

Foraging Ground Characteristics of Adult Female Hawksbill Turtles Satellite-Tracked from Barbados, West Indies

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Four adult female hawksbill turtles (*Eretmochelys imbricata*), fitted with satellite transmitters as part of the Caribbean Hawksbill Research Tracking Project 1998-99 (NOAA/NMFS), were tracked from their nesting beaches in Barbados to their foraging grounds. Following their post-nesting migrations, the study animals traveled to foraging ground locations in four different countries and

have been resident in the same areas for periods of up to four months to date. This paper describes the types of habitats that the study animals have settled in, their home ranges and patterns of diving behaviour at the different locations, potential threats to sea turtles in the areas they have settled in and the legislative protection for sea turtles whilst in the foraging grounds.

Departure of Marine Turtles from Developmental Habitats: Evidence from Bermuda and Panama

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Evidence from fieldwork in Bermuda and Panama allows further characterization of the end of the developmental habitat portion of the life cycle of cheloniid sea turtles. Capture and study (including laparoscopy) of turtles in developmental habitats, in combination with international tag returns, provide information on the size and maturity

status of individuals that depart from developmental habitats in these two countries. Data are presented for green turtles from Bermuda and the Caribbean coast of Panama, and for loggerheads from Caribbean Panama. The satellite track of a 79-cm subadult green turtle traveling from Bermuda to the easternmost point of Cuba is presented.

Post-Nesting Migrations of Hawksbill Turtles in the Granitic Seychelles and Implications for Conservation

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Significant populations of hawksbill turtles (*Eretmochelys imbricata*) nest in the Republic of Seychelles (western Indian Ocean), but in numbers much reduced from historic levels (Meylan and Donnelly, 1999). Hawksbill nesting in Seychelles is most concentrated at the granitic islands of the Seychelles Bank, in the Amirantes Islands group, and on Platte and Coetivy islands (Mortimer, 1984) (Fig. 1). Since 1973, more than 750 nesting hawksbills have been tagged at these sites. The tagging programme began in 1973 at Cousin Island (Mortimer and Bresson, 1999), and was expanded in 1980 to Curieuse, in 1981 to St. Anne Marine Park and Aride Island, in 1994 to Cousine Island, and in 1995 to Bird Island. Nesting hawksbills also have been tagged opportunistically at other islands within the Seychelles Bank and on many of the outer islands of the Seychelles since 1981 (Mortimer, 1998). Although inter-island movements of nesting hawksbills have been recorded on the granitic islands of the Seychelles Bank (Mortimer, Hitchins, Bresson, Collie and Roberts, unpubl. data), no tagged hawksbills have been recovered outside the country. Nor have tags been recovered from females

