Micronesica 31(2):85–94. 1999

Marine Turtle Survey on Tinian, Mariana Islands

SUSAN PULTZ[1], DONNA O'DANIEL[2], SCOTT KRUEGER[3], HEATHER MCSHARRY[4],

Pacific Islands Office, U.S. Fish and Wildlife Service,
P.O. Box 50167 Honolulu, Hawai'i 96850

GEORGE BALAZS

National Marine Fisheries Service, Southwest Fisheries Science Center Honolulu Laboratory,
2570 Dole Street Honolulu, Hawai'i 96822

Abstract—Turtle nesting activity for 1995 occurred between 31 January and 16 July. A minimum of 24 nests were laid, with additional nesting activity that could represent as many as 24 nests. Six green turtles (*Chelonia mydas*), were tagged between 1 April and 23 May 1995. Two to four additional turtles were believed to have been nesting, but were not encountered. Mean curved carapace length for tagged turtles was 104.5 ± 2.5cm, and mean width was 94.2 ± 3.5 cm. Although turtles were encountered on different beaches, individual tagged turtles were encountered on the same beach every time. Mean incubation period was 62 ± 5 days. Mean clutch size was 91 ± 10 eggs, with a mean hatch success of 89 percent for successful nests. Percentage of successful nests was not calculated as nests were evacuated on an opportunistic basis. During ten aquatic surveys conducted during the nesting season, all 36 turtles observed were green turtles and 92 percent were subadults. Data from this study combined with anecdotal historical information reveal that virtually all of Tinian's beaches are used by turtles for nesting.

Introduction

From August 1994 through August 1995, the U.S. Fish and Wildlife Service (USFWS) conducted a marine turtle survey on the island of Tinian, Commonwealth of the Northern Mariana Islands (CNMI). Both green turtles *(Chelonia mydas)* and hawksbills *(Eretmochelys imbricata)* are known to occur in the waters around Tinian. Prior to this survey, documentation of the extent to

[1]Present Address: U.S. Fish and Wildlife Service, Division of Endangered Species, 4401 N. Fairfax Dr., Rm 420, Arlington, VA 22203. Email: Susan_Pultz@fws.gov

[2]Present Address: P.O. Box 714, APO AP 96558, Johnston Atoll

[3]Present Address: 2801 Green Acres Rd. Ext., St. Augustine, FL 32095

[4]Present Address: U.S. Fish and Wildlife Service, South Florida Restoration Projects Office, P.O. Box 2676, Vero Beach, FL 32961-2676

which marine turtles occur around Tinian and utilize its beaches for nesting was based on infrequent observations by visitors (Pritchard 1977, Wiles et al. 1989, Rodda et al. 1991). Nesting in recent years has been considered occasional (Wiles et al. 1989). Although the existence of turtle nesting is common knowledge among Tinian residents, Wiles (1989) noted that there were no published records of *C. mydas* nesting on the island prior to 1989.

The primary goals of this survey were to: 1) Identify the species and number of nesting marine turtles; 2) identify the beaches used by these turtles during 1995; 3) document the timing of nesting during the year, and 4) collect basic biological data on turtles. This survey was a continuation and expansion of research conducted by the USFWS in July 1994 (USFWS 1995). In July 1994, information regarding use of nesting beaches in recent years was gathered via the files and personal accounts of CNMI Department of Natural Resources staff and other island residents, and nesting activity for the month of July was documented via daily diurnal beach monitoring (USFWS 1995).

Study Area

Tinian (15ºN, 145º38'E), the third largest of the Mariana Islands, is bounded by the Philippine Sea and the Pacific Ocean, and located approximately 2,300 km east of the Philippine Islands. Tinian is 102 km^2 and occurs between the islands of Saipan, 5 km to the northeast, and Aguiguan, 9 km to the southwest. A relatively flat island, Tinian consists of low limestone plateau with vegetation dominated by tangantangan *(Leucaena leucocephala)* and is fringed by coral reefs and 13 distinct beaches that extend beyond the high tide line (Fig. 1). Unai Dangkolo, also known as Longbeach, is considered one beach in this survey but consists of a complex of 13 adjacent beaches separated by narrow rocky outcrops and fronted by a single coral reef system. There were 2,118 persons living on the island as of 1990 (USDOC 1992).

