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An Assessment of the Sea Turtles and Their Marine and Terrestrial Habitats at Saipan, Commonwealth of the Northern Mariana Islands

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Abstract–An estimated 169 individual *Chelonia mydas* were observed via 238 sightings over 28 marine surveys covering roughly 54% of Saipan's outer reef and shoreline perimeter. No other sea turtle species were sighted. Sixty percent of the turtles were classified as juveniles, 22% as juvenile/adults, and 12% appeared to be of adult size. A disproportionate number of turtles (60%) were located along relatively uninhabited east coast sites where access to humans is limited but topographically complex benthos and a variety of food resources is apparent. Two species of seagrass and at least 29 species of algae noted as green turtle forage in other regions of the world were identified at Saipan in this and previous surveys. Turtle nesting activity was limited, with 15 crawls and 6 nests recorded throughout the 1999 nesting season.

Introduction

Four species of sea turtles, *Chelonia mydas, Eretmochelys imbricata, Dermochelys coriacea*, and *Lepidochelys olivacea* have been reported to inhabit or transverse nearshore waters of the Commonwealth of the Northern Mariana Islands (CNMI) (NMFS & USFWS 1998a, 1998b, 1998c, Pritchard 1982). All four are listed as Endangered worldwide by the International Union for the Conservation of Nature and Natural Resources (Groombridge 1982) and appear on Appendix I of the Convention on International Trade in Endangered Species of

Wild Fauna and Flora (CITES). As the Northern Mariana Islands are politically a Commonwealth of the United States, these species gain protective status under the U.S. Endangered Species Act of 1973. Unfortunately, however, there is a near absence of documentation which adequately reflects past or present sea turtle

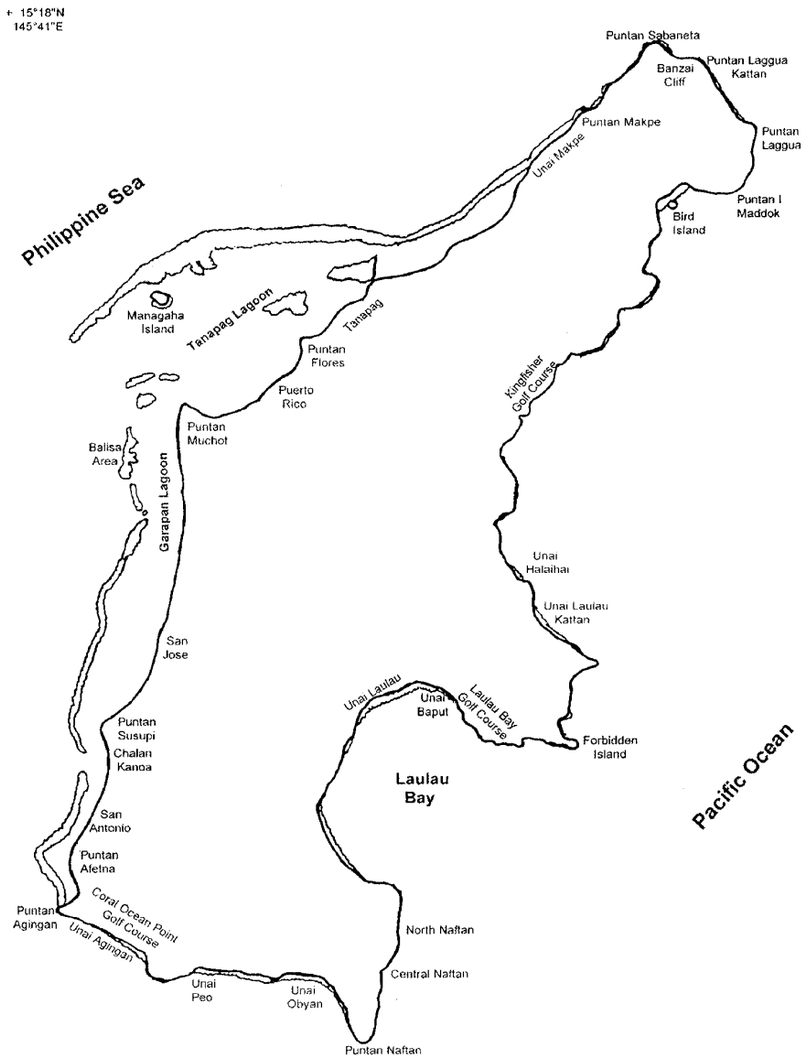

Figure 1: Map of Saipan, Commonwealth of the Northern Mariana Islands.

numbers and activities within the region (Pritchard 1977, 1982, Pacific Basin Environmental Consultants, Inc. 1984, Johannes 1986, Wiles et al. 1989, Rodda et al. 1991, Eckert 1993, McCoy 1997, but see Pultz et al. 1999), thus it is impossible to gauge the status and reaction of turtle populations relative to human activities in the area and the protection purportedly provided by domestic and international law.

