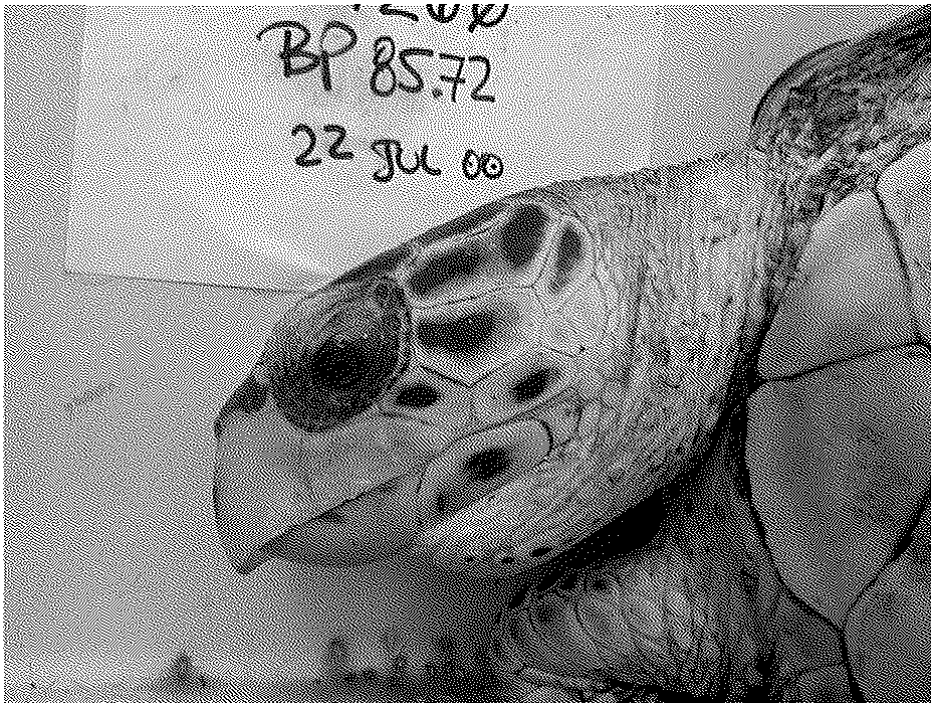
RESEARCH REPORT FOR 2000

# HAWKSBILL TURTLE RESEARCH PROJECT




PREPARED BY

Carlos E. Diez and Robert P. van Dam

NOTICE

This technical report is issued exclusively for agency and personal use and contains unpublished data. Views expressed herein are solely those of the authors mentioned on the cover. The authors reserve the right to submit materials presented here for later publication in appropriate scientific journals.

PROJECT SUPPORT FOR 2000

Funding for this research was received from:

- U.S. National Marine Fisheries Service
- Departmento de Recursos Naturales y Ambientales (Negociado de Pesca y Vida Silvestre)
- Japan Bekko Association

Logistical support was provided by the Departamento de Recursos Naturales y Ambientales. Grupo Jaragua, Inc., Fundación Osiskun.

Research at Puerto Rico was conducted under permits by US NMFS (Permit No. 1253) and DRNA (Permiso DRNA 00-EPE-21 (E)).

JUNE 2001

**Status survey of hawksbill turtles at Mona and Monito Islands, Puerto Rico: Results for 2000**

## Introduction

The waters surrounding Mona and Monito Islands provide important foraging habitat for hawksbill turtles. Our principal study area comprises of 2/3 of the available habitat and harbors an estimated 250 immature turtles with a maximum level of 375 individuals. Local population densities are relatively high and through development of efficient capture techniques, allow for sampling (including measurement and tagging) of about ½ of turtles present in the study area per year. Our in-water studies with hawksbills follow two mayor objectives: 1) population status and dynamics; 2) behavior and ecology.

The size of the juvenile aggregation currently appears stable, with little measurable effects even of the major disruption caused by hurricane Georges in 1998. Foraging ground densities average 38 immatures/km2 or translated into biomass, 270 kg/km2. Influx of small juveniles averages 35 individuals per year with about half becoming residents of the study area. Once established, turtles maintain a home range limited to <0.25 km2. Overall annual immature hawksbill survival rates are at least 85%. Twelve years is the projected mean time for turtles to grow from 23 to 60 cm. The study area contains habitat types of differing qualities resulting in highly variable somatic growth.

Behavioral studies of hawksbill span the foraging behavior of immature to adult male breeding behavior. Diving behavior of immature varies significantly by habitat types, with animals on Mona reefs foraging twice as long as those at Monte, reflecting high prey sponge abundance at the latter location. Males visit the breeding grounds at Mona Island annually and behavior there consists principally of crusing the shallow reef areas (2/3 of the daytime). Outside of the breeding season, males reside on foraging grounds <100 km distant. Migrations of females after nesting on Mona, in contrast, are to feeding areas 550-1600 km away.

The beaches of Mona Island harbor the largest hawksbill nesting colony in the Caribbean Region, with over 500 nests deposited annually, resulting in some 60,000 hatchlings produced. Total female population size is estimated at 280 individuals and appears to be increasing.

