Documented Effects of Coastal Armoring Structures on Sea Turtle Nesting Behavior

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INTRODUCTION

As do other sandy beaches around the world, the ocean beaches of Florida erode and accrete. During the erosion phase of this cycle, man-made structures built close to the beach become threatened. In response to this threat many property owners in Florida have built coastal armoring structures to protect their upland property from erosion. The number of these armoring structures in Florida is increasing (Schmahl and Conklin, 1991). Superimposed upon the value of Florida's beaches to coastal property owners is the importance of Florida beaches to nesting sea turtles. Florida beaches host approximately 95% of all the sea turtle nesting in the continental United States (Turtle Expert Working Group, 1998).

In a study of the impact of coastal armoring structures on sea turtle nesting behavior, seawalls were shown to have had detrimental effects on sea turtle nesting (Mosier, 1998). Results showed that fewer turtles emerged onto beaches in front of seawalls than onto adjacent, non-walled beaches, and of those that did emerge in front of seawalls, more turtles returned to the water without nesting. The threat for nesting sea turtles posed by seawalls may lie in a reduction of nesting habitat, in an elevation of the physiological cost of nesting, and in displacement of turtles into nesting habitat that is sub-optimal (e.g., a lower beach elevation where eggs would drown; Murphy, 1985).

There are few data available that examine potential effects from beach armoring on nest site choice in sea turtles. Consequently, coastal resource managers are left with few details on how differently constructed and positioned armoring structures affect sea turtle nesting. This means that there are no appropriate definitions for coastal armoring from a nesting sea turtle perspective.

In response to the need for such a definition, a follow-up study was conducted during the 1999 nesting season comparing the effects of different types of armoring structures, placed on various parts of the beach. A central goal of the analysis was to define coastal armoring from the perspective of effects on sea turtle nesting. Our objectives were to map and characterize the dune (vegetation, armoring structures, topography) on a two-mile stretch of nesting beach in order to analyze the nesting attempts by loggerhead turtles. These data were used to test the hypotheses that predict nest-site choice and nesting behavior dependence upon dune character (e.g., the presence of armoring).

METHODOLOGY

Study Area:

The study area was a two-mile stretch of beach at Jupiter Island on the southern Atlantic coast of Florida. Bordered by St. Lucie Inlet to the north and Jupiter Inlet to the south, the island has experienced chronic erosion problems that threaten the private property of it's coastal residents (Clark, 1989). In response to erosion threats, approximately 80% of the shoreline on Jupiter Island is protected by varying types of coastal armoring (Aubrey, 1995).

Jupiter Island is also a critically important nesting beach for sea turtles. Density of loggerhead (*Caretta caretta*) nesting is particularly high, with the number of nests per mile ranging from 200 to greater than 1300 (Steinitz, 1994), which is one of the highest densities in the state (Conley and Hoffman, 1986, Meylan et al., 1995). Additionally, Jupiter Island is part of Florida's Index Nesting Beach Survey program and is represented by ten years of detailed nesting data.

Mapping Dune Character:

We mapped and characterized all structures on the beach and primary dune that had the potential to significantly affect the nesting behavior of sea turtles including; 1) all man-made structures greater than one meter in continuous breadth that might be a physical barrier to nesting turtles attempting to access the sandy dune or 2) structures that are greater than one meter in continuous breadth and that visually subtend a vertical angle of 30° or greater from the perspective of an observer looking landward at the base of the dune (or structure). All position data was collected by DGPS. We mapped armoring structures by recording beginning and end (e.g., north and south) points at individual structures and by assigning them to discreet categories. We used seven categories which included: vertical seawall; vertical seawall with dune in front; vertical seawall with rocks in front; revetment wall; revetment wall with dune in front; natural dune, and natural dune with rocks in front.

Mapping and Characterizing Sea Turtle Nesting Attempts:

Evidence of sea turtle nesting attempts was judged by the track and nest sign left in the sand the morning following nightly sea turtle nesting attempts. Each location where a nesting attempt had been made was identified to species (principally loggerhead and green turtle, *Chelonia mydas*) and categorized as 1) track only; 2) track and abandoned primary body pit with no nest; and 3) a nest. A DGPS position was taken at each nesting attempt at the point where the turtle turned toward the surf to return to the sea (which for a successful nesting attempt is nearly always the position of the nest itself). To reinforce the linkage of nesting data to mapped dune-character data, we recorded the character of dune (or armoring) immediately landward of each of the nesting-attempt positions.