Recent interest in renewing traditional practices involving sea turtles as a means of expressing and maintaining Carolinian culture (McCoy 1997, see also McCoy 1974, 1982, Lessa 1983, Alkire 1989), in combination with an almost complete absence of documented information reflecting sea turtle population size and status, created the need for a rapid assessment of sea turtle numbers, sizes, activities, locations and habitat characteristics along the shores of Saipan. Although the main focus of this assessment was to provide information on likely areas for further, more intense, scrutiny, a substantial amount of data was collected that can serve as a baseline for comparative studies.

Study Area

Saipan (15˚05´N, 145˚50´E) is one of 16 islands comprising the Mariana Archipelago. Its nearest neighbor to the south is Tinian (5 km) and to the north is Farallon de Medinilla (117 km). Western waters belong to the Philippine Sea and those to the east to the Pacific Ocean. Saipan is a high (474 m) volcanic island with raised limestone terraces and a land area of approximately 122 km^2 (Wells & Jenkins 1988). Limited reef development occurs along the windward north, east, and leeward south sides of the island (Goreau et al. 1972, Eldredge & Randall 1980). An extensive shallow lagoon and barrier reef system runs contiguous along 75% of the leeward west coast (Fig. 1). Roughly 26 beaches of varying composites exist along the island perimeter and range from extensive medium to coarse grained calcareous sand shoreline along the protected west coast (9 defined but more or less integrated beaches) to coarse grain sand, gravel and rubble that dominates in less frequent, isolated pockets along the north, east and southern coasts (Cloud 1959, Eldredge & Randall 1980). A relatively large portion of the north, east and south shoreline consists of precipitous limestone cliffs, caverns and narrow intertidal benches. Human development is focused mainly along the west coast, with tourism and garment manufacturing as the primary economic industries. Roughly 55,000 residents inhabited the island as of 1995 (McCoy 1997).

Methodology

Terrestrial Habitat Surveys

Representatives of the Saipan Division of Fish and Wildlife (DFW), with the assistance of local community members, monitored beaches on an infrequent basis throughout the summer nesting season (April through August). Crawl and

nest activity were documented. Although occasionally encountered by community members, nesting females were not directly observed by DFW staff, thus tagging and measuring of these turtles did not occur.

Marine Habitat Surveys

A survey of nearshore environments was conducted from 15 to 29 August 1999 by investigators of the University of Hawai'i and the Saipan Division of Fish and Wildlife. Various members of the community, including Division of Fish and Wildlife representatives, local fishermen, turtle poachers, dive shop personnel and other local observers, provided information regarding notable sea turtle habitat believed worthy of investigation. Approximately 54 % of the island's outer reef and shoreline perimeter was examined using one or more of the following three methods:

1. Tow surveys were conducted along the north, south and west shorelines as permitted by oceanic conditions. Two people were towed along the sides of a 27 ft. whaler. When a turtle was sighted the boat was stopped, and the species, estimated size, activity, time, depth and habitat characteristics were relayed to a recorder on the boat. Latitude and longitude were noted using a GPS unit at the location where each turtle was encountered. In addition, boat observers searched the waters' surface for turtle ascents, which were also recorded.
2. In snorkeling surveys anywhere from two to seven observers swam an imaginary transect along a barrier or fringing reef slope, maintaining observer distances of approximately 10 m in a straight line perpendicular to the transect. Turtle species, size, activity, time, depth and habitat characteristics were relayed to a single person for recording on underwater writing paper. Latitude and longitude at the beginning and end of the transects were measured using a GPS unit.
3. Shoreline surveys of nearshore waters were conducted mainly along the east coast which, with the exception of Bahia Laulau, was inaccessible to the water-based methods. Observers sketched the shoreline and prominent submerged benthic features within their range of visibility. When a turtle was sighted on the surface or swimming subsurface, the time was noted and binoculars were used to identify species and estimate size. Features such as tail length and any identifying marks were recorded when observed. The estimated surface time and behavior of each turtle was noted when possible, and the location and/or route of each turtle was plotted on the map sketch and numbered. The location of each observer was measured using a Garmin hand-held GPS unit. Environmental conditions and location factors deemed relevant were recorded.