Last year, we presented a summary report of the results from 1992 to 1999. The following report is the continuation of the research conducted by us focusing on the population dynamics and ecology of hawksbill turtles. The results and other information regarding the field season of the year 2000 is presented in the this report. Where appropriate, information on data collected in other years is included.

The assembly of hawksbill turtles at Mona and Monito Islands is unique for its accessibility for research, and turtles are found there in relative high abundance. By applying and optimizing a variety of methods for capture, sampling and tagging of turtles we have collected a substantial amount of information on the characteristics and behavior of hawksbill turtles. In addition to the in-water studies, we provide summary data on the turtle nesting activity observed on the beaches of Mona Island.

## Methods and results

Study area:

Situated in the middle of the Mona Passage between the islands of Hispaniola and Puerto Rico, Mona (18°05'N, 67°54'W) and Monito Islands are uninhabited natural reserves managed by the Puerto Rico Departamento de Recursos Naturales y Ambientales. Both islands are uplifted plateaus consisting of carbonate rock of marine origin dating from the Miocene-Pliocene. Mona Island, with a surface area of 55 $km^2$, features a low-lying, sandy coastal plain along most of its southwestern half; the northeastern coast and that of Monito is dominated by high vertical cliffs standing in 20-40m of water. A wide range of sublittoral bottom types is found along the topographically contrasting shores and,

together with microclimate variation, gives rise to a great diversity of benthic communities. Sponge dominated communities are found along the cliff walls, sea caves, and drop-offs. Communities dominated by hard and soft corals occur in all shallow (<30 m depth) and non-vertical hard bottom types along the southern half of Mona Island.

Mona and Monito Islands are reserves managed by the Puerto Rico Department of Natural and Environmental Resources. Sea turtles have been formally protected there since the introduction of the Endangered Species Act of 1973. In 1982 the U.S. Fish and Wildlife Service declared the beaches of Mona Island Critical Nesting Habitat for hawksbill turtles. On September 2, 1998, the "waters extending seaward 3 nm from the mean high water line" of Mona and Monito Island were declared Critical Habitat for hawksbill turtles.

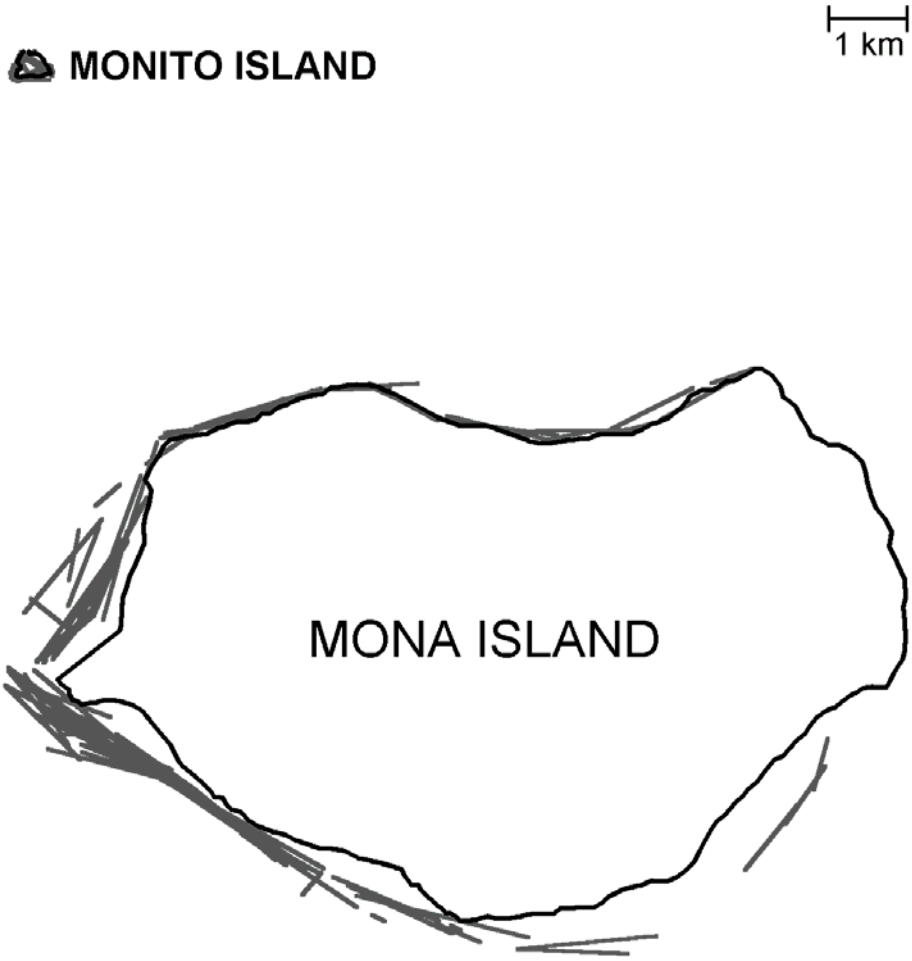



**Figure 1.** Approximate location of turtle survey transects conducted during 2000.

Turtle capture:

Fieldwork during 2000 was conducted from July 12 to September 13, with additional short visits to Mona for nesting censuses and miscellaneous purposes throughout the year.

