PROGRESS REPORT

In-water surveys of green sea turtles at Culebra Archipelago, Puerto Rico

Prepared by

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Introduction

The U.S. National Marine Fisheries Service (NMFS) designated the seagrassess beds near the coastal areas of Culebra Archipelago as Critical Habitat for its importance as green turtles' feeding grounds (NMFS, 1998). In-water surveys on these critical habitats were conducted during 1986 to 1989 to obtained information on habitat fidelity, relative abundance, size class composition and growth of the juvenile and sub-adult green turtles found in the area (Collazo *et al.*, 1992). During 1998, José Rivera from NMFS reinitiated this study for one-year survey to evaluate the current status of this aggregation. The information gathered on 1998, combined with the data collected by Collazo *et al.* (1992) strengthen the importance of the area and the proposal for continuing a long-term project to assess trends in this green turtle aggregation and the collection on other important parameters, such as growth rates. The following report is a summary of the activities and results obtained during in-water surveys conducted on June 2000 to June 2001 at the Culebra Archipelago.

Methods and Results

Study-site:

The Culebra Archipelago is located at 30 km from Puerto Rico's east coast (Fig 1). Sea grasses and coral reefs surround the Archipelago, which is composed of more than 9 cays. Three study sites were selected from previous studies. These sites are Bahía Mosquito, Puerto Manglar, and Culebrita (Fig 1). The depth of all sites varies from 8 to 15 meters.

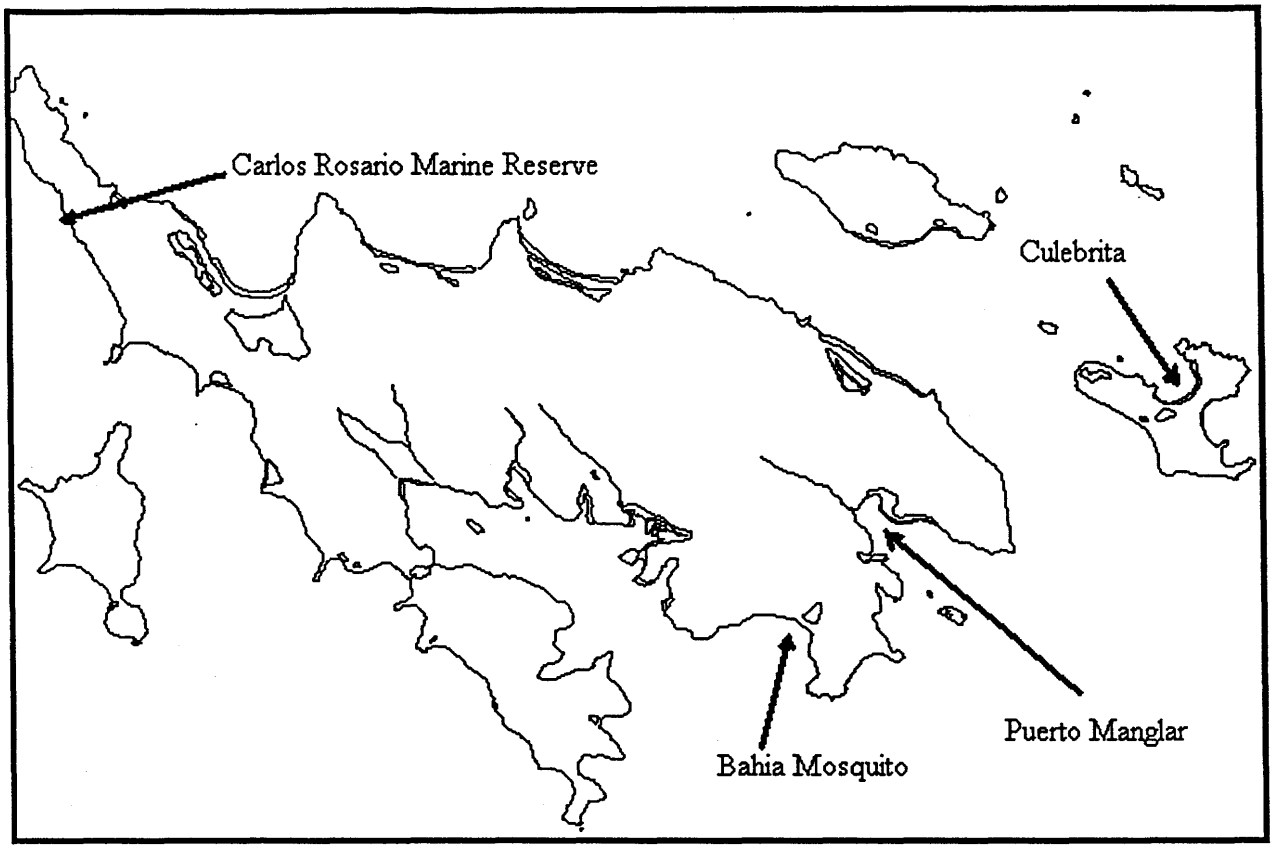


Figure 1. The Culebra Archipelago and the study sites.

Turtle captures and biometrics:

All work was done from three boats (approximately 15, 17 and 28 feet in length). The method for capturing turtles was adapted from Collazo *et al.* (1992). During the 1998 survey, these locations were the areas of consistently highest turtle densities. Netting was done with a 183 m long, 9.1 m deep net (#12 monofilament line, 9 cm stretch mesh) deployed parallel to shore. Water depth varied depending on site (see study area section). An average of 8 swimmers were snorkeling along the net to capture turtles as the turtles encounter the net. Once captured, the turtle was taken to a boat for data collection. Netting for capture and recapture of juvenile green turtles was conducted every three months (Table 1) with an effort range of 12-16 hours of net soaked in the water (3-4 hours of net soaked in the water per session).

Table 1. Dates of surveys at Culebra Archipelago and number of turtles captured.

Date	N° of turtles captured
27-29 Jun 00	22
18-20 Oct 00	22
27 Feb-1 Mar 01	11
26-28 Jun 01	26

Measuring the time spent for each survey session assessed the effort involved with finding and capturing turtles at Culebra Archipelago. Effort assessments were made for all survey sessions during the research period but does not include captures made incidentally. Surveys were generally performed with an average of 8 persons (range 7-10) swimming parallel to the net. With a net set (total sampling occasions) defined as a unit of effort, the catch per unit effort (CPUE) was calculated for each net set. At Culebrita and Bahía Mosquito, nets were set twice and Manglar was set once. All study sites were sampled for three occasions at different times of the day. Table 2 indicates CPUE data for FY 00-01 as presented by Collazo *et al.* (1992). However, cautious should be taken when making comparisons, since our data is only for one year, while Collazo *et al.* (1992) is for three years. We also presented CPUE data on Table 3 by average and STD for each site. The CPUE in both tables suggests Puerto Manglar site as the highest amount of turtles per net set, and Bahía Mosquito with the least. In the future, we would consider other ways of calculating CPUE data, such as time of net soaked and length of net.

Table 2. Green turtles captured per net set at Culebra, Puerto Rico, 2000-01.

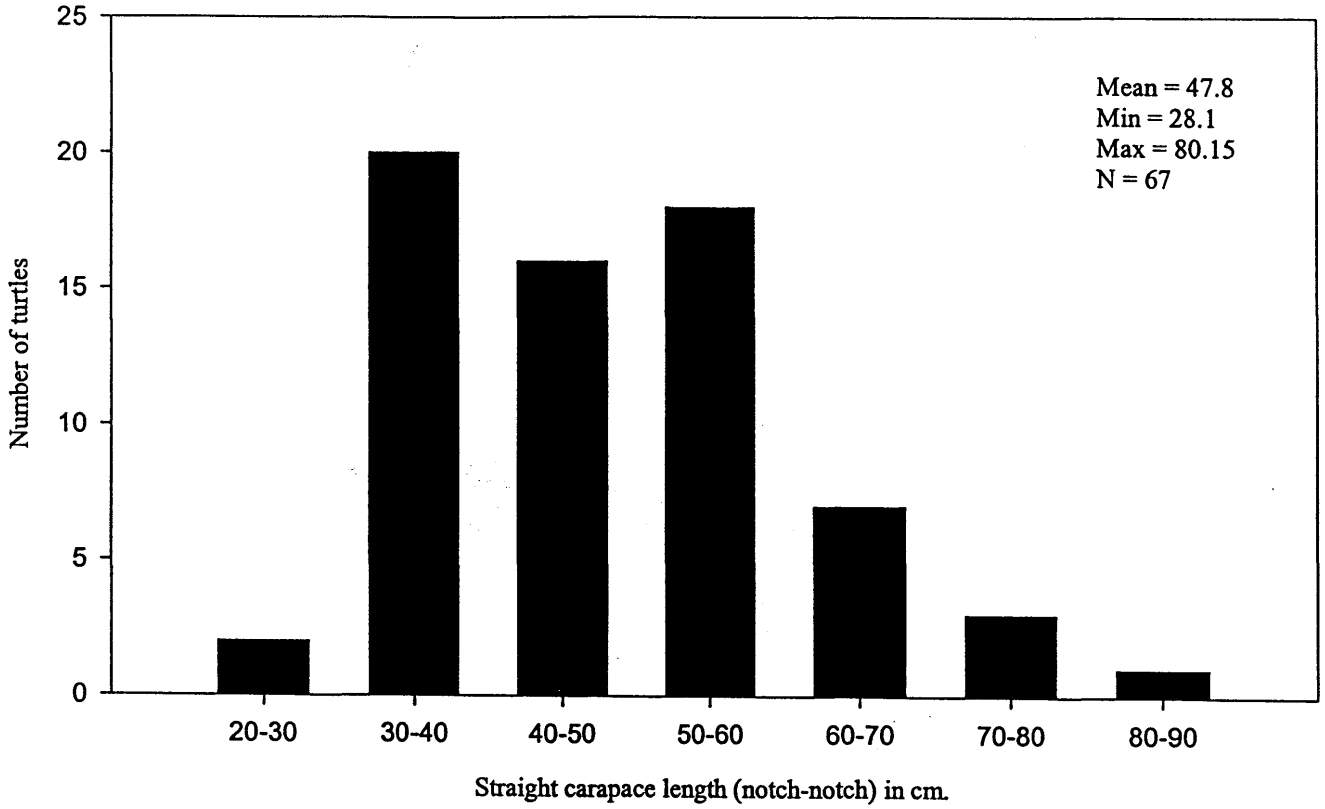
Site	Total captures	Sampling occasions	Mean captures/trip to Culebra
Manglar	42	12	10.50
Culebrita	31	18	10.33
Bahía Mosquito	8	24	2.0
Total	81		