Actual numbers of turtles were estimated by adjusting for resightings on the basis of unique features, time and specific locations and/or routes.

Algae and seagrass samples were collected as a means to identify potential green turtle forage along seven established west lagoon transects and from various areas along the north and east coasts where assessable. All specimens were identified by Dr. Dennis J. Russell, American University of Sharjah, United Arab Emirates. In addition, a literature review was conducted and a species list of potential green turtle forage was compiled, along with locations and references. Hirth (1997) was used as a guideline for listing only those species identified as turtle forage in other parts of the world. Potential food resources of other turtle species were not surveyed.

Results

Terrestrial Habit Surveys

A minimum of 15 green turtle nesting attempts was made between April and August 1999 (Table 1). Evidence of nesting attempts by other turtle species was not found. Forty percent of identified crawls resulted in turtle nests (egg deposition). The greatest proportion of nests and activity was reported from the south side of the island. Turtle hatchlings were first encountered in late June. A single nest laid at Unai Obyan in July hatched 63 days later.

Marine Habitat Surveys

A total of 169 individual *Chelonia mydas* were estimated to have been observed via 238 sightings over 28 surveys covering roughly 51 km of coast and barrier reef (Table 2). No other turtle species were encountered. Sixty percent (101 turtles) of the turtles were juveniles, 22% (37 turtles) were categorized as juvenile/adult, and 12% (21 turtles) appeared to be of adult size. Size determinations could not be made for 10 of the turtles (6%). Sixty percent of the turtles (101

Table 1. Known turtle nesting activity on Saipan beaches during the 1999 nesting season.

Beach	Number of Known Nests	Number of Known False Crawls	Recorded Observer Visits
Unai Fanonchuluyan (Bird Island Beach)	1	-	3
Unai Halaihai (Tang Beach)	1	1	7
Unai Laulau Kattan (Marine Beach)	-	-	1
Unai Baput	-	-	2
Unai Obyan	4	7	35
Unai Peo (Ladder Beach)	-	-	3
Unai Agingan (Sisters Beach)	-	1	5
Unai Makpe (Wing Beach)	-	-	2
Total	**6**	**9**	**58**

Table 2. Observations of green turtles, *Chelonia mydas*.

Site	Date	Max. Time (hrs:mins)	Method	Transect Length (km)	Number of Observations: Juv	Juv./Adult	Adult	Unknown	Estimated Number of Turtles Observed: Total	Juv/Adult	Adult	Unknown	Total
North Saipan													
Puntan Laggua to Puntan Makpe	08/20/99	1:39	Tow	5.80	12	3	3	0	18	11	3	3	0	17
Banzai Cliff	08/17/99	1:00	Shoreline	0.75	1	0	5	0	6	1	0	5	0	6
Subtotal:		2:39		6.55	13	3	8	0	24	12	3	8	0	23
East Saipan														
Grotto, Puntan I Maddok	08/21/99	1:15	Shoreline	0.38	7	0	0	0	7	6	0	0	0	6
Bird Island (Isleta Maigo Fahang)	08/18/99	0:41	Shoreline	0.60	0	0	0	0	0	0	0	0	0	0
	08/22/99	1:18	Shoreline	*0.60	7	1	0	1	9	6	1	0	0	7
Kingfisher Golf course, Sabanan Fiiang	08/19/99	2:13	Shoreline	0.50	12	2	0	1	15	10	2	0	0	12
Forbidden Island, North of Isthmus	08/25/99	1:02	Shoreline	0.63	26	1	0	0	27	18	1	0	0	19
Forbidden Island, South of Isthmus	08/25/99	0:22	Shoreline	0.33	1	1	0	0	2	1	1	0	0	2
Laulau Bay Golf Course, Bahia Laulau	08/20/99	1:40	Shoreline	0.37	7	0	0	1	8	6	0	0	1	7
Unai Laulau Reef Slope	08/19/99	0:31	Snorkel	0.80	0	0	0	0	0	0	0	0	0	0
North Naftan	08/19/99	1:12	Shoreline	0.48	1	5	6	7	19	1	5	5	6	17
Central Naftan	08/23/99	1:15	Shoreline	0.50	18	21	2	1	42	13	16	2	0	31
Subtotal:		11:29		4.58	79	31	8	11	129	61	26	7	7	101
South Saipan														
Puntan Agingan	08/26/99	1:01	Shoreline	0.33	4	0	0	3	7	4	0	0	3	7
Agingan to Puntan Naftan	08/18/99	1:48	Tow	6.50	0	2	1	0	3	0	2	1	0	3