Turtles were captured by hand in open water by snorkeling (skindiving) or with SCUBA. The 17-foot whaler "TAIMAI" fitted with a new 60 horsepower outboard motor was used for most in-the-water activities and made for a reliable research vessel.

Surveys for turtles were made along the coasts of Mona and Monito Islands, with the exception of Mona's northeast cliff coast, which was not visited. The methods used for these surveys consisted of snorkeling where water depth is less than 15 meters (50 feet), and a combination of snorkeling and diving with SCUBA or just diving with SCUBA, along the cliff coasts of Mona and Monito. Such surveys were made almost daily depending on weather and sea conditions. Sea conditions are good when water is clear and wind, waves or currents are minor.

The shallow water snorkeling surveys usually involved four people: three in the water and one person steering the boat. Those in the water swam in a certain direction, separating themselves to maximize area coverage, but remaining within visual contact of each other. A turtle sighting was hand-signaled to the others who then join 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 to grab it, or one person captured a turtle by swimming down from directly above the animal. Grabbing both its front flippers was found to be the most effective way of immobilizing and bringing up a turtle. Caution was used when doing this as some individuals try to bite the hands when handled in this way.

Along the cliff coast, where the vertical cliff wall stands in water between 20 and 40 meters deep, turtle capture was most effective when snorkelers and divers with SCUBA

were present simultaneously. This method involved one or two divers swimming along the cliff wall at 10 to 15 meters depth, followed by one or two snorkelers at the surface. In this way, the faster snorkelers could follow turtles seen swimming away along the cliff, and the divers could pursue turtles descending towards the seafloor. Captured turtles were generally handled as described above, with the exception of very large animals captured by a single diver with SCUBA. In this situation, bringing the turtle to the surface could be accomplished by holding the turtle at the front nuchal notch and posterior end of the carapace and steering the animal towards the surface. When diver and turtle reach the surface, immediate assistance is necessary to prevent the animal from descending.

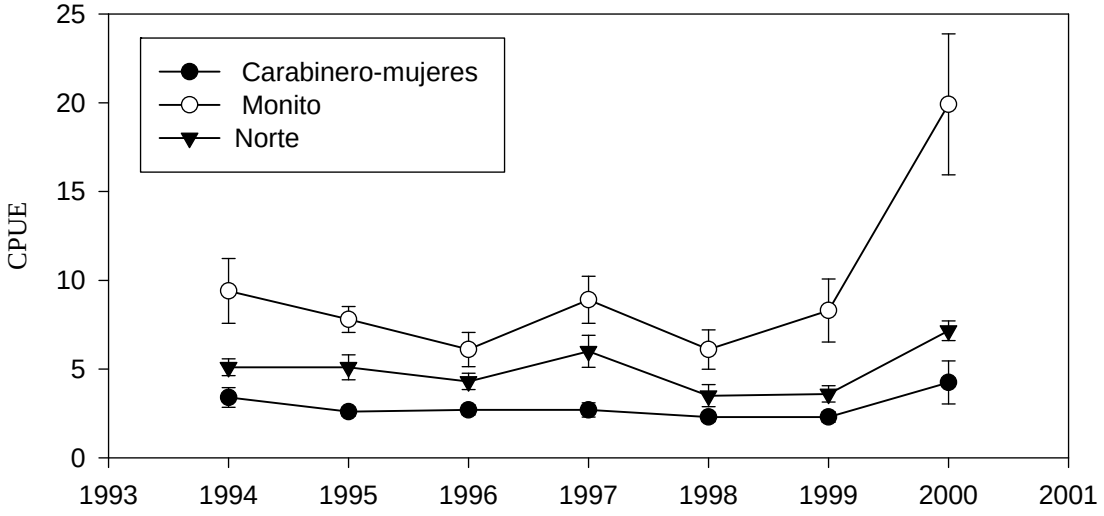



Figure 2. Catch per unit effort for our main study sites.
Y error bars denote plus and minus one standard error.