Table 3. Catch per unit effort at Culebra Archipelago, 2000-01.

Site	Mean CPUE	STD	SE	Min	Max
Manglar	3.5	1.12	0.56	2.3	5.0
Culebrita	1.7	0.75	0.43	1.00	2.5
Bahía Mosquito	0.33	0.23	0.12	0.17	0.67

During FY 00-01-field season a total of 81 green turtles were captured during the net sessions with 57 (70%) turtles being captured for the first time. Twelve turtles were recaptures from previous years and eleven were recaptures within the FY 00-01. Green turtles ranged in size from 28.1 to 80.15 cm (mean = 47.8cm) N-N SCL (Fig. 2). Turtles in the 30-40 and 50-60 cm SCL size class were most commonly caught; suggesting Culebra Island as a developmental habitat for juvenile and sub-adults green turtles. Two hawksbills were caught in Manglar study site (53.9 cm and 45.0 cm SCL notch-tip).

Turtles were tagged on both flippers with small monel tags prior to release. In addition, juvenile and sub-adult turtles were injected with Passive Integrated Transponder (PIT tags, AVID brand) in their front right flipper muscle (Appendix I).



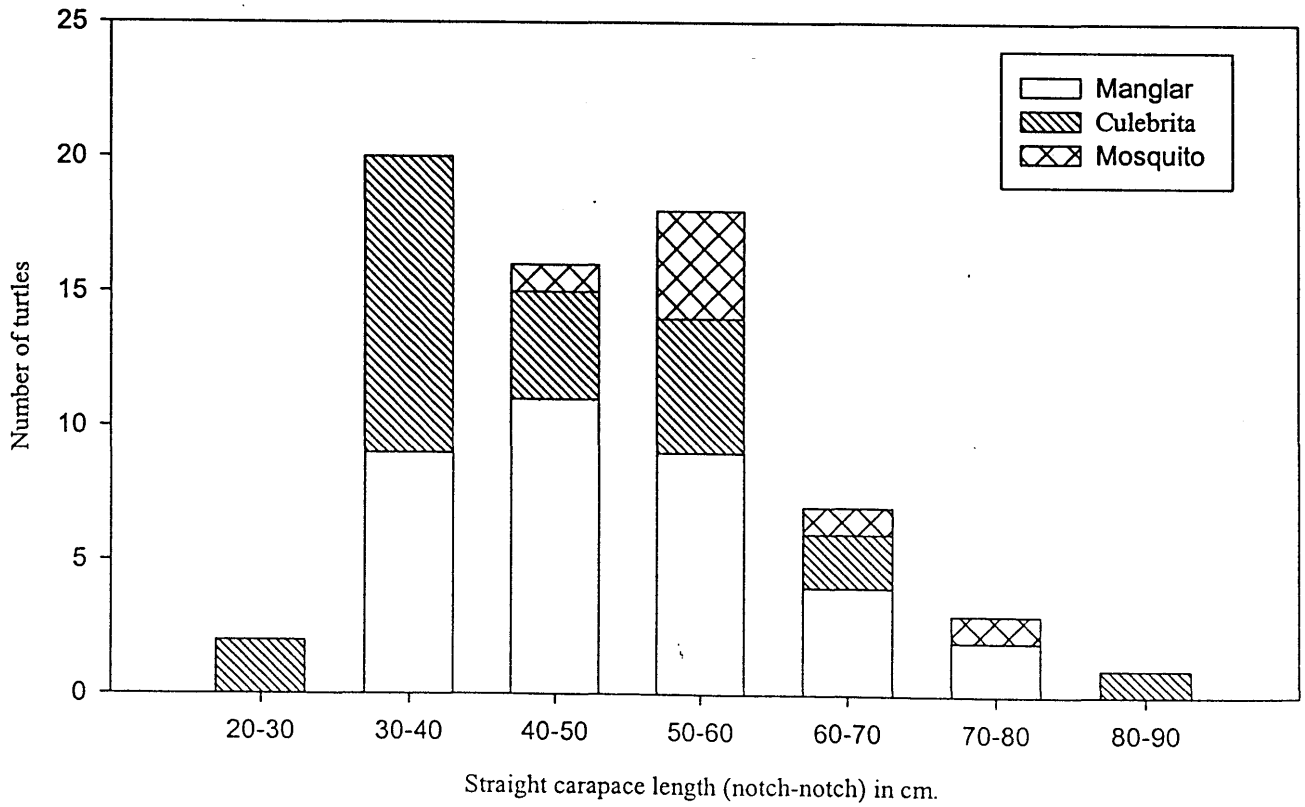


Fig 2. Size distribution of 67 green turtles captured during June 2000-June 2001.

Growth:

Knowledge of turtle growth rates is critical to understanding turtle population dynamics. This information also forms the basis of age to maturity estimates necessary to understand life history stages. Growth data obtained from Collazo *et al* (1992) reported a different pattern than those reported for the Atlantic green turtles. Therefore, in order to determine if, growth rates data is needed. The tagging effort of the fieldwork performed during FY00-01, aimed at juvenile and sub-adult green turtles provided a baseline for growth rates data and would contribute to determine if the discrepancy between the reported growth rates is valid or simply the result of a limited size sample. A total of seventeen recaptures yielded growth rate data. Only eight individuals have growth rate data for intervals greater or equal to twelve months. This was to allow for seasonal changes, which can affect feeding rates and may alter growth rates (Van Dam, 1999). Table 4 summarizes the data for all recaptured animals.

Table 4. Annualized growth rate of turtles recaptured during June 2000-June 2001, at Culebra Island, Puerto Rico. All measurements are straight carapace length (notch to notch) in cm.

Site	L Tag	Date previous measurement	N-N Carapace length	Date latest measurement	N-N Carapace length	Increment	Interval (days)	Annual growth (cm/year)
Culebrita	ppm241	29-Jun-00	51.9	18-Oct-00	53.0	1.09	110	3.62
Culebrita	ppm243	29-Jun-00	51.3	18-Oct-00	52.7	1.43	110	4.76
Culebrita	ppm244	29-Jun-00	55.4	18-Oct-00	55.8	0.76	110	2.52
Manglar	ppm225	28-Jun-00	62.7	18-Oct-00	63.8	1.10	111	3.62
Culebrita	ppm214	27-Jun-00	33.7	19-Oct-00	35.6	1.90	113	6.14
Manglar	ppm209	27-Jun-00	55.7	19-Oct-00	57.0	1.30	113	4.20
Mosquito	ppm372	28-Jun-00	54.8	28-Feb-01	59.1	4.30	246	6.38
Culebrita	xxn824	20-Oct-00	33.3	27-Jun-01	36.7	3.40	250	4.96
Manglar	ppy329	20-Oct-00	67.0	28-Jun-01	71.0	4.00	251	5.82
Manglar	ppm221	28-Jun-00	48.9	28-Jun-01	56.5	7.60	365	7.60
Manglar	ppm208	27-Jun-00	29.8	28-Jun-01	36.9	7.10	366	7.08
Culebrita	ppy354	18-Feb-98	39.5	29-Jun-00	54.6	15.1	861	6.40
Manglar	ppy371	18-Feb-98	54.1	19-Oct-00	65.0	10.9	971	4.10
Mosquito	mnftpy327	18-Aug-97	37.0	27-Jun-00	58.0	21.0	1042	7.36
Manglar	ppm225	18-Aug-97	44.9	28-Jun-00	62.7	17.8	1043	6.23
Manglar	ppy329	19-Aug-97	45.8	20-Oct-00	67.0	21.2	1155	6.70
Culebrita	ppy344	19-Aug-97	48.4	26-Jun-01	63.5	15.1	1404	3.92
							Mean	5.38

Blood sampling:

Blood samples were collected for thirty individuals for both, sex and DNA studies. Ten additional samples were collected for DNA only. Analysis of these materials through genetic profiling may allow us to relate this aggregation of juveniles' green turtles to others among the Caribbean-Atlantic Region. Serum samples would be used for sex determination through testosterone assays. These samples were sent to Dave Owens at University of North Carolina (the results were not available by time this report was written). See appendix for list of turtles bled.

