum accumulated migrating distance ( $D_m$ ) in kilometer was calculated as  $A \times \sum_{i=1}^n \sqrt{(y_{i+1} - y_i)^2 + (x_{i+1} - x_i)^2}$ , where;  $A$  is a conversion constant from a degree to km, which equals to 111.12;  $Y_i$  and  $X_i$  are decimal degree of latitude and longitude, respectively. The swimming speeds were interpreted from slopes between accumulated migrating distance and time. All sampling errors were calculated as confidence interval at 95%.

**Table 2.** Name, body weight (BW), type of PTT, release date and place in the Andaman Sea.

Name*	BW(kg)	Type of PTT	Release date	Release place
<i>Panwa</i>	93	ST18	7/5/2000	Phuket
<i>Sri Nuan</i>	-	ST18	10/6/2000	Similan Islands
<i>Kayano</i>	-	KiwiSat101	5/9/2000	Similan Islands

\*All turtles were female green turtles *Chelonia mydas*.

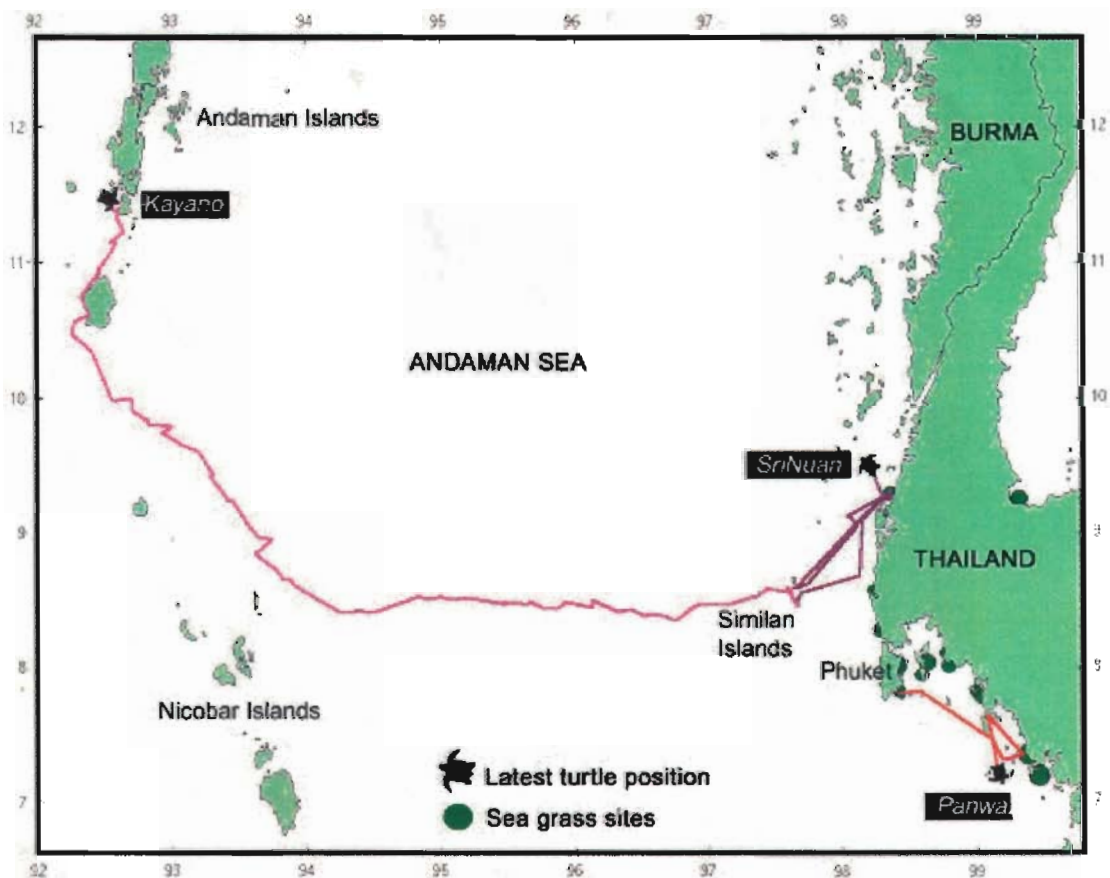
### Results and discussion

Comparison between Kiwisat101 and ST18 showed that Kiwisat101 sent twice higher number of data per day than ST18 ( $4.0 \pm 0.9$  times/day vs.  $1.6 \pm 0.3$  times/day). However,

this is because Kiwisat101 has higher sending power (1 w) compared to ST18 (0.5w). Besides, Kiwisat101 was turned on 24 hr a day while ST18 was turned on 8 hours a day only. The number of signal was high during 4:00-11:00 and 16:00-21:00 (local time).