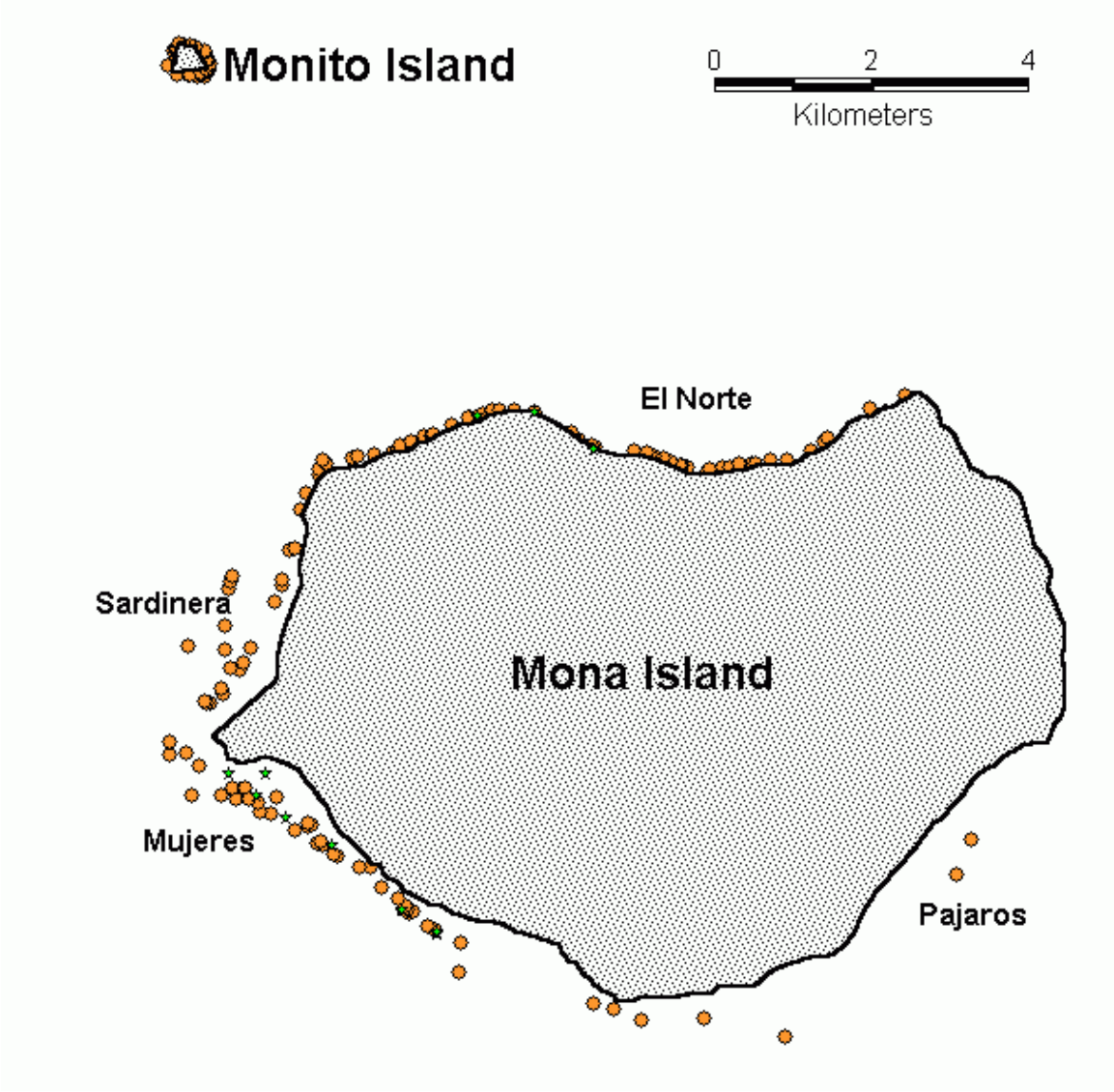



**Figure 3.** Locations where hawksbill (circles) and green turtles (stars) were captured during 2000.

The effort involved with finding and capturing turtles at the three main study areas (the Carabinero-Mujeres reef and the cliff walls of El Norte and Monito Island was assessed by measuring the time spent for each survey session and the turtles captured and sighted. The catch per unit effort (CPUE) is defined as one survey hour as a unit of effort. As far as population trends during our study period, all sites seem to have an increase. However, CPUE values varied according to site when pooled data from all years (see figure 2). During 2000 a total of 95.46 hours were spend in the water yielding an average CPUE of 3.06 hawksbills/hour (captures and sighted), with on average 2.9 persons in the water. Table 1 gives a breakdown of CPUE's by survey sites during the 2000 field season. The cliff wall habitats of Mona -and especially Monito- have exceptionally high densities of hawksbill turtles. Survey transects start and endpoints were recorded by GPS and approximate survey tracks are plotted in figure 1.

Table 1. Summary of CPUE data by site during the 2000 field season.

| Year | Site | Number of turtles | Mean CPUE | STD | SE | Min | Max |
|---|---|---|---|---|---|---|---|
| 2000 | Carabiner-mujer | 156 | 4.24 | 8.59 | 1.21 | 0 | 60 |
| | Monito | 26 | 19.91 | 15.89 | 3.97 | 5.97 | 75 |
| | Norte | 110 | 7.16 | 3.06 | 0.55 | 1.47 | 15.15 |

During 2000, we captured a record number of turtles: a total of 171 hawksbill and 11 green turtles. Turtles were caught primarily along the northwest half of Mona Island and around all of Monito Island. (figure 3). Hawksbill turtles ranged in size from 20.4 to 86.7 cm notch-tip straight carapace length (N-T SCL); green turtles ranged from 27.6 to 42.5 cm N-T SCL. (figure 4). One green turtle and ninety-eight hawksbills were captured bearing tags applied in previous years (recaptures). Untagged hawksbill turtles measuring less than 30 cm SCL size class is considered new arrivals to the study area and in 2000 we found 36 such recruits.