Other observations:

-Fibropapillomas

Three green turtles were observed with fibropapillomas tumors at Puerto Manglar. Although in all cases, the tumors were not severe, it was an important documentation since it is the first time that tumors were reported on green turtles at this study site. Turtle PPM209-PPM211 was biopsied and the sample was sent to Dr James Casey at Cornell University for pathological analysis (see Appendix I).

-Home range

Only one turtle moved from one study site to another. Turtle number Mnftpy 327/PPM408 was first captured at Bahía Mosquito on August of 1997 and was recaptured three years later (June 2000) at Puerto Manglar. Although the distance from the two sites is not long (approximately 1 km), it was the first and only report of displacement, indicating a limited home range within feeding areas.

-Hawksbills in-water surveys

In addition to the netting sessions, surveys to evaluate the current status of hawksbill turtles at potential feeding grounds in Culebra were conducted. We concentrated our efforts at the Carlos Rosario Marine Reserve (Fig 1.), which is located at the northeast side of Culebra mainland. Surveys were conducted using the same methods as in Mona-Monito and Desecheo Islands (Diez

and Van Dam, 2000). Table 6 summarizes the CPUE for hawksbills in-water surveys at Carlos Rosario Marine Reserve. A total of 14 hawksbills were captured during 8 hours of in-water surveys. Only two turtles were recaptured. The size range for all turtles captured was 20.5 to 39.2 cm SCL (notch-tip), suggesting the area as a developmental habitat for juvenile hawksbills.

Table 6. CPUE for hawksbill turtles captured at Carlos Rosario Marine Reserve. CPUE was calculated by dividing the number of turtles seen (whether captured or not) by the total time of each survey (hours).

Year	Hours of surveys	Number of hawksbills (captured and seen)	CPUE
1997	1.5	3	2.0
2000	5.5	11	2.0
2001	1	4	4
Total	8	18	2.25

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Literature Cited

Collazo, J. A., R. Boulon, Jr., and T. L. Tallevast. 1992. Abundance and growth patterns of *Chelonia mydas* in Culebra, Puerto Rico. J. Herp. 26 (3): 293-300.

Diez, C.E. and R.van Dam. 2000. Research Report for 1999 with summary of findings 1995-99: Mona and Monito Island Hawksbill Research Project. NMFS. 48 pp.

U.S. National Marine Fisheries Service/ Federal Register. 1998. Rules and Regulations. Critical Habitat for Green turtles at Culebra Archipelago, Puerto Rico. Vol. 63. No 170.

Van Dam, R.P. 1999. Growth rates. *In:* Eckert, K.L, Bjorndal, K.A., Abreu-Grobois, F.A., Donnelly, M. (Eds). Manual for Research Techniques on Marine Turtles. 235 pp.

Appendix I: Comprehensive list of green turtles captured at Culebra Island during June 2000-June 2001

Site	Date	L-Tag	R-Tag	PIT tag	Capture	N-N SCL	Blood sample
Culebrita I	27-Jun-00	ppm214	ppm217	*040064824	New	33.7	DNA/sex
Culebrita I	27-Jun-00	ppm215	ppm216	*0400076265	New	45.8	no
Manglar	27-Jun-00	mnftpy327	ppm408	114519455A	New	58	DNA/sex
Manglar	27-Jun-00	ppm207	ppm210	*040055768	New	47.6	no
Manglar †	27-Jun-00	ppm209	ppm211	*040075859	New	55.7	no
Manglar	27-Jun-00	ppm206	ppm212	*040059616	New	59.9	DNA/sex
Manglar	27-Jun-00	ppm208	ppm213	*040073819	New	29.8	DNA
Manglar	28-Jun-00	ppm237	ppm234	*040100381	New	52.8	DNA/sex
Manglar	28-Jun-00	ppm240	ppm236	*040090893	New	48.8	DNA/sex
Manglar	28-Jun-00	ppm239	ppm235	*040077632	New	49	no
Manglar	28-Jun-00	ppm221	ppm227	*040103091	New	48.9	DNA
Manglar	28-Jun-00	ppm218	ppm229	*040080560	New	47	DNA/sex
Manglar	28-Jun-00	ppm225	ppm226	113735692A	Reca	62.7	DNA/sex
Manglar	28-Jun-00	ppm222	ppm230	*040054850	New	41.3	no
Manglar	28-Jun-00	ppm223	ppm224	113734445A	Reca	68.4	no
Manglar	28-Jun-00	ppm220	ppm228	*040054595	New	56.6	DNA/sex
Mosquito	28-Jun-00	ppm372	ppy380	114624685A	Reca	54.8	DNA/sex
Culebrita I	29-Jun-00	ppm241	ppm242	*040102302	New	51.91	DNA/sex
Culebrita I	29-Jun-00	ppy354	ppm429	114519234A	Reca	54.58	DNA/sex
Culebrita I	29-Jun-00	ppm243	ppm446	*040071876	New	51.26	no
Culebrita I	29-Jun-00	ppm244	ppy338	113726677A	Reca	55.04	no
Manglar	29-Jun-00	ppm246	ppm245	*040073622	New	31.92	DNA/sex
Culebrita I	18-Oct-00	ppm243	ppm446	*040071876	Reca	52.7	no
Culebrita I	18-Oct-00	ppm241	ppm242	*040102302	Reca	53	no
Culebrita I	18-Oct-00	ppm244	ppy338	113726677A	Reca	55.8	DNA
Manglar	18-Oct-00	ppm225	ppm226	113735692A	Reca	63.8	no
Manglar	18-Oct-00	ppm238	ppm233	*040062550	Reca	60.2	DNA
Manglar	18-Oct-00	xxn801	xxn802	none	New	31.7	DNA/sex
Manglar	18-Oct-00	xxn804	xxn803	none	New	44.2	DNA/sex
Manglar	18-Oct-00	ppm208	ppm213	*40073819	Reca	32	DNA/sex
Culebrita 2	19-Oct-00	ppm444	xxn808	none	Reca	64.5	DNA
Culebrita 1	19-Oct-00	none	xxn807	none	New	34.8	DNA
Culebrita 1	19-Oct-00	ppm214	ppm217	*40064824	Reca	35.6	DNA/sex
Manglar	19-Oct-00	ppy371	ppy376	114474492A	Reca	65	DNA
Manglar	19-Oct-00	ppm209	ppm211	*40075859	Reca	57	DNA/sex
Manglar	19-Oct-00	xxn805	xxn806	none	New	42.5	no
Culebrita 1	20-Oct-00	xxn824	xxn825	none	New	33.3	DNA/sex
Culebrita 1	20-Oct-00	xxn810	xxn809	none	New	39.7	DNA/sex
Culebrita 1	20-Oct-00	xxn812	xxn811	none	New	39.6	DNA/sex
Culebrita 1	20-Oct-00	xxn813	xxn814	none	New	34.3	DNA/sex