Coral Ocean Point Golf Course, 7th tee and hole, Agingan	08/26/99	1:00	Shoreline	0.30	2	0	0	0	2	2	0	0	0	2
Coral Ocean Point Golf Course, 14th tee and hole, proximal Puntan Obyan	08/26/99	0:40	Shoreline	0.33	0	0	0	0	0	0	0	0	0	0
Puntan Naftan	08/23/99	1:18	Shoreline	0.40	2	3	0	1	6	1	2	0	0	3
Subtotal:		5:47		7.85	8	5	1	4	18	7	4	1	3	15
West Saipan														
Puntan Makpe to Tanapag lagoon entrance	08/20/99	2:05	Tow	11.60	0	0	0	0	0	0	0	0	0	0
Tanapag Lagoon Seagrass Pastures (night)	08/26/99	0:50	Tow/Capture	2.50	0	0	0	1	1	*0	*0	*0	*1	*1
Tanapag Lagoon Entrance towards Puntan Flores	08/17/99	0:54	Tow	3.10	2	0	0	0	2	2	0	0	0	2
Red Bouy No. 10	08/17/99	0:07	Boat	0.20	3	0	0	0	3	3	0	0	0	3
Charlie Dock	08/25/99	0:30	Shoreline	0.30	0	0	0	0	0	0	0	0	0	0
Puntan Muchot Patch Reefs, Garapan (night)	08/26/99	1:00	Tow/Capture	1.30	0	0	0	5	5	*0	*0	*0	*5	*5
Outer Reef Matrix, Balisa Area, Garapan	08/16/99	1:29	Snorkel	*4.00	8	4	0	0	12	*7	*4	*0	*0	*11
	08/17/99	1:35	Snorkel/Tow	5.70	10	4	4	0	18	10	4	4	0	18
	08/27/99	3:00	Tow/Capture	*?	2	0	0	16	18	*2	*0	*0	*16	*18
Chalan Kanoa to San Antonio	08/17/99	0:57	Snorkel/Tow	4.40	6	0	0	0	6	5	0	0	0	5
Puntan Susupi to Puntan Afetna	08/18/99	0:41	Tow	2.78	1	0	1	0	2	1	0	1	0	2
Subtotal:		13:08		31.88	32	8	5	22	67	21	4	5	0	30
TOTALS:		33 hrs 3 min		50.85	132	47	22	37	238	101	37	21	10	169

*numbers not included in final sum as likely noted in previous

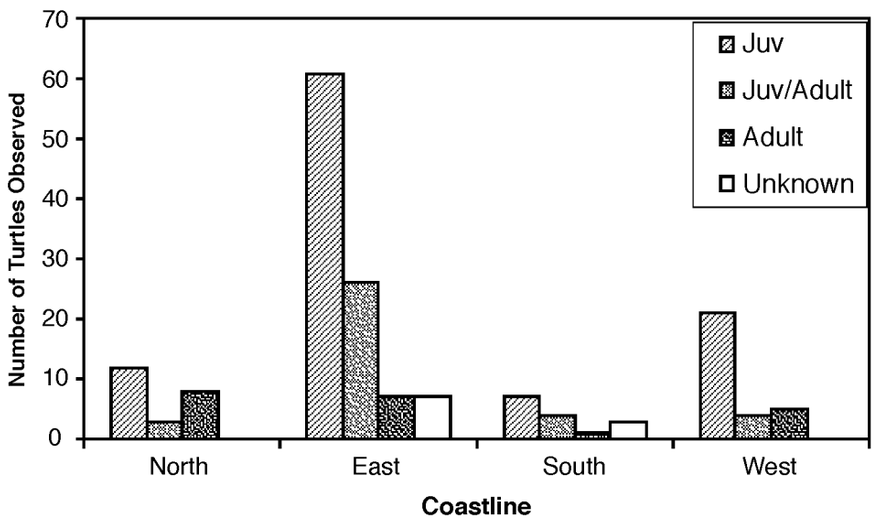

Figure 2. Estimated number of green turtles observed categorized by size and location.

