

# Satellite Tracking of the Post-nesting Migration of a Green Turtle (*Chelonia mydas*) from Hong Kong

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Four species of sea turtles have been recorded in the waters of Hong Kong (Chan 2003) but only the green turtle (*Chelonia mydas*) breeds locally, albeit in very low numbers of one to several nesting individuals per nesting season. The nesting site is located at a small sandy beach of an offshore island called Lamma Island (22.191°N, 114.139°E). This 0.5 ha beach is now the only Hong Kong site where green turtles are known to nest regularly. Dedicated conservation efforts have been put in place to safeguard the nesting beach for this population, including designation of the nesting site as a protected area, regular warden patrols and site management. However, there is no knowledge of the migratory pathway and location of foraging grounds for the green turtles nesting at this location. In the absence of such information, it is impossible to draw up a comprehensive protection strategy for this population. Therefore, a study using the Argos satellite-based system to describe the migratory pathway and the location of the foraging grounds was started in August 2002.

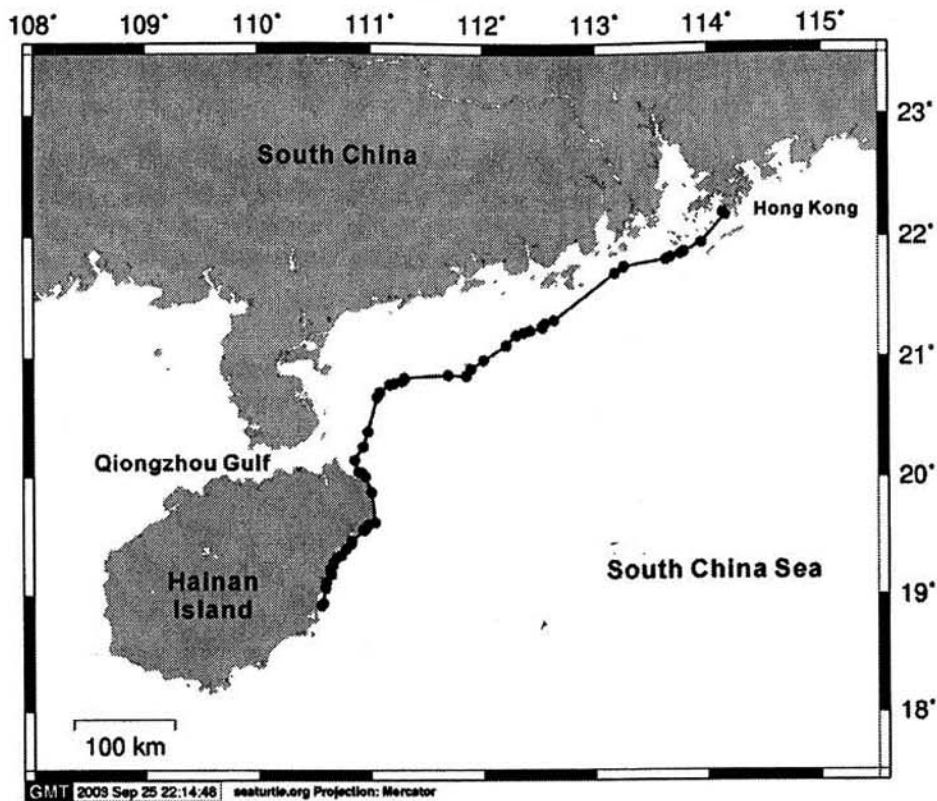
A satellite transmitter was attached to a female after nesting at Lamma Island. She measured 100cm in straight carapace length. Her first nest of the season was made on 13 June 2002 and she subsequently laid four more clutches. She was the only green turtle nesting in the 2002 season. On 9th August 2002, after laying the final clutch of eggs, the turtle was temporarily detained for attachment of the transmitter. A Platform Transmitter Terminal (PTT) from Telonics Inc. (Model ST-14, A-2400) was deployed using the attachment procedures adopted by Balazs *et al.* (1996) and Schroeder *et al.* (2000). The duty cycle of the PTT was 24 hours on and 12 hours off. The turtle was released on the same day at the nesting site.