Methodology

TERRESTRIAL SURVEYS

During the course of this survey, 10 of the 13 beaches on the island were monitored on a regular basis and the remaining three beaches were monitored several times, but not regularly. From August 1994 to early March 1995, diurnal beach monitoring was conducted weekly by USFWS biologists at most of the island's accessible beaches (Leprosarium, Barcinas, Chulu, Babui, Lamlam, Dangkolo and Masalok) in order to note any sporadic nesting activity and to identify the start of the 1995 nesting season. Beginning 7 March 1995, diurnal monitoring of these beaches was increased to semi-weekly. No attempt was made to distinguish between false crawls, potential nests, and nests until April. False crawls are crawls that are not accompanied by either a body pit or nest hole, or that have evidence that nesting was attempted but no eggs were laid. Potential

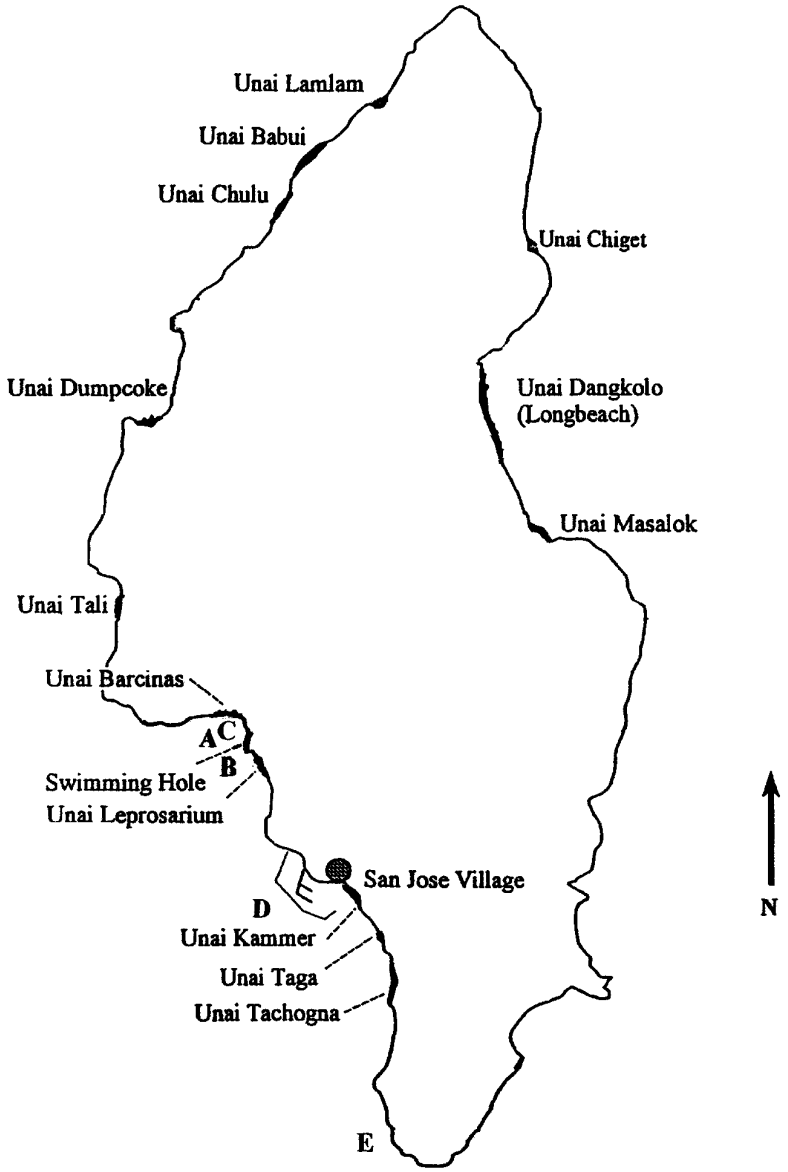

Figure 1. Island of Tinian with beaches indicated. Location of aquatic surveys: A) Two Corals/ Barcinas Buoy, B) Swimming Hole, C) Barcinas, D) Harbor Wall, E) Carolinas Point.

nests are defined here as nests into which eggs may have been deposited, but for which the observer could not see clear evidence that this had occurred.