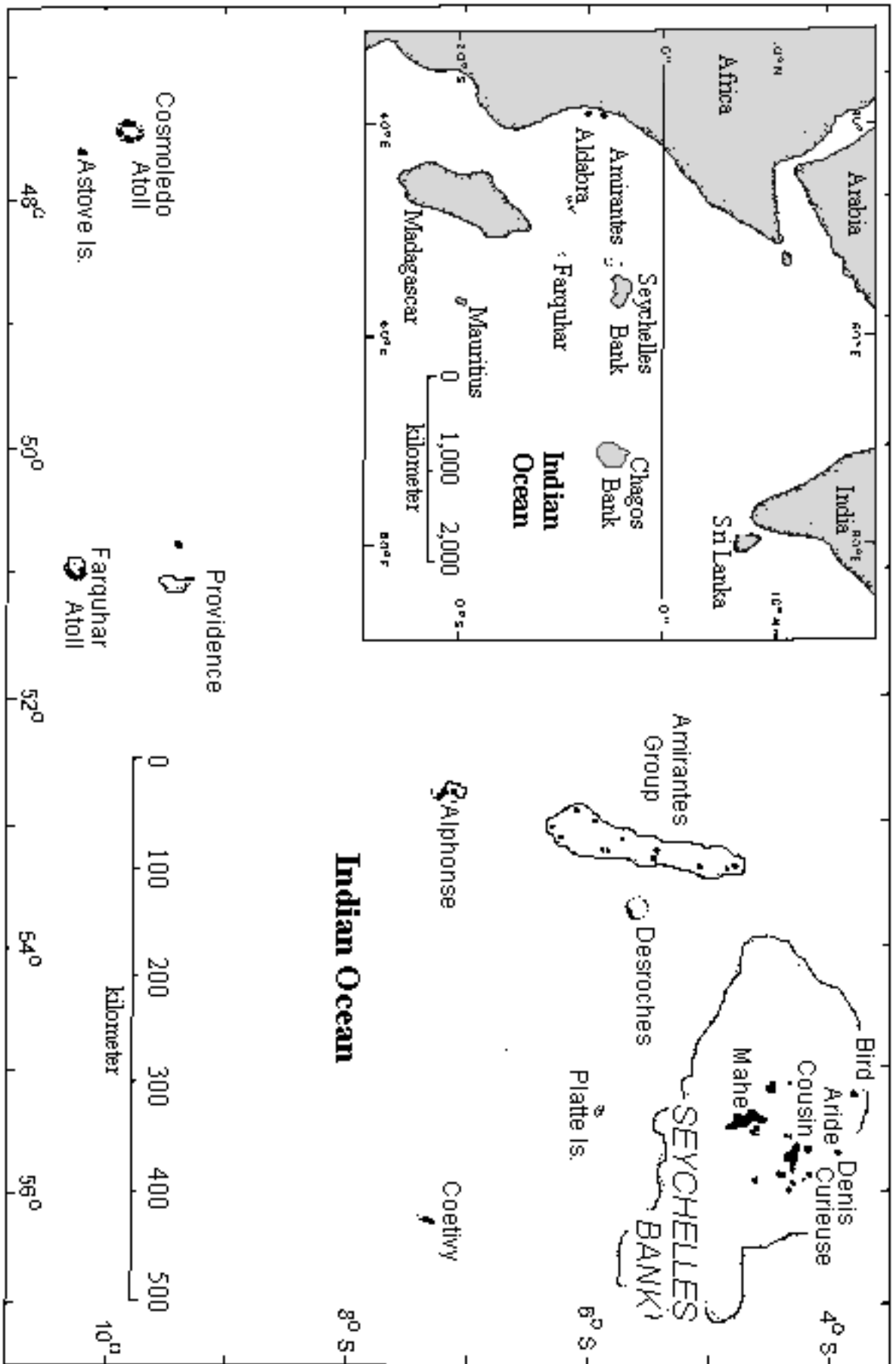
captured at points distant to the nesting beaches.

Our lack of knowledge about the resident foraging grounds, where the adult females live during the several-year intervals between nesting seasons, has compromised efforts to effectively manage and conserve both the turtle populations and their foraging habitats. Data obtained from 25 years of tagging nesting hawksbills had not solved this mystery. So, we employed satellite telemetry in an effort to identify the resident foraging grounds and to track the routes taken to reach them.

The Tracking Study

In January 1998, we attached five ST14 satellite transmitters (Telonics of Mesa, Arizona) to post-nesting hawksbill turtles at Cousin Island (4°20'S; 55°40'E), using methods patterned after Balazs *et al.* (1996), and tracked them using the Argos system. Mapping of results was accomplished as described by Ellis and Balazs (1998). Our study has been very successful. **Figure 2** maps the

Figure 1. The Republic of Seychelles (next page).



movements of the five turtles. As of early March 1999, after 13.5 months, transmitters (#4806, #4807, and #4809) were still sending good position data for three of the turtles. Two of the transmitters (#4805 and #4808) had stopped transmitting after 2.3 and 1.5 months, resp., but not before the turtles are believed to have completed their migration back to the foraging grounds. None of the five turtles traveled beyond the edges of the Seychelles Bank, and none moved farther than 175 km from the nesting beach.