After release, the turtle immediately headed offshore and started its migration travelling at a distance of some 80 km from the southern coastline of South China (fig. 1). It travelled at an average speed of 1.5 to 2 km.hr<sup>-1</sup> until it reached Qiongzhou Gulf (20.049°N 110.891°E) of Hainan Island, China about 10 days later. During

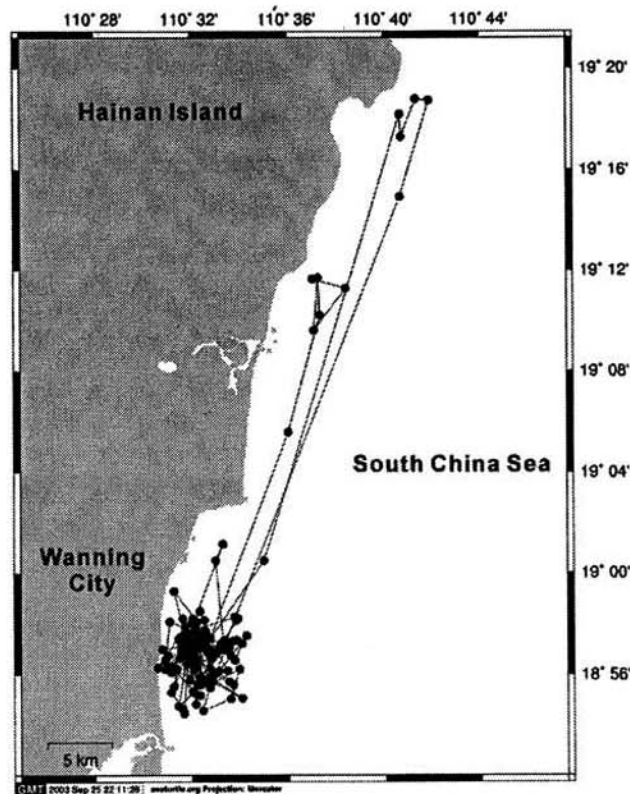
this period, the turtle seemed to be travelling very actively and continuously as shown by the short dive time and frequent surfacing. The average dive time  $\pm$  SD was  $5.6 \pm 1.4$  minutes (11 12-hour periods) and average number of dives per 12-hour period was  $130 \pm 34$  (11 12-hour periods).

From Qiongzhou Gulf onwards, the turtle seemed to adopt a different migratory behaviour. It travelled at a slower speed, about 0.5 km.hr<sup>-1</sup>, towards the eastern part of Hainan Island, staying very close (within a few kilometers) to the coastline. The turtle may have been resting or feeding intermittently in the shallow coastal waters as the mean number of dives reduced to  $58 \pm 16$  per 12-hour period (15 12-hour periods) and the mean dive time increased to  $12.9 \pm 3.7$  minutes (15 12-hour periods). Godley *et al.* (2002) have also found a similar swimming pattern of reduced speed and increased dive time in post-nesting green turtles during coastal travelling. It was suggested that the turtles were feeding during their coastal movements so as to reduce the overall cost of migration. The turtle finally arrived at the shallow coastal waters off Wanning City (18.928°N 110.534°E) of Hainan Island some 500 km away from Hong Kong, on or around the 30th August 2002 (i.e. 21 days after leaving the nesting site). The turtle had travelled a total distance of about 600 km during its trip, first off the coastline of South China and then following the coastline of Hainan Island, rather than taking the shortest distance (about 500 km) in open waters (fig.1).

In the foraging ground, location data showed that the turtle spent most of its time within a distinct home range of about 8 km in diameter. It was interesting to note that the turtle travelled to a northern site 45 km away from the resident foraging ground in November 2002 and stayed there for about one month before returning (fig. 2). In August 2003, at the time of finalisation of this manuscript, the turtle travelled to the north again but this time only travelled to an area 25 km from the resident foraging ground. The reason for these short-distance movements from its resident foraging ground is unknown. It is possible that the turtle was in



**Figure 1.** Post-nesting migratory pathway of a green turtle from Hong Kong. The turtle arrived at its resident foraging ground at the shallow waters of Hainan Island, China [Note: The migratory pathway was plotted with mostly positional data from LC 1-3 signals but large spatial gaps were filled using data points of LC 0, A and B following visual filtering for obvious inaccurate points. Map produced with: SEATURTLE.ORG Maptool].



**Figure 2.** Short-distance movements made by a green turtle at its resident foraging ground in Hainan Island. The turtle travelled 43 km from the resident foraging ground to the north for a short stay before returning back. She travelled 25 km to the north again 8 months later [Note: Only LC 1-3 positional data were used to create this map. Map produced with: SEATURTLE.ORG Maptool].

search of suitable alternate foraging areas.