turtles) were observed along relatively uninhabited east coast sites, even though this side of the island had the lowest total area surveyed (Table 2). Eighteen percent (30 turtles) were noted along the west coast, 14% (23 turtles) along the north coast, and 9% (15 turtles) along the south coast. Numbers of turtles categorized by size and general location are shown in Figure 2. Immature turtles predominated along all coastlines. The proportion of adults to other turtles was greatest along the north coast.

The highest concentrations of turtles were located along the east coast at Central Naftan, Forbidden Island (north of isthmus), North Naftan, and the Kingfisher Golf Course (Table 2). The Balisa Area (west coast) also had a relatively high concentration of sea turtles, with the transect length actually reflecting the combined lengths of parallel transects. These five locations showed the greatest potential for capturing and tagging large numbers of turtles, given appropriate oceanic conditions.

A compilation of data from this and previous marine plant and algae surveys indicated the presence of at least 29 species of algae which have been identified as green turtle forage in other parts of the world (Table 3). Thirteen (45%) of these species are Chlorophytes, seven (24%) are Phaeophytes, and nine (31%) are Rhodophytes. Four species of seagrass were identified, two of which have been listed as green turtle forage in other areas (Table 3). Two seagrass species (neither of which has been noted as forage) and 23 of the noted algae species have been observed within east coast survey areas (74% of total noted species). No seagrass species and three of the algae species were noted in a south coast survey (10% of

Table 3. Saipan marine plants and algae which are listed by Hirth (1997) as turtle forage.

Classification	Location and Reference
Chlorophyta	
Bryopsis pennata	Bahia Laulau [10], East Saipan Barrier reef slope, Balisa region [5, 14] & Chalan Kanoa/San Antonio [14,] West Saipan
Caulerpa cupressoides	Tank Beach [13], Bahia Laulau [10, 13], East Saipan Tanapag region [4, 11], Managaha Island, Balisa region San Antonio [5], West Saipan
Caulerpa lentillifera	Tank Beach/Bahia Laulau [13], East Saipan Unai Paupau (north), San Roque, Puntan Muchot patch reef area [5], West Saipan
Caulerpa racemosa	Bahia Laulau [10, 13], East Saipan San Roque [14], Tanapag region [4, 11, 14], Managaha Island [5], Charlie Dock area [6], Puntan Muchot [2,] patch reef area [5] Barrier reef slope Balisa region [14], Chalan Kanoa San Antonio [5], West Saipan
Caulerpa sertularioides	Bahia Laulau [10, 13], East Saipan San Roque [5], Tanapag region [11, 14], Puntan Muchot patch reef area, Chalan Kanoa [5], West Saipan
Caulerpa urvilleana	Bahia Laulau [10], East Saipan Puntan Muchot [2] patch reef area [5], Chalan Kanoa, San Antonio [5], West Saipan
Codium edule	Balisa region [5], West Saipan
Dictyosphaeria cavernosa	Obyan [12], South Saipan Tanapag region [11], Charlie Dock area, Unai Sadog Tase [6], Tanapag Lagoon entrance, Puntan Muchot patch reef area [5], West Saipan
Dictyosphaeria versluysii	Tank Beach [13], Bahia Laulau [10, 13], East Saipan Obyan [12], South Saipan Tanapag region [11], Echo, Baker & Able Dock areas [6], Mahagaha Island [5], Garapan [8], Puntan Muchot patch reefs, Liyang [5], Chalan Kanoa, Unai Afetna [14], West Saipan
Halimeda gracilis	West Saipan[1]
Halimeda tuna	Puntan Flores, Puntan Muchot, Unai Afetna [2], West Saipan
Ulva lactuca	Bahia Laulau [13], East Saipan Garapan lagoon [9], West Saipan