Site	Date	L-Tag	R-Tag	PIT tag	Capture	N-N SCL	Blood sample
Manglar	20-Oct-00	xxn819	xxn821	none	New	71.43	no
Manglar	20-Oct-00	ppy329	ppm410	none	Reca	67	no
Mosquito 2	20-Oct-00	xxn815	xxn816	none	New	42.4	DNA/sex
Mosquito 2	20-Oct-00	xxn817	xxn818	none	New	54.1	DNA/sex
Manglar	27-Feb-01	ppm262	nnw248	none	New	41.6	good
Manglar	27-Feb-01	ppm267	nnw247	none	New	31.5	no
Manglar	27-Feb-01	nnw244	nnw245	none	New	35.9	DNA/sex
Manglar	27-Feb-01	ppm263	nnw246	none	New	45.9	no
Manglar	27-Feb-01	ppm265	ppm292	none	New	46.1	DNA/sex
Manglar †	27-Feb-01	ppm263	nnw246	none	New	45.9	no
Mosquito 1	28-Feb-01	xxn855	xxn854	*41060283	New	56.5	DNA
Mosquito 2	28-Feb-01	xxn853	xxn852	*40874274	New	70.4	no
Mosquito 2	28-Feb-01	ppm372	ppy380	114624685A	Reca	59.1	no
Mosquito 2	28-Feb-01	nnw243	xxn851	11372165A	Reca	68	no
Manglar	1-Mar-01	xxn863	xxn862	*41574012	New	50.7	DNA
Culebrita 1	26-Jun-01	xxn885	xxn886	*050023571	New	28.1	DNA
Culebrita 1	26-Jun-01	xxn889	xxn890	*050076343	New	41.5	DNA
Culebrita 1	26-Jun-01	xxn887	xxn888	*050112773	New	43.7	DNA/sex
Culebrita 1	26-Jun-01	xxn894	xxn895	*050122345	New	33.8	DNA/sex
Culebrita 1	26-Jun-01	xxn881	xxn880	*050307346	New	29.3	no
Culebrita 1	26-Jun-01	xxn879	xxn878	*050273342	New	55.1	no
Culebrita 1	26-Jun-01	ppy344	xxn897	113727217A	Reca	63.5	no
Culebrita 1	26-Jun-01	xxn891	xxn892	*050311358	New	33	no
Culebrita 1	26-Jun-01	xxn884	xxn882	*050017082	New	33.3	no
Culebrita 1	26-Jun-01	xxn896	xxn893	*050052862	New	31.6	no
Manglar	26-Jun-01	xxn876	xxn877	*050302573	New	37.8	DNA/sex
Mosquito 2	26-Jun-01	xxp707	xxn898	*050071054	New	51.7	no
Culebrita 2	27-Jun-01	xxp713	xxp714	*050316555	New	41.3	no
Culebrita 2	27-Jun-01	xxp711	xxp712	*050117793	New	66.9	no
Culebrita 1	27-Jun-01	xxp710	xxp708	*050315894	New	36.6	no
Culebrita 1	27-Jun-01	xxn824	xxn825	*050115840	Reca	36.7	DNA/sex
Manglar	27-Jun-01	xxp718	xxp717	*050009775	New	47.2	no
Manglar	27-Jun-01	xxp715	xxp716	*050071527	New	37.7	no
Manglar	28-Jun-01	ppy329	ppm410	113723570A	Reca	71	DNA/sex
Manglar	28-Jun-01	ppm221	ppm227	*040103091	Reca	56.5	no
Manglar	28-Jun-01	xxp726	xxp727	*040103091??	Reca	56.9	DNA
Manglar	28-Jun-01	xxp719	xxp720	*050027288	New	34.1	no
Manglar	28-Jun-01	xxp722	xxp721	*050032545	New	39.4	no
Manglar	28-Jun-01	ppm208	xxp723	*040073819	Reca	36.9	no
Manglar †	28-Jun-01	xxp725	xxp724	*050289784	New	53.7	no
Culebrita 1	28-Jun-01	xxp731	xxp730	none	New	80.15	no

Note: † is to denote those turtles with Fibropapiloma.

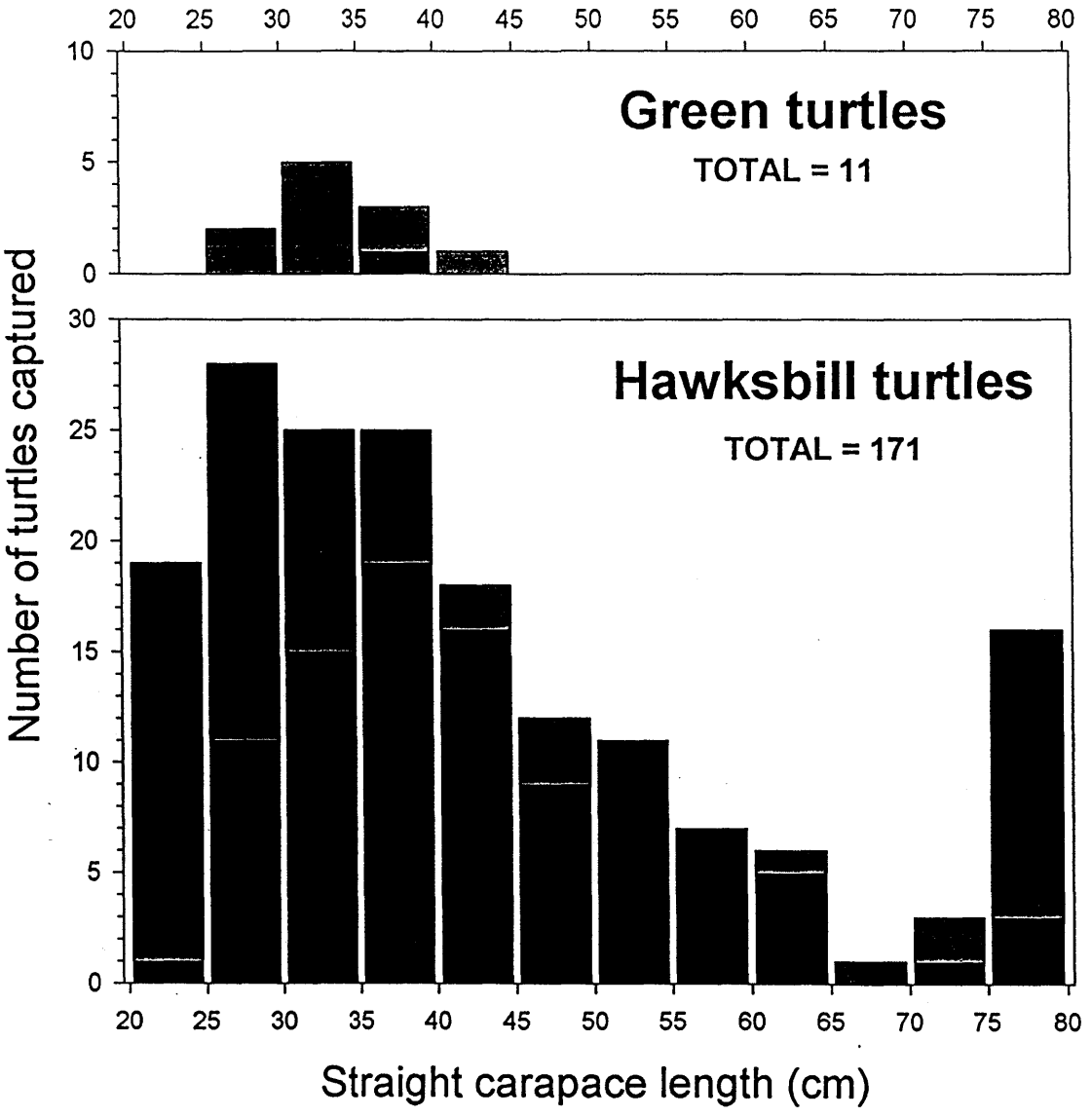

Figure 4. Size distribution of turtles captured in the study area during 2000. Gray bars are turtles tagged for the first time, black bars indicate animals tagged previously and recaptured this season.

Blood sampling:

Blood and/or tissue samples were collected from 10 adult males, 3 adult females and 20 recruitment size hawksbills, 7 green turtles. Analysis of these materials through genetic profiling may allow us to assign the source population in the case of immature turtles, and for the adults further characterize the Mona Island breeding population. Dr Peter Dutton of the NMFS Southwest Fisheries Science Center, La Jolla, will conduct sample processing where the samples will be incorporated into the genetic materials archive.

Instrumentation:

One Mk7 time-depth recorder was deployed on a 51.6cm hawksbill, ID 92-045, off Playa Mujeres on 6 September 2000. The recorder was attached together with a sonic tag to the posteriormost edge of the carapace (figure 5). Our goal is to retrieve this instrument in 2001 and learn about seasonal variation in diving behavior patterns.

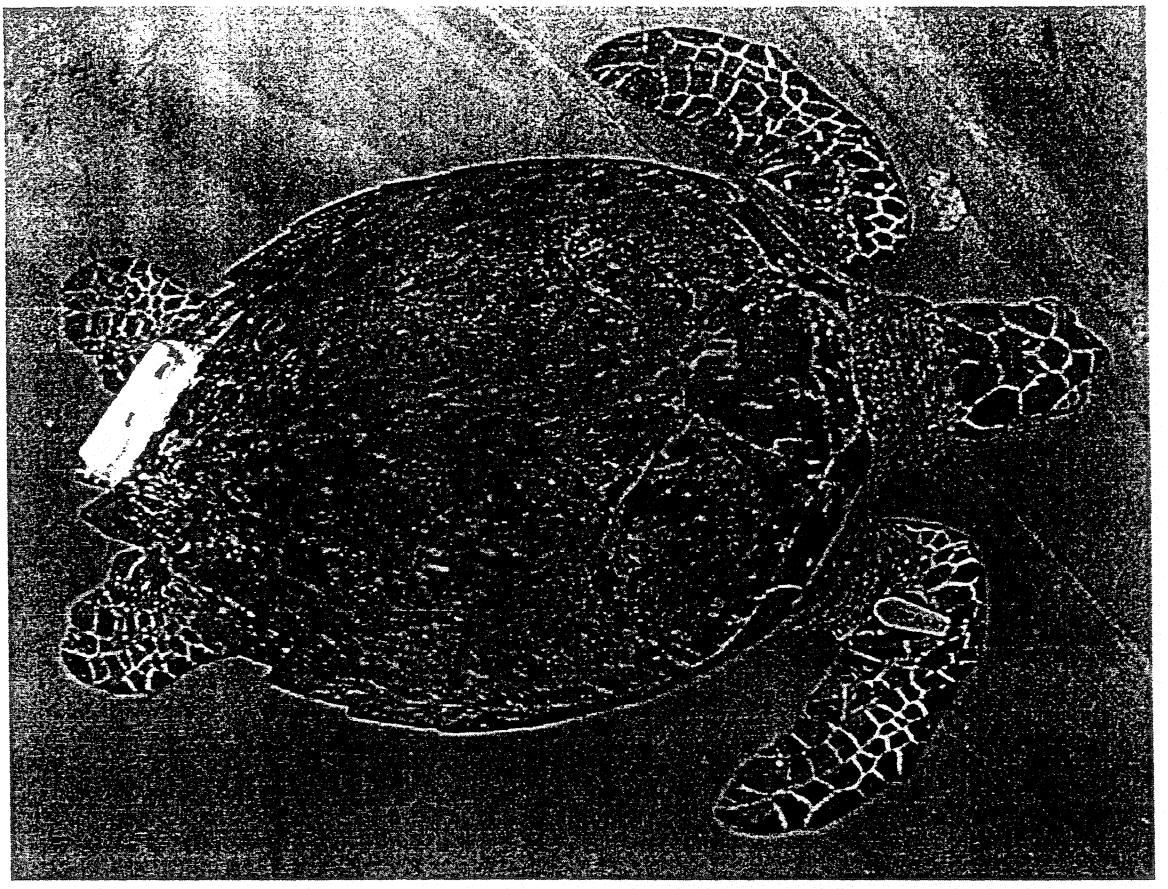

Figure 5. Time-depth recorder attached to 51.6 cm hawksbill 92-045.