The dive data in the foraging areas indicated that the mean dive time was  $20.9 \pm 14.1$  minutes (405 12-hour periods) and the mean number of dives per 12-hour period was  $43 \pm 19$  minutes (405 12-hour periods) at the foraging ground.

The PTT was still transmitting as of 21 August 2003 by which time the turtle had spent more than 12 months at the coastal waters off Wanning City. A total of 1,821 transmissions were obtained during this period, of which 1.0% were Location Class (LC) 3, 2.6% LC 2, 5.6% LC 1, 9.4% LC 0, 21.8% LC A, 56.1% LC B and 3.5% in LC Z.

The post-nesting migratory pathway and the location of foraging grounds for the Hong Kong nesting population of green turtles were entirely unknown until this study was undertaken. However, although only a single individual was tracked in this study, insights were obtained and this study proved that satellite tracking was a useful and effective means to find out such information. This is particularly true in this case when traditional tagging practice carried out for 17 years in the South China region has yielded no tag return data. Other satellite tracking studies on the post-nesting migration carried out for the green turtles in the South China region by Song *et al.* (2002) and Cheng (2000) revealed that nesting females from each population had more than one migratory pathway and multiple foraging grounds. Song *et al.* (2002) found that nesting females from Mainland China either travelled off the South China coastline or across open waters to foraging grounds at Hainan Island, China and Okinawa Island, Japan. Turtles from Taiwan had a more diverse migratory pattern as reported by Cheng (2000), with their foraging grounds included Hainan Island, Ryukyu Archipelago, Taiwan and Japan. Further studies of other individuals nesting in Hong Kong will provide useful additional information.

The convergence of green turtles after nesting from Mainland China, Taiwan and Hong Kong to the resident foraging ground in Hainan Island indicates that the waters just off the coastline of Hainan Island represented an important foraging area. It is worth considering long-term measures for safeguarding this area for regional turtle stocks.

*Acknowledgements:* We wish to acknowledge that this study was supported by the Agriculture, Fisheries and Conservation Department (AFCD), Hong Kong Special Administrative Region Government of the People's Republic of China. We are grateful to Dr. Brendan Godley, Miss Denise Parker and the two anonymous reviewers for their helpful review and comments on the manuscript. We also thank Mr. I.C. Choi and the Nature Wardens of the AFCD for their logistical support.

- BALAZS, G.H., R.K. MIYA, & S.C. BEAVERS. 1996. Procedures to attach a satellite transmitter to the carapace of an adult green turtle, *Chelonia mydas*. In: J.A. Keinath, D.E. Barnard, J.A. Musick, and B.A. Bell (comps.), Proceedings of the Fifteenth Annual Symposium on Sea Turtle Biology and Conservation, February 20-25, 1995, Hilton Head, South Carolina, p. 21-26. U.S. Dep. Commer. NOAA Tech. Memo. NMFS-SEFSC-387.
- CHAN, S. 2003. Green turtles in Hong Kong. Agriculture, Fisheries and Conservation Department & Friends of the Country Parks. Cosmos Books Ltd., 104 pp.
- CHENG, I. 2000. Post-nesting migrations of green turtles (*Chelonia mydas*) at Wan-An Island, Penghu Archipelago, Taiwan. *Marine Biology* 137:747-754.
- GODLEY, B.J., S. RICHARDSON, A.C. BRODERICK, M.S. COYNE, F. GLEN & G. HAYS. 2002. Long-term satellite telemetry of the movements and habitat utilisation by green turtles in the Mediterranean. *Ecography* 25: 352-362.
- SCHROEDER, B., G.H. BALAZS & M. ROGERS. 2000. ST-14 sea turtle satellite transmitter attachment instructions. Prepared specifically for Pacific Region Hawksbill Research – Satellite Tracking Project 2000 and Caribbean Hawksbill Research – Satellite Tracking Project 1998/1999/2000. National Marine Fisheries Service, USA.
- SONG, X., H. WANG, W. WANG, H. GU, S. CHAN & H. JIANG. 2002. Satellite tracking of post-nesting movements of green turtles *Chelonia mydas* from the Gangkou Sea Turtle National Nature Reserve, China, 2001. *Marine Turtle Newsletter* 97: 8-9.