Starting in April, diurnal monitoring was intensified to a daily basis, whenever possible, at all accessible beaches (those mentioned above as well as Chiget, Kammer and Tachogna), and several times between April and July at the less

accessible beaches of Dumpcoke, Tali, and "Swimming Hole." Also starting in April nocturnal monitoring was conducted by a combination of USFWS biologists, CNMI Conservation Officers, and volunteers. Nocturnal monitoring was conducted in order to locate, tag and collect size data on nesting female turtles. For each turtle encountered, curved carapace length and width were measured, and Inconel alloy identification tags were attached to all four flippers. If the turtle had been tagged previously, it was identified by those tags.

As time and circumstances allowed, hatched nests were excavated to ascertain hatching success. Counts were made of the number of eggs hatched, number of unhatched eggs containing embryos in each of the early, mid and late stages of development, and infertile eggs. Early-stage embryos showed signs of blood vessel formation but the embryo, if visible, was unpigmented. Mid-stage embryos had a pigmented body, and late-stage embryos were fully pigmented and more or less fully formed. Hatching success was measured as a percentage of total clutch size. The incubation period was determined from the estimated or actual dates of nesting and hatching. Excavation of nests occurred after the major emergence of hatchlings took place. Live hatchlings encountered during excavation were released after sunset on the same day.

AQUATIC SURVEYS

In April and May, aquatic surveys were conducted at five locations in order to identify species and relative numbers of turtles in waters surrounding the island and, if possible, to distinguish breeding size adults (Fig. 1). SCUBA diving was used to conduct the surveys at Two Corals/ Barcinas Buoy (Transect A) and Carolinas Point (Transect E) where the water was approximately 20 m in depth. Transects B-D were snorkeled in waters of approximately 3–12 min depth. Transects B-E were approximately 150–200 m in length and 15–30 m from shore or, in the case of Transect D, from the harbor wall. Transect A, at Two Corals/ Barcinas Bouy, took a rough figure eight around the two coral outcrops. The bottom substrate for all transects was a combination of coral reef and white sand. All transects were followed by two to four snorkelers/divers, swimming approximately 5 meters apart. Surveys were replicated at three of these locations, following roughly the same transect as during previous surveys. The number of turtles, sighted by species, was noted, and distinctions between subadults and adults were made. Because only green turtles were sighted, turtles that were recorded as subadults were approximately 50–75 cm in length and distinctly smaller than the breeding sized adults (approximately 1 meter), which stood out clearly the few times they were observed.

Results

TERRESTRIAL SURVEYS

Turtle nesting activity in 1995 occurred between 31 January and 16 July. The last nest of 1994 had been observed on 31 July 1994 (USFWS 1995). No nesting

Table 1. Green Turtle nesting activity on Tinian, Mariana Islands, 1995

Beach	Number of Known Nests	Number of Cases of Undetermined Activity (Nests or False Crawls)	Number of Known False Crawls	Number of Tagged Turtle Sightings**	Comments
Leprosarium*	7	1	1	4(ID I-678)	
"Swimming Hole"	–	–	–	–	Not checked in 1994; three visits in 1995
Barcinas*	4	10	6	4(ID I-630)	
Tali	–	–	–	–	Inaccessible–One visit in 1994; two visits in 1995
Dumpcoke	–	–	–	–	Inaccessible–One visit in 1994; two visits in 1995
Chulu	1	2	–	–	
Babui*	–	–	–	–	
Lamlam*	3	3	6	4(ID I-629) 2(ID I-613)	
Chiget*	–	–	–	–	
Dangkolo*	8	7	4	2(ID I-605)	Complex of 13 beaches–
(Long beach)				2(ID I-615)	at least 9 had activity in 1994 and 1995
Masalok	1	1	1	–	
Tachogna*	–	–	?	–	Possible crawl in 1995
Kammer*	–	–	–	–	
TOTAL	24	14	19	18	

*Beaches with reports of nesting in previous years

**Includes initial encounter when turtle was tagged

activity was noted between 1 August 1994 and 30 January 1995. Although the first crawl of 1995 was noted on 31 January 1995, no nest was evident. During February and March, two beaches, Unai Barcinas and Long Beach (Figure 1), saw regular activity. Because monitoring was still being done on a semi-weekly and diurnal basis, it was difficult to distinguish nests from false crawls, and the first actual nest was not noted. In April, nesting took place on three beaches, and three turtles were tagged. May saw the most activity, with nesting on four beaches.