Seawater temperatures:

Water temperature records for mid-1999 to mid-2000 season were obtained for the for the Mona reef off Playa Mujeres (10m depth) and at Monito Island cliff wall site (15 m depth) of Mona Island using TidBit dataloggers. An additional data logger installed at the Mona Island cliff wall could not be found and temperature monitoring at this location was discontinued.

Measured water temperatures ranged seasonally from 24.5 to 29.5°C (figure 5). Waters at the shallow Mona reef site heat up considerably during summer and with less exposure to current results in elevated temperatures (central figure 6).

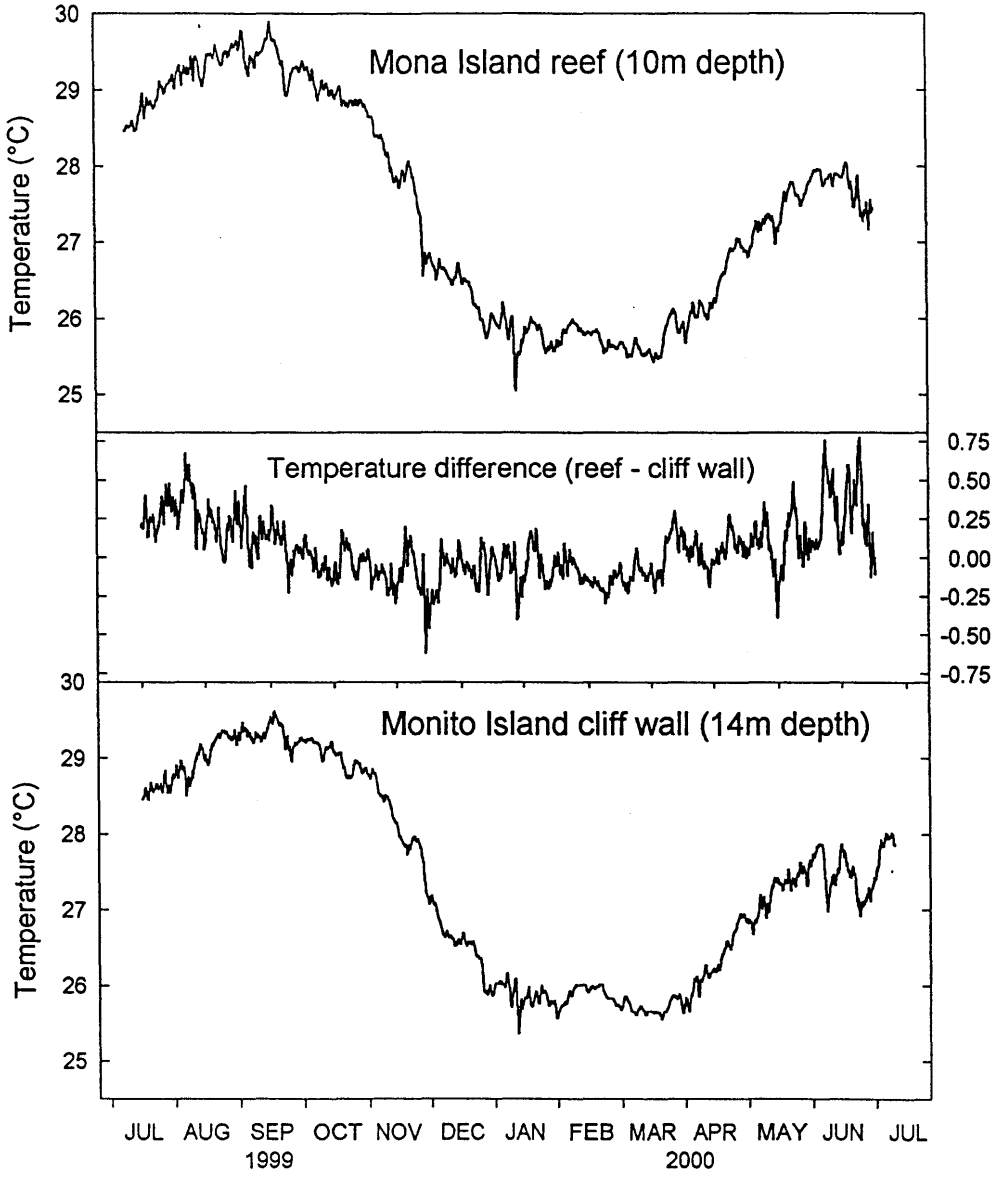

Figure 6. Water temperatures in the study area at Mona and Monito Islands.

Nesting beach surveys:

Surveys of the Mona nesting beaches were conducted weekly from July to December 2000, and at irregular intervals from January to February 2001. Surveys consisted of counting the number of fresh turtle tracks, determining whether a nest was deposited or not ("false crawls"), and assessments of reproductive success by digging up hatched nests.

For the survey period from 17 July to 5 December 2000, we found a total of 541 hawksbill nests and 582 false crawls. Eight green turtle nests were also encountered. The 2000 hawksbill nesting season on Mona Island showed a continued rise in the hawksbill nesting activity detected since 1989 (figure 7).

A subset of 110 nests were examined after hatching and yielded the following nest productivity parameters. Average nest hatching success, lower limit 76.8% (assuming live hatchlings encountered would have perished), upper limit 83.1% (assuming all live hatchlings would have eventually emerged). Mean clutch size was 153.2 eggs. No nest predation by pigs was observed.

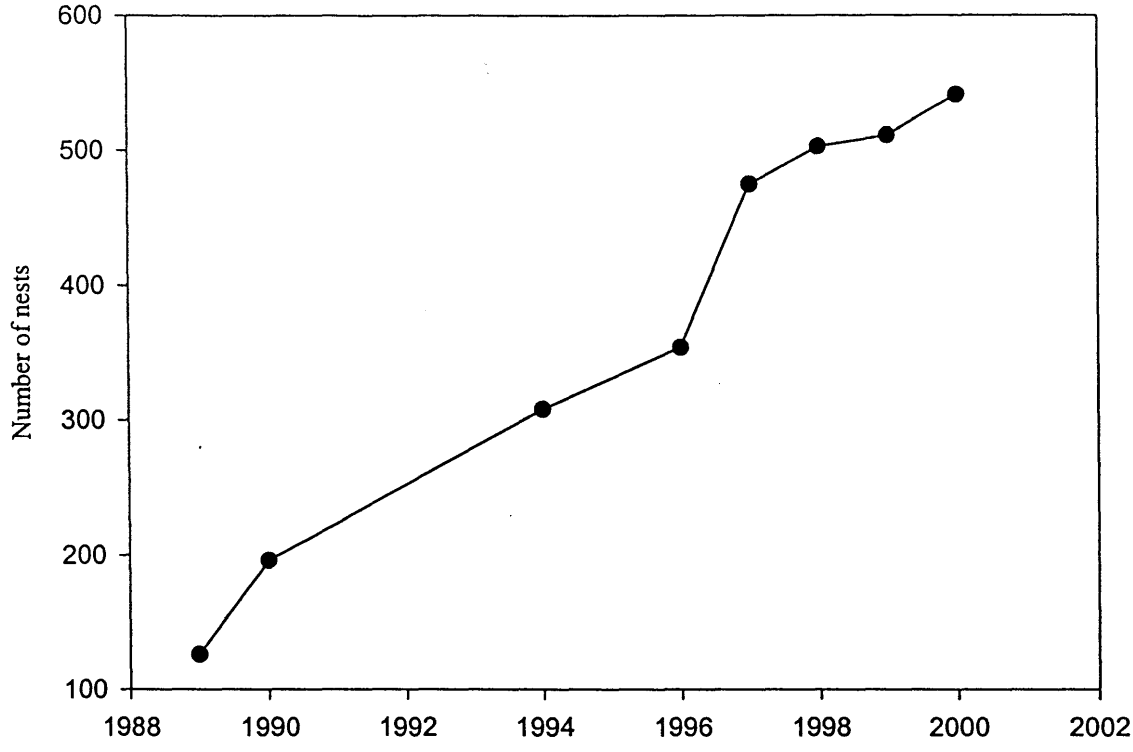

Figure 7. Number of hawksbill nests during 1989, 1990, 1994, 1996-2000 at Mona Island, Puerto Rico

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Appendix I - List of all turtles captured at Mona and Monito Islands during 2000.