All five turtles displayed similar patterns of movement. After laying their last egg clutch of the season, the five turtles traveled for three to five days in a directed fashion to discrete and different locations on the Seychelles Bank that ranged from 20 to 175 km from the nesting beach. Upon reaching their destinations none of the turtles traveled beyond a radius of about 15 km in any direction. In fact, their travel appeared more restricted as the months passed (Fig. 2). Detailed results of this study will be published separately (Mortimer, Balazs, Hitchins, Constance and Nolin, in prep.). The tracking data confirmed in a few months what 25 years of flipper tagging had inconclusively suggested: that hawksbills nesting in Seychelles are likely to spend their adult lives within the territorial waters of Seychelles. Satellite tracking in the Hawaiian Islands has shown similar short-range post-nesting migrations (Ellis *et al.*, in press).

Implications for Conservation

The conclusions of our study enhance efforts to conserve sea turtles in Seychelles. A source of frustration when trying to manage sea turtle populations—in Seychelles, as elsewhere—is the disregard turtles have for international boundaries. Some Seychellois complain that it is unfair and futile to expect the people of Seychelles to protect turtles that will only be slaughtered when they migrate from Seychelles to the national waters of another country in the region. The present study provides evidence that hawksbills, which nest in the granitic Seychelles, remain within the territorial waters of Seychelles even after leaving the nesting habitat. As such, they are a resource that belongs to the people of Seychelles, whose responsibility it is to ensure their long-term survival.

Our data provide an incentive to the people of Seychelles to protect their hawksbills. But this only complements the extraordinary action already taken by the Government of Seychelles during the past eight years. In 1993, as a first step towards banning all domestic trade in hawksbill products, the Government devised and implemented the “Artisan Training and Compensation” programme that provided financial assistance to hawksbill artisans to help them find alternate livelihoods. A component of that programme was Government purchase of the remaining stocks of the raw hawksbill shell still in the possession of the

