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1995 - THE HURRICANE SEASON OF THE CENTURY, BUCK ISLAND REEF NATIONAL MONUMENT, ST. CROIX, VIRGIN ISLANDS

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Buck Island Reef National Monument, administered by the National Park Service is a 300 acre tropical dry forest island and associated marine system 1.5 miles north of St. Croix in the United States Virgin Islands. Research on the small population of hawksbill turtles (Eretmochelys imbricata) nesting on Buck Island has been the focus of a saturation tagging program since 1988. The program objectives include, the long-term population study of nesting adult and foraging juvenile hawksbill turtles, collection of basic biological data on nesting and foraging behavior, population genetics, nesting beach temperature and hatchling sex ratio studies, and to investigate management concerns and most recently, natural disaster recovery strategies.

The study site consists of four nesting areas. The eastern most nesting area, Turtle Bay, is a narrow beach with low sea grape vegetation located inside the barrier reef. The north and south shorelines are beach forest with narrow coral cobble/sand berm a few meters above the associated shoreline reefs. West Beach, the popular recreational area, encompasses a wide sand beach with vegetated dunes and no near shore reef.

Six years ago on September 17, 1989, Hurricane Hugo devastated Buck Island Reef National Monument. By 1995 the nesting beaches, vegetation and berm, had begun to recover. The berm along the beach forest edge had mostly disappeared. Beach forest vegetation, manchineel saplings and sea grape, were growing providing cover for hawksbill nesting. Hawksbill nesting activities were again distributed equally between northshore and south shore, with the remainder of the activities split between West Beach and Turtle Bay (Figure 1). Nesting hawksbill turtle's emergence to lay ratio had returned to the pre-Hugo level of two emergences per successful nest.

We began the 1995 season with the largest research team in years anticipating 3 1/2 months of nightly patrols to encounter every nesting hawksbill turtle. To our dismay we were first hit by Hurricane Luis on September 5th which luckily passed to the north of the island. Ten days later, September 15th, Luis was followed by Hurricane Marilyn, which effectively curtailing further nightly research operations on Buck Island. Marilyn, a Category II hurricane with winds exceeding 150 mph and 20 foot seas, pounded the island for 8 hours. We lost 28 nights of patrol and upon returning to Buck Island, October 6th, found the nesting beaches altered beyond recognition.

The north shore nesting area lost 3 meters of "permanent" heavily vegetated beach forest, including trees with over 1 meter diameter. Dead, fallen trees and storm washed debris lay parallel to the shoreline blocking turtle's access to prime nesting areas, and hurricane erosion created one meter high berm along the edge of the beach forest. The south shore nesting area lost 2-5 meters of beach forest and created berm over one meter high preventing turtle access to nesting areas. The associated shoreline reef was covered under one or more meters of replenished sand. West Beach lost up to 12 meters of vegetated shoreline. However, below the eroded berm the hurricane had completely removed the beach sand, and then replaced it with over two meters of new sand. Turtle Bay lost between 3 to 4 meters of vegetated shoreline, and seaward of the vegetation sand was removed down to the rock and replenished with over two meters of new sand and debris.

HURRICANE IMPACTS TO NESTING SUCCESS

We reviewed the nesting activities of the same six hawksbill turtles who were active during the period twenty-five days prior to and after the hurricane. We examined what effect the hurricane altered nesting beach had on their nesting behavior and nesting success, including beach debris, eroded berm, and fallen trees.

Beach debris reduced the average distance nesting females were able to crawl beyond the edge of the shoreline vegetation on a successful nesting. Pre-hurricane crawls averaged 6 meters into shoreline vegetation. Post-hurricane crawls averaged 3 meters into the vegetation. Hurricane eroded berm, fallen trees, and debris prevented access to beach forest nesting areas and hawksbill nesting activities shifted to West Beach. Non-hurricane years West Beach receives less than 15 percent of all hawksbill nesting activities. This same shift occurred after Hurricane Hugo in 1989, and was witnessed again with Hurricanes' Luis and Marilyn, 1995 (Figure 1).