Date 2000	New or Rec	Turtle ID	Tag left	Tag right	PIT	SCL cm	Mass kg
Hawksbill turtles (immatures)							
14-Jul-00	N	00-003			034845330	23.6	1.5
14-Jul-00	R	94-110	SSJ995	SSJ994	1F5004404D	40.4	8.5
15-Jul-00	N	00-004	X7269	BP8565		39.1	7
15-Jul-00	N	00-005	X7268	BP8566		36.4	6
15-Jul-00	R	94-006	SSJ933	SSJ931	1F484B1539	39.5	7.5
15-Jul-00	R	96-022	1618	BP8568	4039472C32	35.4	5.5
15-Jul-00	R	98-029	SSN249	SSN250	41504E2627	31.1	4
15-Jul-00	R	98-058	X6918	X6929-BP8564		38.8	6.5
15-Jul-00	R	98-107	BP8567	X6977	410977272D	32.7	5
15-Jul-00	R	99-113	X7137	X7138	040097789	27.5	2.5
16-Jul-00	N	00-015	X7265	X7266	040074278	32.1	4
16-Jul-00	R	95-081	SSL275	BP1102	22422E416F	44.5	10.5
16-Jul-00	R	95-105	SSM915	BP4481	2242383E27	36.7	6.5
16-Jul-00	R	98-056	X6916	X6917	41504D2159	29.2	3
16-Jul-00	R	99-003	X7152	X7153	41097D1D12	26.2	2
18-Jul-00	R	92-016	X6910	BP1131	7F7D371D27	58.5	23
18-Jul-00	R	97-050	X3907	X3908	2242405B29	36.7	5.5
19-Jul-00	N	00-019			040097275	23.3	1.2
19-Jul-00	N	00-020	X7264	BP8569		31.8	4
20-Jul-00	R	95-093	SSM905	BP1141	2242330F5D	57.3	23
20-Jul-00	R	97-039	SSN298	BP1139	403969303B	59.7	28
21-Jul-00	R	93-016	1816	BP474	7F7D3E214E	53.2	16
21-Jul-00	R	98-117	X6989	X6988	2242181756	38.7	7.5
22-Jul-00	N	00-026	X7262	BP8570		43.7	10
22-Jul-00	N	00-027	X7259	X7258	040103615	30.4	4
22-Jul-00	N	00-028	X7261	BP8571		47.5	12
22-Jul-00	N	00-029	BP8572	X7260		39.9	7.5
23-Jul-00	N	00-031	X7253	BP8573		41.9	9
23-Jul-00	N	00-033	X7252	X7251		25.1	2
23-Jul-00	N	00-034	X7257	X7254		31.3	4
23-Jul-00	R	95-012	SSL232	SSL231	22422C0937	52.4	17
23-Jul-00	R	97-026	X6944	X6945	40351D2312	44.9	11
23-Jul-00	R	99-030	X7167	X7166	410A3A785C	30.1	3.5
23-Jul-00	R	99-067	X7203	X7204	410A343C03	27.4	2.5
23-Jul-00	R	99-069	X7205	X7206	410A196965	28.4	2.5
23-Jul-00	R	99-134	X7059	X7058	410A194419	32.0	4
23-Jul-00	R	99-137	X7061	X7062	410A3C1625	33.8	4
24-Jul-00	N	00-045			035060288	23.3	1.5
24-Jul-00	R	94-045	SSJ904	SSJ905	7F7D4A555F	44.0	10
24-Jul-00	R	97-103	X3940	X3941	2242295574	34.2	4.5
25-Jul-00	N	00-047	X7210	BP8590		64.5	30
25-Jul-00	N	00-048	X7211	X7212		24.8	1.8
25-Jul-00	N	00-049	X7213	X7214		25.4	1.5
25-Jul-00	R	00-050	X7215	X7180	4105162220	30.5	3
25-Jul-00	N	00-051	X3979	X3978		34.2	4.5
25-Jul-00	N	00-055			040062895	23.7	1.5
25-Jul-00	N	00-057	X7217	X7216		25.7	1.5
25-Jul-00	R	94-094	SSJ972	SSJ973	1F4A2C115A	44.6	10.5
25-Jul-00	R	94-095	BP4425	SSJ974	1F482F6802	50.0	16.5
25-Jul-00	R	96-061	SSM988	BP1109	2242373A15	57.9	24
25-Jul-00	R	96-070	BP8521	SSM996	22421D5E52	42.1	9
25-Jul-00	R	96-089	SSN208	SSN207	22422A1B16	42.8	9.5
27-Jul-00	N	00-060	X7219	X7220		26.7	2
27-Jul-00	R	99-036	X7176	X7175	41505A1137	27.7	2.5
29-Jul-00	N	00-065	X7226	X7227	042557784	23.9	1

Date 2000	New or Rec	Turtle ID	Tag left	Tag right	PIT	SCL cm	Mass kg
Hawksbill turtles (immatures)							
29-Jul-00	R	99-098	X7040	X7039	41050E3E39	30.7	3.5
1-Aug-00	R	95-126	SSM936	SSM937	40397F3F77	37.2	6
1-Aug-00	R	96-077	SSN201	BP1113	22423D021E	53.2	17.5
2-Aug-00	N	00-072	X7235	X7236		26.7	2
2-Aug-00	N	00-074	X7233	X7234		22.4	1.5
2-Aug-00	R	95-023	SSL240	SSL241	224217117E	43.3	9
3-Aug-00	N	00-076	X7238	BP8596		35.6	5
3-Aug-00	N	00-080	X7240	X7239	042577105	26.2	1.5
3-Aug-00	N	00-082	X7242	X7241	042538003	30.5	3.5
3-Aug-00	N	00-083			042537888	22.8	1.2
3-Aug-00	N	00-086			042615113	22.8	1
3-Aug-00	R	94-035	BP1155	X7237	7F7D4F440F	48.2	13
3-Aug-00	R	94-077	SSJ948	BP4417	1F4C264A25	45.8	11.5
3-Aug-00	R	97-018	X3936	X3937	2242180608	35.4	5.5
3-Aug-00	R	97-119	X3959	X3958	2242165309	30.7	3.5
3-Aug-00	R	97-129	SSN251	SSN252	4039322B3D	50.7	16.5
3-Aug-00	R	99-051	X7182	BP8520		36.2	5.5
4-Aug-00	N	00-088	X7244	X7243	042558870	30.4	3.5
4-Aug-00	R	93-037	BP1106	SSM970	7F7D570A7E	51.9	15
4-Aug-00	R	94-028	SSN220	SSN221	7F7D4D0332	43.2	9
5-Aug-00	R	93-009	1809	BP8598	7F7D394E61	48.8	14.5
5-Aug-00	R	99-021	X7161	BP8530	410A222A54	36.7	5.5
5-Aug-00	R	99-023	X7247	X7248	4105183678	27.7	2.5
6-Aug-00	R	95-043	SSL248	X3910	22423B1954	42.5	8.5
6-Aug-00	R	97-086	X3931	X3932	22421C5D51	41.6	8
7-Aug-00	N	00-102	X7302	BP8600		37.7	6
7-Aug-00	R	97-115	X3954	X3953	2242300B34	41.3	8
8-Aug-00	N	00-103	X7306	X7305	042553120	26.7	1.8
8-Aug-00	N	00-106	X7304	X7303	042619332	28.7	2
8-Aug-00	N	00-108	X7308	X7307	042608880	28.9	2.5
8-Aug-00	N	00-109			042558096	21.4	1
8-Aug-00	R	92-024	BP8576	X7309	7F7D373B5F	60.1	24
8-Aug-00	R	94-053	SSJ912	SSJ915	1F4D4000354	48.0	12.5
8-Aug-00	R	97-003	SSN267	SSN266	40392D3933	32.1	4
8-Aug-00	R	97-101	X3939	X3938	2242355E12	35.0	5
8-Aug-00	R	99-079	X7027	X7028	410A024E23	28.9	2.5
9-Aug-00	N	00-113	X7310	BP8577		49.4	15
9-Aug-00	N	00-120	X7311	X7312	042597055	27.0	2.5
9-Aug-00	R	94-070	SSJ939	BP4411	1F4A312541	59.5	30.5
9-Aug-00	R	97-104	BP1156	X3942	22422D1501	55.8	20
9-Aug-00	R	98-013	SSN238	BP1163	41503C3F41	50.5	16.5
9-Aug-00	R	98-078	X6949	X6948	41504B6E00	39.9	8
9-Aug-00	R	99-068	X7194	X7195	410A352201	35.4	5
9-Aug-00	R	99-074	X7200	X7199	410A2E1965	30.1	3
9-Aug-00	R	99-076	BP8532	X7026		46.6	14
9-Aug-00	R	99-096	BP8536	X7035		63.4	31
10-Aug-00	N	00-126			042570081	23.9	1
10-Aug-00	N	00-129			041304546	20.4	0.8
10-Aug-00	N	00-133	X7321	BP8579		33.4	4.5
10-Aug-00	R	93-032	BP4495	SSM946	7F7D352954	45.0	10.5
10-Aug-00	R	94-079	SSJ951	BP4418	1F4778257D	48.6	13.5
10-Aug-00	R	94-104	SSJ986	SSJ985	1F4A4D2E1C	38.8	6.5
10-Aug-00	R	97-005	SSN271	SSN270	403935752D	36.6	5.5
10-Aug-00	R	98-108	X7316	X7315	410531215F	28.2	2.5
10-Aug-00	R	99-019	X7139	X7140	4109797A69	27.4	2.5
11-Aug-00	N	00-135			042593514	21.4	1
11-Aug-00	N	00-138	X7323	X7324	041309600	25.3	2
11-Aug-00	R	94-052	SSJ911	SSJ916	22422B344A	41.2	8.5