Three additional turtles were tagged in May. In June and July, Leprosarium was the only beach that saw any activity and the only turtle seen nesting during that time had been tagged in May. Only green turtles were observed on beaches.

Six green turtles were tagged between 1 April and 23 May 1995. These turtles were encountered on beaches a total of 18 times (Table 1). It is our estimation that two to four additional turtles (including two believed to have been harvested illegally) may have been nesting, but were not encountered by researchers. All tagged turtles were encountered more than once, and these turtles were encountered on the same beach or beach complex each time. Nesting was observed during nine of these encounters. Four turtles were encountered on subsequent nestings, and three of these four were encountered on two or more subsequent nestings.

The curved carapace length for nesting turtles ranged from 101.0-107.4 cm, with a mean of 104.5 ± 2.5 cm (n=6), and the width ranged from 87.5-99.0 cm, with a mean of 94.2 ± 3.5 cm (n=6). Because turtles were encountered while nesting only nine times, estimation of the number of clutches laid by each turtle was not possible. However, on Unai Leprosarium, Turtle #6 was actually observed nesting four times, and regular internesting intervals of 10-13 days between 24 May and 16 July suggest that the same turtle may have laid all seven clutches.

At least 24 nests were known to be laid during 1995, with an additional 24 potential nests found during diurnal surveys (Table 1). Two turtle nests were known to be harvested illegally for their eggs during the season, and two turtles were believed to be harvested illegally from their nesting beach, based on evidence (tire tracks or drag marks adjacent to nesting activity with a one-way crawl) found on the beach.

Eleven undisturbed nests were excavated after hatching (Table 2). It is believed that four of these nests were laid by the same turtle (Turtle #6 on Unai Leprosarium). Clutch size ranged from 73-110 eggs, with a mean of 91 ± 10 eggs. Hatching success ranged from 58-96 percent, with a mean of 89 ± 11 percent. The nest with 58% hatching success was located on an extremely small beach that saw a lot of nesting activity, and may have been partially tide-washed or disturbed by subsequent nesting activity. Incubation period was estimated for seven nests, and ranged from 55-73 days, with an average of 62 ± 5 days.

Table 2. Nest excavation data from 11 green turtle nests on Tinian, Mariana Islands, 1995.

	Mean	SD	Range	Total
No. of Total Eggs/Nests	90.8	9.8	73–106	999
No. of Eggs Hatched/Nest	81.1	13.8	55–102	892
No. of Early Stage Embryos/Nest	1.5	3.3	0–11	17
No. of Middle Stage Embryos/Nest	2.9	5.6	0–19	32
No. of Late Stage Embryos/Nest	0.6	0.6	0–2	7
No. of Non-developed Eggs/Nest	4.6	2.1	2–9	51
% Hatch Success	89.2	10.7	57.9–96.2	

Table 3. Results of aquatic turtle surveys near the island of Tinian, Mariana Islands, April-–May, 1995.

Transect Location	Number of Surveys	Number of Turtles Observed	Species	Size Class	Time in Water (minutes)
Harbor Wall	2	6	*C. mydas*	11 subadult	26
		6		1 adult	45
Two Corals/	3	1	*C. mydas*	all subadult	31
Barcinas Buoy		2			35
		3			not recorded
Swimming Hole	3	5	*C. mydas*	all subadult	35
		2			30
		4			not recorded
Carolinas Point	1	2	*C. mydas*	all subadult	26
Barcinas	1	5	*C. mydas*	3 subadult	25
				2 adult	
TOTAL	10	36	*C. mydas*	33 subadult	–
				3 adult	

AQUATIC SURVEYS

Ten aquatic surveys were conducted during April and May (Table 3). All 36 turtles observed were green turtles. Three were adults and the remainder were subadults.