Emergence to lay ratio, number of emergences for a successful nesting event, was changed by these same obstructions as well. Pre-hurricane the emergence to lay ratio was 2 emergence to 1 nest laid. Post-hurricane this increased to 5 emergences to 1 nest laid. Debris and steep berm dramatically increased the amount of time and energy each female put into laying one clutch.

Hurricane erosion destroyed an estimated six thousand eggs. A total of 27 known hawksbill nests, 4200 eggs counted at egg deposition, were lost to the hurricanes (10 to Luis and 17 to Marilyn). Fourteen suspected nests were also lost to the hurricanes for a possible additional loss of over 2000 eggs. Seasonally between 6000 to 8000 hawksbill eggs are laid at Buck Island. More than fifty percent of the seasonal production was lost to the hurricanes.

Seasonal hatch success has been below 70 percent since Hurricane Hugo in 1989. This is suspected due to loss of vegetative cover, higher temperatures, drought conditions, and rat predation. This year, nests surviving the hurricanes, had higher

hatch success possibly indicating the first signs of recovery from Hurricane Hugo. The hatch success of nests surviving hurricanes; N = 69, Mean Hatch Success = 77%, SD = 16, Range 0 to 98%. Unfortunately, when you include nests lost to the hurricane (zero hatch success) the whole beach success drops greatly; N = 96, Mean Hatch Success = 54%, SD = 38, Range 0 to 98%. Recovery is a slow process and it looks like were beginning all over again.

HURRICANE IMPACTS TO RESEARCH PROGRAM

Each night the research team traveled to Buck Island by boat, patrolled the beaches, and left at dawn. Because Buck Island is an offshore island, when weather conditions deteriorate, the research team is unable to get to work. This season 36 patrol nights were lost to tropical storms and hurricanes. Loss of patrol nights resulted in several gaps in our data, and our saturation tagging goal was not achieved. Due to the large number of nests laid by unidentified females, confirmed post-hatching, we suspect 7 to 9 nesting females were never identified.

Unable to follow our "priority females" consistently, consecutive clutch data was missed. We had also hoped to monitor priority females' change in weight and blood glucose levels through the nesting season. Unable to do this, we collected blood glucose levels on 19 nesting females at different times during the nesting season. Preliminary results indicate nesting female's blood glucose levels do decline through the nesting season. Unfortunately, the research team can not live on the island, so we will continue to be at the mercy of the elements each season.

HOW TO BETTER PREPARE FOR THE NEXT HURRICANE

Nesting Beach Markers - The majority of the 1x1x48 inch wooden beach markers used to record nesting distribution were lost in the hurricanes. In order to replace these, the beach had to be remeasured from a known point. To avoid having to remeasure after every storm, steel "rebar" stakes will be placed deep in beach forest behind shoreline seasonal markers, as permanent reference points.

Baseline Beach Measurements - In many areas, loss of shoreline was so great that all known references were destroyed. No baseline was available from which to accurately measure loss of beach forest and shoreline vegetation, or measure the amount of replenished sand covering the shoreline reef. The "new" steel markers will be used as fixed reference points to measure distance to seaward edge of beach forest vegetation.

Photo Documentation - Quarterly, photographs of the nesting beach shoreline are taken from known points. However, with the possibility of radical changes at any time from storms, it would be better to photo document the nesting beaches monthly. Photos should be taken from select points on each nesting beach which would include a view up and down the beach, and include a photograph to document the condition of the beach forest and shoreline vegetation at that point.

Nest Relocation - Due to our experience with Hurricane Hugo in 1989, we had already modified the nest relocation protocol to account for severe beach loss to storm erosion. Hurricanes Luis and Marilyn have modified this again. Six of ten nests relocated this year were lost to the hurricanes. In the future, relocations will be made more than 5-8 meters from shoreline vegetation into the beach forest and/or further back on West Beach to avoid newly defined hurricane erosion zones.

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