Valonia aegagropila	Bahia Laulau [13], East Saipan Unai Makpe [14], West Saipan
Phaeophyta	
Chnoospora implexa	San Roque, Balisa region [5], West Saipan
Dictyota dichotoma	Bird Island, (Unai Fanochuluyan) [14], East Saipan Tanapag region, Puntan Muchot, Micro Beach, Liyang, San Jose, Unai Afetna [14], West Saipan
Hydroclathrus clathratus	Tank Beach, Bahai Laulau [13], East Saipan San Roque [5], Puntan Muchot [2], Balisa region [5], San Jose [14], Chalan Kanoa [5, 8], Puntan Afetna [2], West Saipan
Padina australis	Bird Island, (Unai Fanochuluyan) [14], East Saipan Unai Paupau (north), San Roque, Tanapag region, Micro Beach, Liyang [14], West Saipan
Padina minor	Tank Beach [13], Bahia Laulau [10], [13], East Saipan Tanapag region [11], Managaha Island, Tanapag Lagoon entrance, Puntan Muchot patch reef area, Balisa region [5], West Saipan
Padina tenuis	Puntan Flores, Puntan Muchot [2], West Saipan
Turbinaria ornata	Bird Island, (Unai Fanochuluyan) [14], Tank Beach [13], Bahia Laulau [10, 13, 14], East Saipan Obyan [12], South Saipan Unai Makpe, Unai Paupau (north), San Roque [14], Tanapag region [3, 11, 14], Managaha Island [5], Charlie Dock area [6], Puntan Muchot [2] patch reef area [5], Balisa region [5], San Jose [14], West Saipan
Rhodophyta	
Acanthophora spicifera	Bahia Laulau [10, 13], East Saipan Unai Makpe, San Roque [14], Tanapag region [11, 14], Unai Sadog Tase [6], Puntan Muchot [2], Micro Beach [5], Chalan Kanoa [5, 8], San Antonio, Puntan Afetna (south) [5], West Saipan
Centroceras clavulatum	Bahia Laulau [10, 13], East Saipan
Champia parvula	Bahia Laulau [10], East Saipan Managaha Island [5], West Saipan
Gelidiella acerosa	Bird Island, (Unai Fanochuluyan) [14], Tank Beach [13], Bahia Laulau [10, 13], East Saipan Unai Makpe [14], Tanapag region [11, 14], Managaha Island, Puntan Muchot patch reef area, Balisa region [5], Chalan Kanoa [14], West Saipan
Hypnea cervicornis	Bahia Laulau [13], East Saipan Puntan Muchot patch reef area [5], West Saipan

Leveillea jungermannioides	Bird Island, (Unai Fanochuluyan) [14], Tank Beach [13], Bahia Laulau [10, 13], East Saipan Unai Makpe, San Roque [14], Tanapag region [11], Managaha Island, Puntan Muchot patch reef area [5], West Saipan
Melamansia glomerata	Bahia Laulau [13], East Saipan
Spyridia filamentosa	Bahia Laulau [10, 13], East Saipan Tanapag region [11], Echo & Baker Dock areas, Unai Sadog Tase [6], Garapan 8, Micro Beach, Balisa region, Liyang [5], Chalan Kanoa [5, 8], Puntan Afetna (south)[5], West Saipan
Tolypiocladia glomerulata	Bahia Laulau [10, 13], East Saipan San Roque [5], Tanapag region [11], Garapan [8], Puntan Muchot patch reef area, Liyang [5], Chalan Kanoa [5, 8], San Antonio, Puntan Afetna (south) [5], West Saipan
Anthophyta	
**Enhalus acoroides*	Bahia Laulau [10, 13, 14], East Saipan Tanapag region [11], Puntan Flores [2], Echo Dock area [6], Unai Sadog Tase [2, 6], Tanapag Harbor, Memorial Park, Garapan [8], Puntan Muchot (south) [2], Liyang [5, 7, 11, 14], West Saipan
Halodule uninervis	Unai Paupau [5, 7, 14], San Roque [14], Tanapag region [5, 7, 11, 14], Unai Sadag Tase [6], Tanapag Harbor, Memorial Park, Garapan [7, 8], Puntan Muchot [7, 14], patch reef area [5], Micro Beach [14], Liyang [5, 14], San Jose [14], Susupe [7], Chalan Kanoa [5, 7, 8, 14], San Antonio [5], Unai Afetna [14], West Saipan.
**Halophila minor*	Bird Island, (Unai Fanochuluyan) [14], East Saipan San Roque [14], Tanapag region [11], Echo, Charlie & Baker Dock areas, Unai Sadog Tase [6], Tanapag Harbor [7, 8], Memorial Park, Garapan [8], Puntan Muchot patch reef area [5, 7], Liyang [5], Chalan Kanoa [5, 7, 8], San Antonio, Puntan Afetna (south) [5], West Saipan
Halophila ovalis	Unai Paupau (north) [14], Tanapag region, Puntan Muchot [2], Micro Beach, Liyang, San Jose, Chalan Kanoa, Unai Afetna [14], West Saipan