Discussion

The results of the 1995 marine turtle survey, combined with data collected in 1994 (USFWS 1995), indicate that most, if not all, beaches on Tinian are used for nesting. The three beaches on which nesting activity was not reported, Swimming Hole, Unai Tali and Unai Dumpcoke, are not readily accessible and were checked for nesting activity three times in 1994 and 1995. At two other beaches, Unai Chiget and Unai Kammer, nesting was reported to have occurred in the past, but not in recent years. Indeed, a young adult resident reported frequent turtle nesting on Kammer beach in his childhood. He also reported that turtles nesting on this beach were regularly harvested because of the beach's proximity to the island's only town. Beaches used for nesting in 1995 were as small as 10-15 m^2 above the tide line or had entrances carved out of rock that were as narrow as 2 m.

During 1995, nesting occurred regularly for approximately six months of the year. It is assumed that all nesting activity was attributable to green turtles, but it is possible that early activity could have been by one or more hawksbills, partic-

ularly because this would not be an atypical time of the year for hawksbills to nest. However, nothing unusual about crawls was ever noted, such as alternate use of flippers typical of hawksbills, and the fact that nesting activity continued and increased throughout the spring means that this early activity may simply have marked the start of a long green turtle nesting season.

No hawksbills were observed during the course of the survey. Observations of turtles in the water were admittedly limited in both time and area covered, and hawksbills could have been missed. However, the absence of a confirmed hawksbill sighting during the 13-month survey is a matter of concern as this species is rapidly declining in number throughout the Pacific (NMFS & USFWS 1998).

Tagged green turtles displayed remarkable site fidelity throughout the nesting season, always having been encountered on the same beach on which they were tagged. Although site fidelity by green turtles has been observed on continuous stretches of beaches (Carr & Ogren 1960, Johnson & Ehrhart 1994), the distribution of Tinian's relatively small beaches around the island may be better compared with Ascension Island in the Atlantic, where nesting grounds consist of a series of crescentic beaches in little coves separated from one another by rocky promontories (Carr & Carr 1972). On Ascension Island, it was observed that turtles renesting during a single season, as well as those remigrating from Brazil, return to the same cove to nest. Whether or not Tinian turtles exhibit such strong site fidelity on remigration has yet to be determined.

Although the size of the Tinian green turtle nesting population cannot be determined by one or two years of data, a comparison of nesting activity by 6 to 10 turtles from 1995 (67 nests and false crawls combined) with a similar number of reported nesting attempts in 1994 (59 nests and false crawls combined) (USFWS 1995), suggests that the nesting population is probably small. The observation by Tinian residents and FWS staff that turtles are present in Tinian waters year-round and the majority are subadult, indicates that nesting population is likely a separate population from turtles foraging in the same waters. Recent genetic research shows that it is not unusual for two or more populations of turtles to inhabit the same waters (Bowen 1995). Furthermore, populations of adult green turtles worldwide are known to have distinct foraging and nesting grounds, and to undertake reproductive migrations every two or more years. That the Tinian nesting population is not an exception to this pattern is supported by the recovery in the Philippines in 1996 of an adult nesting turtle that was tagged on Tinian during this survey.

Different populations of the same species of turtle inhabiting waters simultaneously can be misleading to individuals who feel that a relative abundance of turtles in the water ensures the future of the nesting population. Genetic studies have confirmed that nesting populations are distinct demographic entities, consistent with the hypothesis that females return to nest on their natal beaches (Bowen & Avise 1995; Bass et al. 1996). These studies indicate that nesting populations depleted by human or other sources will not be replenished readily by immigration from other populations. Perhaps the most effective means of ensuring the

future of Tinian's nesting turtles is to share information with the public regarding their biology and status. To the maximum extent possible, this should include public participation in survey and conservation efforts.

Acknowledgments

This research was supported by funding from the U.S. Department of the Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, Hawai'i, with the assistance of Mr. Tim Sutterfield, Project Officer. Support was also provided by the Honorable Herman Manglona, Mayor of Tinian; Secretary Benigno Sablan, CNMI Department of Land and Natural Resources (DLNR); Tinian DLNR Resident Director Leon Masga; and Tinian Chief Conservation Officer Henry Cabrera. Field assistance was provided by Conservation Officers Henry Cabrera, Alfredo Castro, Hennry King Elvin Masga, and Joe San Nicolas, as well as numerous dedicated volunteers. Luciana Honigman was responsible for the 1994 data collection effort. We also wish to thank the people of Tinian for their gracious hospitality.

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Received 15 May 1997, revised 15 Aug. 1998