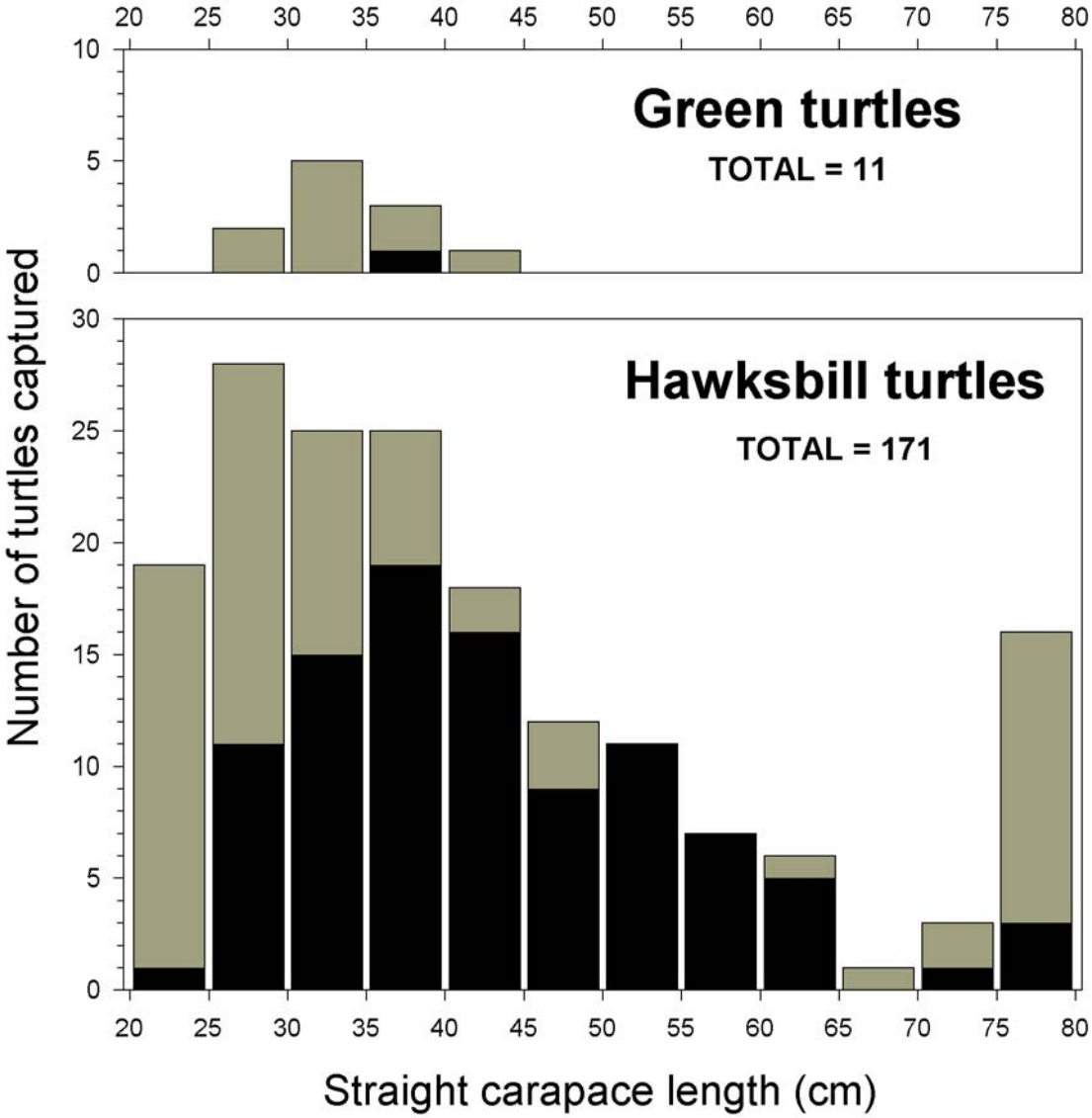



**Figure 4.** Size distribution of turtles captured in the study area during 2000. Gray bars are turtles tagged for the first time, black bars indicate animals tagged previously and recaptured this season.

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).