* Seagrass species present but not listed; [1] = Johnson (1957), [2] = Cloud (1959), [3] = Taylor (1964), [4] = Taylor (1966), [5] = FitzGerald & Tobias (1974), [6] = Tobias (1977), [7] = Tsuda et al. (1977), [8] = US Army Corps of Engineers (1981), [9] = Tsuda (1982), [10] = Pacific Basin Environmental Consultants, Inc. (1984), [11] = Wilkins (1987), [12] = Wilkins (1988), [13] = Wilkins & Meyer (undated), [14] = present study.

total noted species). Twenty-seven of the noted algal species and all four species of seagrasses were identified along the west coast (94% of total noted species). None of six algae species collected at north coast sites were listed by Hirth (1997) as turtle forage at the species level. Pertinent literature examined (Tokita 1939, Yamada 1940, 1941, Johnson 1957, Cloud 1959, Taylor 1964, 1966, Goreau et al. 1972, FitzGerald & Tobias 1974, Tobias 1977, Tsuda & Wray 1977, Tsuda et al. 1977, Itono 1980, Tsuda 1981, 1982, U.S. Army Corps of Engineers 1981, Pacific Basin Environmental Consultants, Inc. 1984, Wilkins 1987, 1988, Wilkins & Meyer undated) made no reference to marine plant and algae species which likely serve as green turtle forage in Saipan's north coast nearshore areas.

One additional Phaeophyte, *Padina pavonia,* was listed by Tokita (1939) as present in Saipan, however a need for reexamination was noted and no subsequent mention of its presence could be found, so it was not listed in Table 3. This may be the first report of *Dictyota dichotoma* and *Padina australis* presence in Saipan. Both species are found in other areas of Micronesia (Tsuda & Wray 1977).

Discussion

Terrestrial Habitat Surveys

Although comprehensive monitoring of all potential nesting beaches was not possible throughout the nesting season, it is believed these observations accurately reflect the limited nesting activity occurring along the shores of Saipan in 1999. Documented assessments beginning in the 1970s, although for the most part anecdotal, tend to support the notion of low level nesting throughout the past 30 years (Pritchard 1977, 1982, Johannes 1986, McCoy 1997). The extent to which turtles utilized Saipan for nesting activities prior to the 1970s is unknown, but is also believed to be low (McCoy 1997). Limited green turtle nesting activity has also been observed on the nearby island of Tinian (Wiles et al. 1989, Pultz et al. 1999), and is suggested for Rota (Grout 1997, McCoy 1997) and Guam (NMFS & USFW 1998a).

The low levels of nesting limit the potential for concentrated tagging efforts of the breeding population. Continued monitoring of the beaches is, however, essential to evaluation of long-term trends in breeding population status. Annual monitoring of breeding activity and monitoring and protection of turtle nests provides an opportunity to gain access to the genetic signature of the breeding population through analysis of adult skin biopsies or tissue from hatchlings that do not survive the climb out of the nest or descent down the beach (FitzSimmons et al. 1999). Comparative studies on other sea turtle nesting islands within the archipelago should allow for elucidation of the geographic boundaries of the population's breeding habitat. Such information will allow for greater accuracy in assessing the status of the breeding population as a whole.

Green turtles are not known to nest in consecutive breeding seasons, and their numbers at a given rookery can fluctuate dramatically from one year to the

next (Carr et al. 1978, Balazs 1980, Limpus 1988, National Research Council 1990, Hirth 1997). Protracted studies on the order of seven to ten years, covering the range of reported remigration intervals of mature females (see Hirth 1997), are thus necessary to gain a reasonable estimate of the number of adult females present within a population. Given projections of 12 to 40 plus years growth to maturation (see Hirth 1997, Chaloupka & Musick 1997), comprehensive monitoring exceeding one or more decades appears essential to determining the degree to which a nesting population is increasing or decreasing in numbers. Trends in Saipan's breeding population may differ from those observed in nearby foraging populations, thus direct monitoring of the breeding population is required.