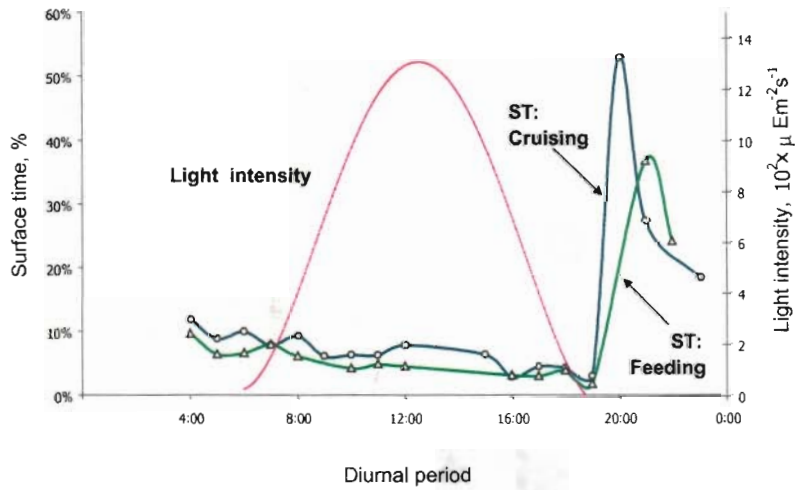
All PTT-attached turtles migrated to different directions (Fig. 4). *Panwa* swam average 18 km/day to the southeastern direction and reached the sea grass habitats 8 days later. She spent 3-4 days in this habitat.  $D_m$  was 215 km in 12 days. The last position recorded was 98°24'N 7°45'E. *SriNuan* went to the northeastern direction from Similan Island and reach to a sea grass habitat in 3 days. She had spent about 7 days feeding in this area before went back to lay eggs for the 7 times in this year at Similan Island (13 days after the previous eggs laying). Later on, she went to the same feeding ground. Her last position was detected at 98°13'N 7°27'E. *SriNuan* swam 35-46 km/day when cruising between nesting and feeding grounds. During staying in feeding ground, she swam 2-4 km/day.  $D_m$  was 524 km in 27 days. *Kayano* traveled to Andaman Islands, India (640 km far from Similan Islands). She swam 66 km/day for 15 days to reach the destination (Woodmason bay, Rutland Island, Andaman Islands) and stayed there until the signal was ceased at 92°37'N 11°26'E.  $D_m$  was 1,174 km in 31 days. It was suspected that there would be a sea grass habitat in that area.

These results reveal that the green turtle from at least two feeding grounds (Andaman Islands and west coast of Southern Thailand) lay eggs at Similan Islands. Thus, conservation of the green turtle in the Andaman Sea areas would require collaboration among countries in these regions.



**Fig. 4.** Migration routes to PTT-attached green turtles (*Panwa*, *Sri Nuan* and *Kayano*) released from Phuket and Similan Islands in 2000.

The sea surface temperature was quite constant at  $29.6 \pm 0.1^\circ\text{C}$ . Surface time counter in PTT attached to *Kayano* showed that she spent  $9 \pm 2\%$  each day. Diurnal pattern of surface time demonstrated that *Kayano* spent highest surface time as soon as it was dark (Fig. 5). The average surface time during day (6:00-18:30) was  $6 \pm 1\%$  and  $16 \pm 5\%$  at night. The lower surface time during day may be explained by feeding behavior and mechanism to avoid enemy.



**Fig. 5.** Diurnal pattern of sea surface time obtained from surface time counter in PTT attached to the post-nesting green turtle, *Kayano*. ST means sea turtles.

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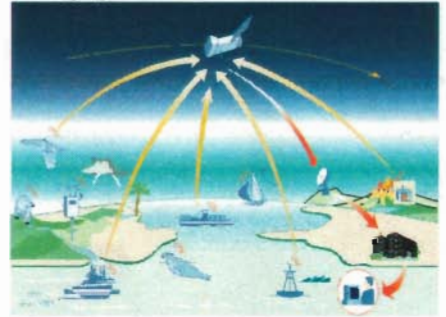


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