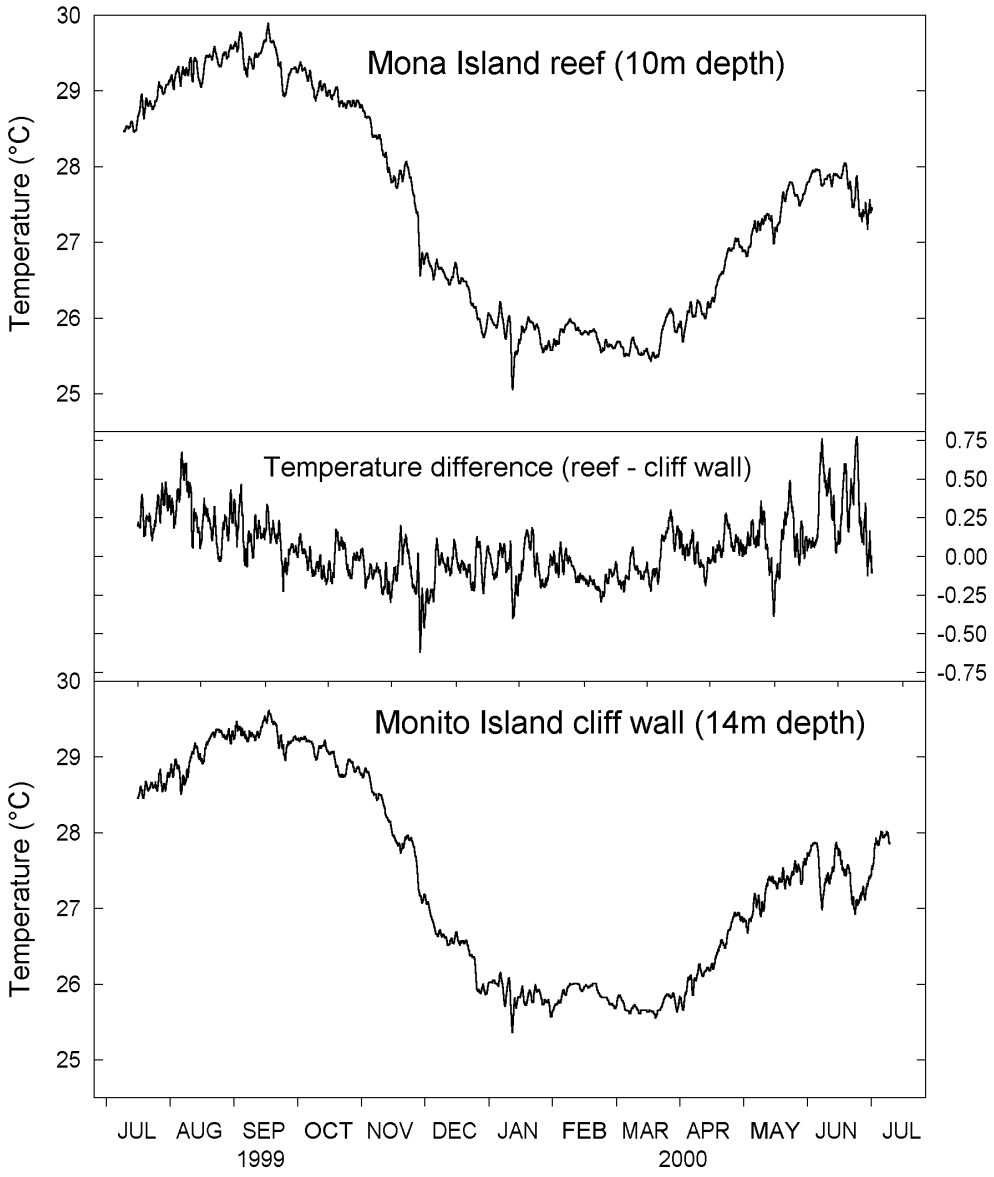



**Figure 6.** Water temperatures in the study area at Mona and Monito Islands.

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.

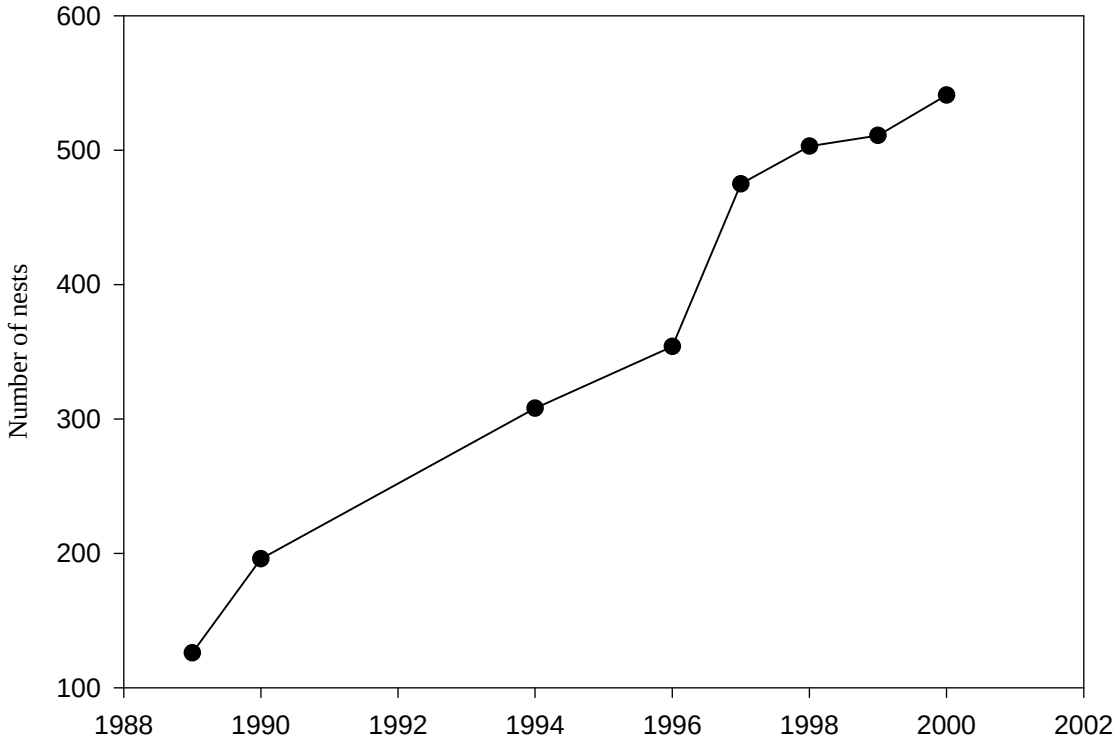



Figure 7. Number of hawksbill nests during 1989, 1990, 1994, 1996-2000 at Mona Island, Puerto Rico