Marine Habitat Surveys

In contrast to the number of breeding turtles, a relatively large number of resident green turtles was identified in Saipan's nearshore environment. However, given the lack of repetition and assessment of variability, and potential turtle usage of non-monitored sites, it is difficult to make a reasonable projection on the size of the total resident green turtle population surrounding the island at this time. The number presented is suggested as a minimum. Continued monitoring will be needed to confirm these findings and to assess seasonal and long-term trends.

The absence of observations of hawksbill turtles is both surprising and discouraging, especially given the extent of this survey and their highly endangered world-wide status. However, hawksbill turtles have only been observed in limited numbers in the past. The Saipan Division of Fish and Wildlife possesses two hawksbill carapaces which purportedly were confiscated within the last few years. Pacific Environmental Consultants, Inc. (1984) recorded three hawksbill turtle observations at Bahia Laulau in 1982-83. Pritchard (1982) observed three stuffed hawksbills and an olive ridley *(Lepidochelys olivacea)* for sale in a Saipan handicraft shop in the 1970s. McCoy (1997) noted pre-historic (on Rota) and historic evidence for hawksbill presence and human use but suggested rarity. Hawksbill turtles were also absent in 10 marine surveys along the shores of Tinian in 1995 (Pultz et al. 1999). The absence of leatherback and olive ridley turtles in this study was expected. Non-nesting leatherbacks tend to inhabit pelagic environments, and olive ridleys in this region of the world are rare and presumed to be waifs (NMFS & USFWS 1998c, 1998d).

The apparent domination of the resident population by "immature" turtles may have been slightly biased, as some adults at the time of the survey may have been on breeding migrations. One of the dive shop owners noted a conspicuous rise in the numbers of large (presumably) adult green turtles during the "winter" season at his most frequented dive site, the Grotto (East Saipan). Continuation of the visual surveys around the island at various times throughout the year would be needed to confirm such suspicions and may provide a means by which the proportion of adults leaving to breed can be determined. Given sufficient surveying, potential correlative factors may be examined (see Limpus & Nicholls 1988).

The disproportionate presence of turtles at east coast sites corresponds to low levels of human accessibility throughout the majority of the year. However, it appeared that turtle resting areas also corresponded with observed and presumed topographic complexity of the benthos. Balazs et al. (1987) suggested that proximity of resting habitat to foraging habitat may be of importance, with green turtle resting areas in Hawaiian coastal waters typically found within 2 km of corresponding foraging habitat. The extent to which poaching and other forms of human disturbance drives disproportionate distributions is unknown, but it should be noted that turtle poaching has been occurring in present high density turtle resting areas along the east coast for years (Pacific Environmental Consultants, Inc. 1984, DFW representatives and Saipan community members, per. comm.). Relatively large numbers of turtles were found in topographically complex areas proximal to west lagoon seagrass and algae habitats, however more than half of the outer barrier reef area examined lacked both substrate complexity and turtles. It is now known that a variety of potential green turtle food resources exists along the east coast within the vicinity of presumed turtle resting habitats. Perhaps a combination of factors, including access to food, preferred resting habitat, and exposure to disturbance by humans, is responsible for present turtle distributions around the island. Detailed assessments of submerged east coast turtle habitats, in combination with knowledge concerning diets, food distribution and abundance, and turtle movements, might help to elucidate the relative importance of each of these factors.

Tremendous opportunity exists to further our understanding of Saipan's resident turtle population and various aspects of green turtle biology. Five resting areas with relatively high concentrations of green turtles have been identified and appear suitable for capture and release efforts given appropriate oceanic conditions. The use of tangle nets (Balazs et al. 1987, Ehrhart & Ogren 1999) in these and west coast lagoon seagrass foraging habitats should be explored as a means of increasing catch efficiency. Investigations of turtle abundance, growth rates (van Dam 1999), food consumption and preference (Forbes 1999), and food availability will allow for estimates of carrying capacity and provide various means to gauge the status of the population. The potential movements of turtles between regions of Saipan, islands within the Mariana Archipelago, and long distance migrations across political boundaries (Kolinski 1995, Pultz et al. 1999) should be elucidated through tagging and genetic analysis of tissue samples (FitzSimmons et al. 1999). Identification of habitat critical to population survival and expansion should result, and will be key to planning future island development that corresponds with appropriate sea turtle conservation and management.

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