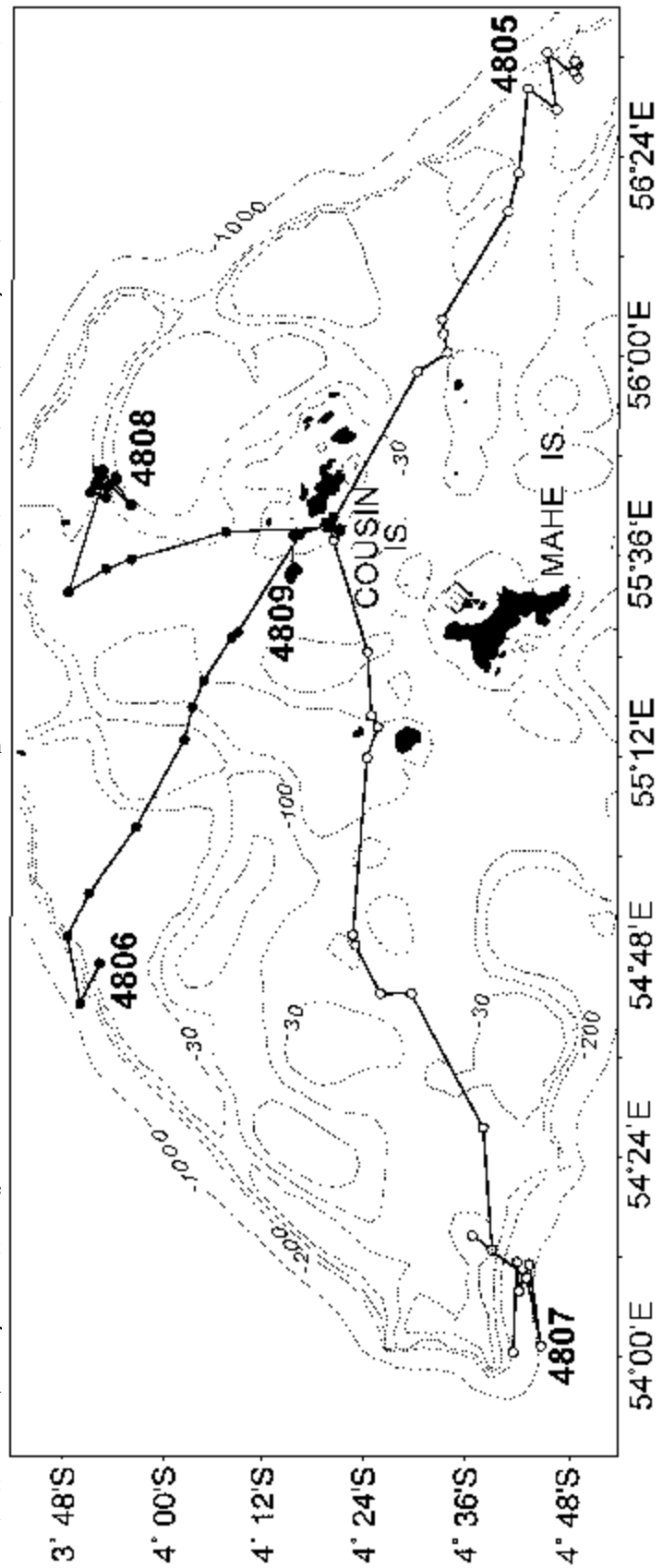


Figure 2. Movements of five satellite tracked post-nesting hawksbills on the Seychelles Bank. Depths are in meters.

artisans. In 1994, a law was passed providing complete legal protection for sea turtles and banning all commercial trade in turtle products. During the past four years the Government has actively promoted enforcement of this legislation, has sponsored public awareness campaigns (Mortimer, in press), and encouraged sea turtle research and population monitoring (Mortimer and Collie, 1998).

Seychelles is the site of some remarkable sea turtle conservation success stories. Green turtle (*Chelonia mydas*) nesting activity has significantly increased at Aldabra since 1968 when the atoll was made a nature reserve (Mortimer, 1988). Likewise, hawksbill-nesting activity at Cousin Island has almost tripled—increasing from some 30 animals in the early 1970's to 70-100 individual turtles nesting annually in recent years (Mortimer and Bresson, 1994). Nearby Cousine Island, protected since 1993, has already documented significant increases in hawksbill nesting activity (P. Hitchins, unpubl. data). The situation at Cousin/Cousine demonstrates that effective protection of nesting beaches can result in the recovery of nesting populations. The turtles nesting at Cousin/Cousine represented about 7% of the total estimated hawksbill nesting population of Seychelles in the early 1980's (Mortimer, 1984). Although hawksbill-nesting populations have declined at many other islands in Seychelles (Mortimer, 1998), new conservation initiatives are underway at some sites. Among them, Bird, Denis, and Aride Islands, and the Marine Parks at St. Anne and Curieuse are taking strong action to protect their nesting hawksbills—in many cases very effectively.

Despite progress made, the long-term survival of hawksbills in Seychelles is not yet assured. Nesting females are particularly vulnerable. They nest in the daytime, returning repeatedly to the same stretch of beach at predictable two-week intervals to lay their eggs. The average female deposits some three to five egg clutches per season, and each clutch laid is usually associated with one or more nesting emergences (Mortimer and Bresson, 1999). Thus, an individual female may emerge onto the same stretch of nesting beach some 4-10 times during a single nesting season. Where constant surveillance is lacking, a small number of determined and energetic turtle poachers can still slaughter dozens of adult turtles at a single island during a nesting season. Foraging hawksbills—especially the immature animals that reside in relatively shallow water—are also easy prey for poachers for they are slow swimmers with little fear of humans.