Acknowledgments

We wish to thank the following persons who made this project possible: to all personnel of the Departamento de Recursos Naturales de Puerto Rico (DRNA-PR), in particular to Gaspar Pons, Eduardo Cintrón, Alberto Alvarez, Miguel "Toño" García and others. For assistance in the field during in-water surveys: Mónica Bustamante and Michelle Scharer; for assistance in the field during nesting surveys: Ana I. Silva y Marina Rujas. -Project support: Japan Bekko Association, National Marine Fisheries Service and DRNA-PR.

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$^{o}$ 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$^{o}$ 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.

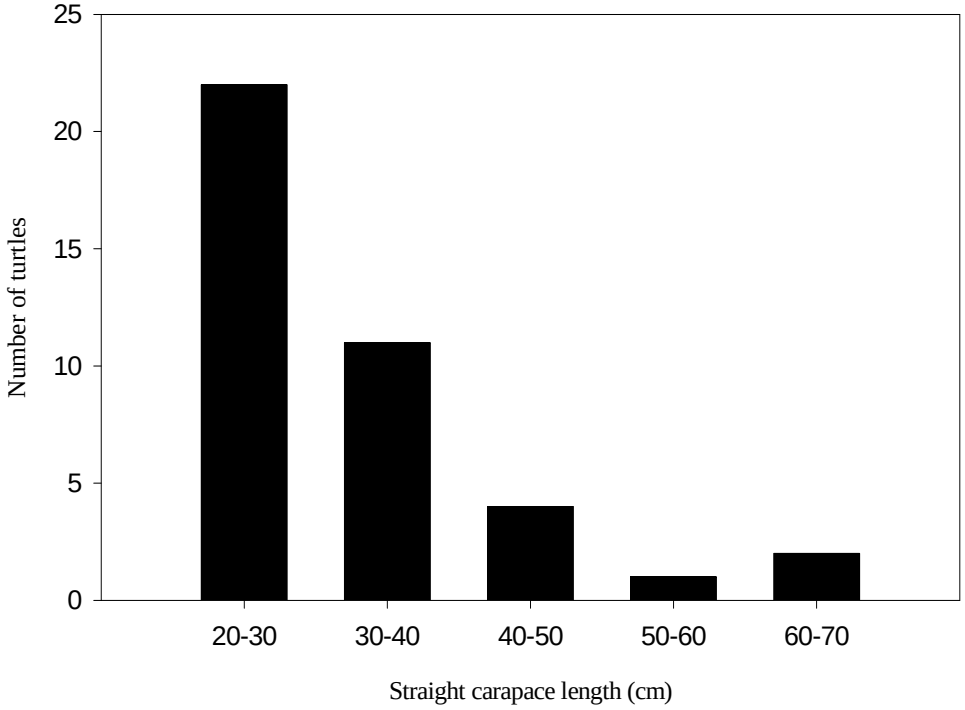



Figure 2. Size distribution of hawksbill turtles captured in Desecheo Island since September 1999 to April 2001.

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).

Acknowledgments

We appreciate the help of all the volunteers and other personnel who participate in this study, particulary the following persons and organizations:

-Our field assistants: Alberto Alvares, Ricardo López and others.
-Boat crew: José Rafort, Vig. Carlos Rodríguez,Vig. Roberto Avilés and others
-Project support: U.S. National Marine Fisheries Service and Departamento de Recursos Naturales de Puerto Rico and Japan Bekko Association.

Literature Cited

Diez, C.E. and R.P. van Dam. 2000. Mona and Monito Island Hawksbill Project. Research Report: Summary of findings from 1995-1999. US NMFS and DRNA. San Juan, Puerto Rico, 73 pp.

León, Y.M. and C.E. Diez. 1999. Population structure of hawksbill turtles on a foraging ground in the Dominican Republic. Chelonian Conservation and Biology 3:230-236.

Van Dam, R.P. and C.E. Diez. 1998. Home range of immature hawksbill turtles (*Eretmochelys imbricata*) at two Caribbean islands. J. Exp. Mar. Biol. Ecol. 220:15-24.