Date 2000	New or Rec	Turtle ID	Tag left	Tag right	PIT	SCL cm	Mass kg
Hawksbill turtles (immatures)							
11-Aug-00	R	98-137	BP8581	X7106	22422C0D2D	37.2	6
12-Aug-00	N	00-141			042547553	20.8	1
12-Aug-00	N	00-143	X7326	X7325		29.0	2.5
12-Aug-00	N	00-144	X7329	X7328		26.0	2
12-Aug-00	N	00-147	X7340	X7339		24.6	1.5
12-Aug-00	N	00-148	X7332	X7331		24.5	2
12-Aug-00	N	00-150	X7338	X7337		21.6	1
12-Aug-00	N	00-151	X7334	X7333		25.8	2
12-Aug-00	R	99-045	X7336	X7335	410A301E28	24.2	1.5
12-Aug-00	R	99-059	X7188	X7187	41097B2F30	33.7	4.5
12-Aug-00	R	99-062	X7191	X7190	4109757E28	36.8	6
13-Aug-00	R	94-010	X4609	X4608	7F7D4F3756	60.0	30
13-Aug-00	R	94-089	SSJ965	BP8560	1F4A001A7D	62.1	31
13-Aug-00	R	96-037	BP1104	SSM967	40392A2340	53.8	20
13-Aug-00	R	98-011	X7172	X7171	4150386235	38.8	7.5
13-Aug-00	R	98-076	X6943	BP1180	4150516E5C	48.4	14.5
13-Aug-00	R	98-080	X6950	BP1181	41504F730D	52.2	15
13-Aug-00	R	99-070	BP8523	X7196		52.0	16
13-Aug-00	R	99-071	X7189	BP8524		38.6	7.5
14-Aug-00	R	98-093	X6965	X6964	410A042757	40.4	7.5
15-Aug-00	N	00-161	X7342	X7341	042611887	29.2	2.5
15-Aug-00	N	00-162	X7343	X7344	042623349	25.0	2
15-Aug-00	N	00-163	X7345	X7346	042580790	31.5	4
15-Aug-00	R	97-059	X3914	X3913	2242333A19	31.6	4
2-Sep-00	N	00-165			41303374	23.3	1.3
3-Sep-00	N	00-169	X7347	BP8584		49.6	14
3-Sep-00	N	00-172	X7349	X7348	041307282	28.4	2.8
3-Sep-00	R	94-017	X4621	X4620	7F7D50223B	46.9	12
3-Sep-00	R	94-041	X4648	BP500	1F4A095F2F	61.0	27
3-Sep-00	R	97-130	SSN254	SSN253	40393E573E	40.3	8
3-Sep-00	R	98-105	X7183	X6974	410A325D31	33.5	4
4-Sep-00	N	00-173	X7350	X7351	042885768	31.5	3.5
5-Sep-00	R	95-040	SSL246	SSL247	22421E3875	43.0	8.5
6-Sep-00	R	92-045	1414	BP8587	7F7D32183C	51.6	16.5
7-Sep-00	R	99-017	BP8529	X7158	4105A1428	33.3	3.5
8-Sep-00	R	94-065	SSJ930	BP4410	7F7D4D2154	57.1	21
9-Sep-00	N	00-181	X7357	X7358	042547638	35.7	6
11-Sep-00	R	99-006	X7359	X7360	41096D7655	27.1	1.5
Hawksbill turtles (matures)							
9-Aug-00	N	00-119	X7313	BP8578		68.2	37
23-Jul-00	N	00-036	X7202	BP8574		71.2	45
31-Jul-00	N	00-068	X7228	BP8593		73.0	45
9-Aug-00	R	97-023	SSN286	BP1133		74.0	50
12-Aug-00	N	00-146	BP8583	X7330		75.0	
6-Aug-00	R	94-014	X4618	BP8546		75.0	60
6-Aug-00	N	00-098	BP8599	X7301		75.9	50
5-Aug-00	R	95-077	BP4468	SSL271		76.4	57
12-Aug-00	N	00-145	BP8582	X7327		76.7	56
2-Sep-00	R	97-100	BP8537	X7038		76.7	
2-Aug-00	N	00-075	X7232	BP8595		79.0	
6-Sep-00	N	00-176	X7353	BP8585		79.8	62
23-Jul-00	N	00-041	BP8575	X7207		79.9	70
24-Jul-00	N	00-046	BP8589	X7209		80.6	58
5-Aug-00	N	00-090	X7245	BP8597		81.8	65
7-Sep-00	N	00-179	X7356	X7355		81.8	76
14-Jul-00	N	00-001	X7201	BP8593		81.9	

Date 2000	New or Rec	Turtle ID	Tag left	Tag right	PIT	SCL cm	Mass kg
Hawksbill turtles (matures)							
23-Jul-00	N	00-042	BP8588	X7208		82.9	75
26-Jul-00	N	00-059	X7218	BP8591		85.7	
7-Sep-00	N	00-178	X7354	BP8586		86.7	80
Green turtles							
20-Jul-00	N	00-021		X7263		35.1	5.5
27-Jul-00	N	00-061	BP8592	X7221		33.4	4.5
27-Jul-00	N	00-062	X7222	X7223		31.4	4
28-Jul-00	N	00-064	X7225	X7224		30.5	3.5
31-Jul-00	N	00-067	X7229	BP8594		42.5	9.5
31-Jul-00	N	00-069	X7231	X7230		29.0	3
5-Aug-00	R	99-035	X7246	BP8518		36.3	6.5
6-Aug-00	N	00-096	X7250	X7249		30.1	3
10-Aug-00	N	00-124	X7320	X7319		27.6	2
10-Aug-00	N	00-131	X7318	X7317		32.3	4
11-Aug-00	N	00-137	X7322	BP8580		36.8	7

PROGRESS REPORT

Status survey of hawksbill turtles at Desecheo Island, Puerto Rico

Introduction

Desecheo Island has been suggested as a potential feeding and developmental habitat for hawksbills turtles (Diez and Van Dam, 1999). Therefore, in-water surveys were conducted to quantify the population structure of sea turtles inhabiting the waters around Desecheo Island. The following report is a summary of the activities and results gathered to date during in-water surveys conducted around the island.

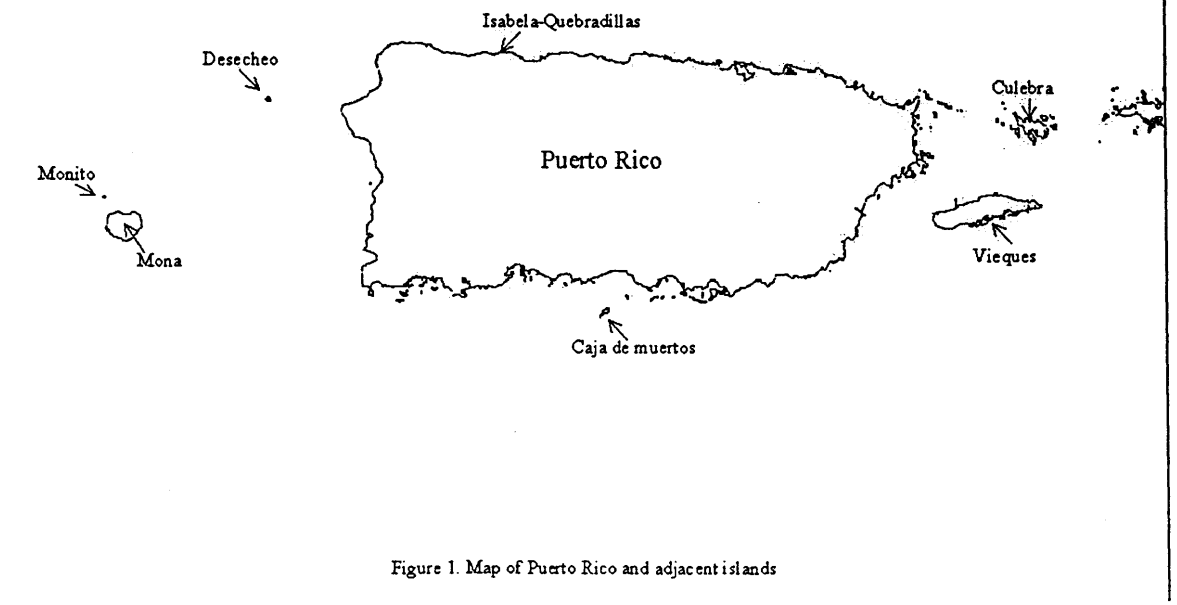

Figure 1. Map of Puerto Rico and adjacent islands

Methods and Results

Study-site:

Desecheo Island, a small uninhabited island, is situated 21 km from Puerto Rico's northwestern coast (Fig 1). Surrounding the island, a narrow sloping shelf to depths of about 50 m supports diverse coral formations in an array of patch reefs that grid the shoreline. Currently, Desecheo Island is an U.S. Fish and Wildlife Refuge, but the coral reefs surrounding Desecheo are not part of the Refuge and are in need of protection from erosion and overfishing. Several proposals have been submitted to Puerto Rico's Department of Natural and Environmental Resources to protect the marine area.