Fortunately, the Government of Seychelles takes this matter seriously. It has reassessed its national priorities and put environmental protection at the head of the list. It appreciates the fact that its pristine environment is a prime attraction for tourists, and that tourism is a major source of foreign exchange for the country. Live turtles have become increasingly popular attractions for visiting tourists who enjoy watching them on the nesting beach and in the water while they snorkel (Mortimer, in press). On 23 November 1998, in conjunction with the Miss World Pageant hosted in Seychelles, the Government publicly burned the stockpile

of raw hawksbill shell that it had procured from the tortoise shell artisans in 1993 (Mortimer, 1999). The stockpile had been kept in a sealed container on Mahe since 1993 and could not legally be sold to a buyer outside the country because of CITES restrictions. Conservationists were concerned that by holding on to the stockpile, the Government was inadvertently sending a message to turtle poachers that eventually the trade in tortoiseshell would re-open. There was concern that this might encourage poachers to amass their own private stockpiles of raw hawksbill shell. Thus, the decision was made to destroy the stockpile in order to send a message to the world that Seychelles is serious about environmental conservation, and to send a message to potential poachers inside the country that slaughter of hawksbills would not be sanctioned or tolerated.

We hope other nations that host hawksbill populations will follow the lead of the Government of Seychelles and take whatever strong action is necessary to protect their own populations of this Critically Endangered species. (*Resolution 1999-6* of this Symposium expands on this theme).

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Winter Movements of Sea Turtles

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Because of accessibility, most sea turtle studies have focused on nesting beaches. Relatively little information exists on the movements of sea turtles during the winter months. To assess activities of sea turtles when water temperatures become cold, ten loggerheads (*Caretta caretta*) and three Kemp's ridleys (*Lepidochelys kempi*) were instrumented with satellite tags and monitored in the Tampa Bay and Kings Bay regions of Florida (Table 1).

The movements of the turtles in the two different areas followed similar patterns. The turtles remained in a general area for days or months at a time and then moved in

response to changing water temperatures. Sea turtles responded to changing water temperatures generally by moving to water above 15 °C. These movements coincided to declining water temperatures during the cold winter months and reflected two trends: 1) movement offshore and/or 2) movement south. In response to warming water temperatures in the spring, sea turtles generally moved inshore and north returning to the same vicinity they left in the fall.

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Table 1. Sea turtles captured by trawler, instrumented with a satellite tag and released back into the channel, Kings Bay (KB) and Tampa Bay (TB), FL.

Identification	Species	Sex	SCL	Release	End	Days Tracked
15240TB	<i>Cc</i>	Male	96.0	11/15/97	10/13/98	343
15241TB	<i>Cc</i>	Subadult	81.7	08/22/97	09/02/98	376
15242TB	<i>Cc</i>	Male	99.3	05/31/98	06/12/98	13
15244TB	<i>Cc</i>	Female	93.8	11/16/97	07/20/98	245
15245TB	<i>Cc</i>	Subadult	62.0	05/28/98	06/28/98	30
15243TB	<i>Lk</i>	Subadult	54.9	11/19/97	03/11/98	111
01381TB	<i>Lk</i>	Subadult	53.4	11/18/97	05/16/98	177
15240KB	<i>Cc</i>	Subadult	69.7	10/29/93	05/29/94	213
15241KB	<i>Cc</i>	Subadult	63.2	10/28/93	03/30/94	154
15243KB	<i>Cc</i>	Subadult	73.5	11/02/93	04/03/94	153
15242KB	<i>Cc</i>	Subadult	65.8	11/02/93	05/03/94	183
15245KB	<i>Cc</i>	Subadult	73.6	11/09/93	10/31/94	356
15244KB	<i>Cc</i>	Subadult	63.0	11/09/93	04/29/94	172
15246KB	<i>Cc</i>	Subadult	68.8	11/11/93	06/28/94	230



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