RESULTS:

A total of 989 loggerhead emergences were recorded along the two mile stretch of study area. There were 444 nests and 545 non-nesting emergences (false crawls). Turtle emergences were not evenly distributed between the different stretches of beach. There were more emergences reported on those stretches of beach that had dunes present than on the beaches that did not have dunes ($P = 0.02742$). There were also differences in the nesting success on the beaches with walls and no walls ($P = <0.0001$).

DISCUSSION:

Similar to the findings in the previous coastal armoring study (Mosier, 1998), overall, there were fewer successful nesting emergences in front of the various armoring structures than in the non-walled "natural" areas (the high nesting success of the sloped revetment wall was most likely an artifact of the low sample size in that area) (Figure 1). Unlike the previous study, this study offered the opportunity to explore differences between different types of coastal armoring structures in addition to comparisons between armored and non-armored beaches. There appeared to be an increase in the number of emergences in front of structures with dunes in their characterization ($P = 0.027$) (Figure 2). These results suggest that turtles may have used the dune profile as a visual cue in the emergence decision making process. However, despite the increase in emergences in front of structures with dunes, there were fewer nesting successes on those stretches of beach than on the non-armored beach, suggesting that there are still other confounding cues to the nest site selection process.

CONCLUSION:

These data, along with nesting behavior studies, nesting population biology and life history studies, coastal erosion studies, and coastal engineering studies indicate that the armoring of Florida's shoreline poses a significant threat to sea turtle populations. But the problems associated with coastal armoring are complex and span many disciplines of knowledge, all of which must be integrated in order to create changes. Meanwhile, turtle nesting habitat continues to be replaced by walls.

In the interest of time, turtles and economics, data must be strategically collected. In order to reach the final goal of protecting turtle nesting habitat from coastal armoring influences, current regulatory policies must be changed. These changes cannot take place without help from the public, whose support is dependent on their perceptions of the problem. The turtle biologist must now either wear additional hats as sociologist, psychologist, economic and political analyst or integrate research efforts with the experts in these disciplines. Above all, we must keep the final goal in the forefront when developing our research plans.

LITERATURE CITED

Aubrey Consulting, Inc., 1995. Analysis of Coastal Processes and Evaluation of Shore Protection Alternatives, Jupiter Island, Florida. Unpublished Report Submitted to Town of Jupiter Island.

Clark, R.R., 1992. Beach conditions in Florida: A statewide inventory and identification of beach erosion problem areas in Florida. *Beaches and Shores Technical Memorandum 89-1, 4th Edition*, Florida Department of Environmental Protection, Division of Beaches and Shores, Tallahassee, Florida. 208 p.

Conley and Hoffman, 1986. Florida Sea Turtle Nesting Activity: 1979-1985. Report to the Permit Holders. Unpublished Report of Florida Department of Natural Resources, 52pp.

Florida Marine Research Institute (Florida D.E.P.), 1994. 1989-1993 Florida Index Nesting Beach Survey Data. Unpublished report.

Meylan, A., B. Schroeder, and A. Mosier, 1995. Sea Turtle Nesting Activity in the State of Florida, 1979-1992. Florida Department of Environmental Protection, St. Petersburg, Florida.

Mosier, A.E., 1998. The Impact of Coastal Armoring Structures on Sea Turtle Nesting Behavior at Three Beaches on the East Coast of Florida. Unpubl. Masters thesis, University of South Florida, St. Petersburg, Florida, 112 p.

Murphy, T.M., 1985. Telemetric Monitoring of Nesting Loggerhead Sea Turtles Subject To Disturbance on the Beach. Paper presented to the 5th Annual Workshop on Sea Turtle Biology and Conservation, 13-16 March 1985. Waverly, GA.

Schmahl, G. P. and Conklin, E.J., 1991. Beach Erosion in Florida: A challenge for planning and management. *In*: MAGOON, O.T.; CONVERSE, H.; TIPPLE, V.;TOBIN, L.T., and CLARK, D., (eds.), *Coastal Zone '91 Volume I*: ASCE, pp.261-271.

Steinitz, J., 1995. The Reproductive Success of Sea Turtles Nesting on Jupiter Island, in 1994. Unpublished report submitted to the Town of Jupiter Island, Florida. 10pp.

Turtle Expert Working Group. 1998. An assessment of the Kemp's ridley (*Lepidochelys kempii*) and loggerhead (*Caretta caretta*) sea turtle populations in the Western North Atlantic. NOAA Tech. Memo. NMFS-SEFSC-409. 96 pp.