Turtle captures:

Daytime snorkeling censuses were conducted around the periphery of Desecheo Island at an average depth of 12.5 m. Ten visits to the site were conducted for a total of 20.7 hours of in-water survey (Table 1). All turtles were hand-captured by the method adapted from Diez and van Dam (1994). It is described as follows: several snorkelers (range between 2 and 7) were involved, and one person steered the boat. Those in the water swam separately from one another to maximize area coverage, but remaining within visual contact of each other. A turtle sighting was hand-signaled to the others who would then joined in the pursuit of the turtle. One of two strategies was then employed: either one person would swim down towards the front or side of the animal to distract it while another person came from behind the turtle and grabbed it, or one person captured a turtle by swimming down from directly above the animal. Grabbing both front flippers was found to be the most effective way of immobilizing and bringing up a turtle. Capture locations were obtained from hand-held Global Positioning System units (GPS), enabling turtles to be returned to capture locations.

Table 1. Dates of surveys at Desecheo Island and number of turtles captured.

Date	N° of turtles captured
23-Mar-99	2
23-Sep-99	4
19-Oct-99	3
4-Apr-00	4
2-May-00	3
12-May-00	3
16-Sep-00	7
27-Oct-00	5
8-Dec-00	8
6-Apr-01	10

Measuring the time spent for each survey session assessed the effort involved with finding and capturing turtles at Desecheo Island. Effort assessments were made for all survey sessions during the research period but does not include captures made incidentally. Surveys were generally performed with an average of 5.5 persons (range 2 to 7). With one survey hour defined as a unit of effort, the catch per unit effort (CPUE) was calculated for each survey session (Table 2).

Table 2. Catch per unit effort (CPUE) at Desecheo Island, 1999-2001. CPUE was calculated by dividing the number of turtles seen (whether captured or not) by the total time of each survey (hours).

Year	N° of Turtles	Mean CPUE	STD	SE	Min	Max	Surveys	Hours
1999	12	1.33	0.98	0.37	0	2.9	7	9.7
2000	38	4.22	1.71	0.57	1	6	9	9
2001	11	5.5					1	2
Total	61						17	20.7

Note: By the time of writing this report only one survey was conducted during 2001.

In order to detect significant trends in the population, long-term data on abundance and variation from year to year are needed. Our survey method seems to be an accurate technique for assessing significant trends in population structure. However, improvement in consistency of the amount of time spent in each survey session should be addressed. During 1999 to early 2001 field season, 49 hawksbill turtles were captured. Hawksbill turtles ranged in size from 21.2 to 62.0 cm notch-tip straight carapace length (N-T SCL) (See Fig. 2). Turtles in the 20-30 cm SCL size class were most commonly caught; suggesting Desecheo Island is a developmental habitat for hawksbill turtles. One male adult hawksbill was also observed in the area. Although no green turtles were captured, we observed 11 individuals and estimated their size to be 30 to 50 cm N-T SCL.

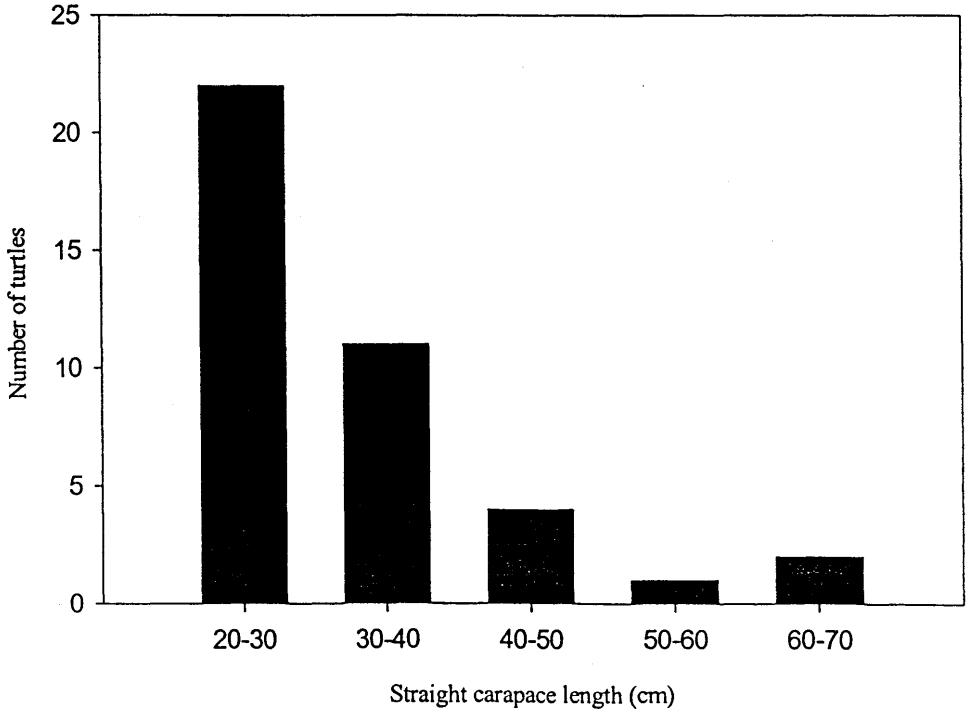

Figure 2. Size distribution of hawksbill turtles captured in Desecheo Island since September 1999 to April 2001.

Tagging:

All turtles larger than 25 cm SCL were tagged in both front flippers along the inside edge of the first or second scale (counting from the base of the flipper) using Monel Stainless Steel tags before being released. Additionally, most hawksbills were tagged with AVID Passive Integrated Transponders (PIT tags) inserted in the frontal right flipper muscle.Tagging allows the identification of individuals, necessary for obtaining growth rate, recruitment and other population parameter data.

Biometrics:

All captured turtles were weighed and measured. Straight-line body measurements were taken using a Haglof tree caliper. Curved measurements were taken using a fiberglass measuring tape. Measurements were made to the nearest tenth of a centimeter. Weights were obtained to the nearest tenth of a kg using Pesola spring scales of 20 kg x 200 g.

Blood sampling:

Blood and/or tissue samples were collected from hawksbills. Analysis of these materials through genetic profiling may allow us to assign the source population in the case of immature turtles, and sex ratios would be determine by using testosterone leves of the serum samples. Dr Peter Dutton and Dr Dave Owens, will conduct sample processing.

Growth:

Knowledge of turtle growth rates is critical to understanding turtle population dynamics. This information also forms the basis of age to maturity estimates necessary to understand life history stages. Such data is largely lacking for hawksbill turtles living under natural conditions. The tagging effort of the fieldwork performed during FY99-00, aimed at juvenile and sub-adult hawksbill turtles and provided a potential baseline for growth rate studies at Desecheo Island. A number of tagged individuals were observed

and sometimes captured, but growth rate data was only recorded for recapture intervals greater than 12 months. This was to allow for seasonal changes, which can affect feeding rates and may alter growth rates (Van Dam, 1999). Three individuals (captured during previous surveys) were recaptured after being at large for 8 or more months (Table 3).

Table 3. Annualized growth rates of turtles recaptured during 2000, at Desecheo Island, Puerto Rico. All measurements are straight-line carapace length (notch-tip). Lengths in cm.

ID	Date initial measurement	Carapace length (cm)	Date final measurement	Interval (days)	Annual growth (cm/year)
98-018-M	11 Jul 98	26.2	2 May 00	488	1.5
99-02-D	23 May 99	43.4	4 Apr 00	379	3.6
99-18-D	19 Oct 99	27.2	4 Apr 00	169	3.2

Movement and home range:

Van Dam and Diez (1998) and León and Diez (1999) concluded that juvenile and sub-adult hawksbill turtles in the Caribbean have a limited home range (<500 km) for at least several years. During our multiple visits to Desecheo Island, we preliminarily observed the same limited home range for recaptured or re-observed animals. However, recent information on survivorship and migration of juvenile hawksbills at Mona Island, revealed that 85% of recruiting hawksbills (<30 cm SCL) migrate to other places or died (Diez and Van Dam, 2000). This conclusion corresponds with the finding of a hawksbill re-captured at Desecheo Island, which was initially tagged at Monito Island (ID# 98-018-M) during 1998 (Table 3). The distance covered by this turtle was 53 km. This finding demonstrates that juvenile hawksbills may utilize various developmental habitats throughout the region (explaining the 85% migration of recruits at the Mona Island's feeding grounds).