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. List of hawksbill turtles captured to date at Desecheo Island.

| Date | time | Flipper tags | PIT | SCL left | SCL right | body mass |
|---|---|---|---|---|---|---|
| 23-Mar-99 | | X7001/X7002 | | | 27.2 | |
| 23-Mar-99 | | X7003/X7004 | 125462224A | | 43.4 | |
| 23-Sep-99 | | X7003/X7004 | 125462224A | 46.2 | 46.2 | |
| 23-Sep-99 | | X7295/X7296 | | 56.4 | 56.7 | |
| 23-Sep-99 | | X7297/X7298 | 125379690A | 26.5 | 26.5 | |
| 23-Sep-99 | | X7299/X7300 | 125361470A | 26.6 | 26.6 | |
| 19-Oct-99 | 11:15 | X7276/X7277 | | 61.2 | 61.4 | |
| 19-Oct-99 | 13:10 | X7279/X7278 | 125364754A | 34.2 | 34.2 | |
| 19-Oct-99 | 15:10 | X7280/X7281 | 125364394A | 27.2 | 27.2 | |
| 4-Apr-00 | 11:00 | X7004/X7003 | 125462224A | 47.1 | 47.1 | 10.0 |
| 4-Apr-00 | 11:00 | X7281/X7280 | 125364394A | 28.7 | 28.7 | 3.2 |
| 4-Apr-00 | 11:00 | X7282/X7283 | | 35.7 | 35.6 | 5.6 |
| 4-Apr-00 | 11:00 | X7284/X7286 | | 35.6 | 35.6 | 5.2 |
| 2-May-00 | 10:00 | X7287/X7288 | 4150425056 | 28.2 | 28.2 | 2.6 |
| 2-May-00 | 10:00 | X7289/X7290 | | 35.0 | 35.0 | 5.2 |
| 2-May-00 | 10:00 | X7291/X7292 | | 34.1 | 34.0 | 5.0 |
| 12-May-00 | 9:45 | X7293/X7294 | | 26.0 | 26.0 | 2.2 |
| 12-May-00 | 10:45 | X7273/X7274 | | 29.9 | 30.0 | 3.6 |
| 12-May-00 | 12:10 | X7271/X7270 | | 33.7 | 33.7 | 5.2 |
| 16-Sep-00 | | PPM280/PPM279 | | 21.3 | 21.2 | |
| 16-Sep-00 | | PPM282/PPM281 | | 22.9 | 22.8 | |
| 16-Sep-00 | | PPM283/PPM284 | | 33.0 | 33.0 | |
| 16-Sep-00 | | PPM285/PPM286 | | 36.0 | 36.0 | |
| 16-Sep-00 | | PPM287/PPM288 | | 24.2 | 24.2 | |
| 16-Sep-00 | | PPM289/PPM290 | | 23.5 | 23.4 | |
| 16-Sep-00 | | X7271/X7270 | | 36.3 | 36.2 | |
| 27-Oct-00 | 10:13 | XXN826/XXN827 | | 41.7 | 41.6 | |
| 27-Oct | 10:15 | XXN828/XXN829 | | 28.2 | 28.2 | |
| 27-Oct-00 | 10:20 | none | 042-610-291 | 21.3 | 21.4 | |
| 27-Oct-00 | 10:20 | none | 042-554-582 | 22.3 | 22.3 | |
| 27-Oct-00 | 10:40 | none | 042-595-609 | 23 | 23.0 | |
| 8-Dec-00 | 10:00 | PPM283/PPM284 | | 34 | 33.9 | |
| 8-Dec-00 | 10:00 | X7271/X7270 | | 37.5 | 37.4 | |
| 8-Dec-00 | 10:00 | XXN830/XXN831 | | 30.3 | 29.4 | |
| 8-Dec-00 | 10:00 | XXN832/XXN833 | | 25.2 | 25.2 | |
| 8-Dec-00 | 10:00 | XXN836/XXN837 | | 62 | 62.0 | |
| 8-Dec-00 | 10:00 | XXN899/XXN900 | | 22.1 | 22.0 | |
| 8-Dec-00 | 12:30 | X7284/X7286 | | 39.1 | 39.0 | |
| 8-Dec-00 | 12:30 | XXN835/XXN834 | | 33 | 33.0 | |
| 6-Apr-01 | 13:00 | XXN844/XXN850 | | 25.4 | 25.5 | 2.0 |
| 6-Apr-01 | 13:16 | XXN847/XXN848 | | 35.8 | 35.8 | 5.3 |
| 6-Apr-01 | 13:24 | X7293/X7294 | | 30.5 | 30.5 | 3.2 |
| 6-Apr-01 | 13:41 | PPM283/PPM284 | | 35.3 | 35.3 | 5.4 |
| 6-Apr-01 | 13:49 | X7278/X7279 | 125364754A | 40.6 | 40.5 | 7.6 |
| 6-Apr-01 | 14:04 | XXN840/XXN841 | | 26.2 | 26.2 | 2.1 |
| 6-Apr-01 | 14:26 | X7003/X7004 | 125462224A | 49.7 | 49.7 | 14.2 |
| 6-Apr-01 | 14:37 | XXN842/XXN843 | | 29.1 | 29.1 | 2.9 |
| 6-Apr-01 | 14:42 | PPM289/PPM290 | | 24.5 | 24.5 | 1.9 |
| 6-Apr-01 | 14:56 | XXN845/XXN846 | | 23.0 | 23.1 | 1.5 |