Journal of Coastal Research	14	4	1343–1347	Royal Palm Beach, Florida	Fall 1998

Effects of Exposed Pilings on Sea Turtle Nesting Activity at Melbourne Beach, Florida

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ABSTRACT

BOUCHARD, S.; MORAN, K.; TIWARI, M.; WOOD, D.; BOLTEN, A.; ELIAZAR, P., and BJORNDAL, K., 1998. Effects of Exposed Pilings on Sea Turtle Nesting Activity at Melbourne Beach, Florida. *Journal of Coastal Research,* 14(4), 1343–1347. Royal Palm Beach (Florida), ISSN 0749-0208.

Beach stabilization and nourishment are critical needs in Florida and along much of the U.S. coast. Because offshore sand resources are diminishing, there is much interest in the installation of beach structures for stabilization and nourishment projects. The STABLER™ Disc System (Shoreline Reclamation Inc., Manasquan, NJ) is an example of one such structure in which a series of cement discs is anchored into the beach by pilings. When functioning properly, the discs are buried by the accretion of sand, and only the pilings are exposed. Before any structure can be installed into Florida beaches, however, its impact on sea turtle nesting should be assessed. This study investigated the effects of exposed pilings on sea turtle nesting activity. Artificial pilings constructed from PVC pipe were installed on Melbourne Beach, Florida, and nesting activity was monitored in areas with and without pilings. Nesting activity decreased significantly in the presence of pilings. However, the installation of structures remains an option on sea turtle nesting beaches because some nesting continued to occur. Further research is needed on the effect of exposed pilings on hatchling orientation.

ADDITIONAL INDEX WORDS: Caretta caretta, Chelonia mydas, *beach nourishment, beach stabilization, erosion, green turtle, loggerhead sea turtle, nesting disturbance.*

INTRODUCTION

Beach erosion is a growing problem threatening coastlines throughout the United States. One study conducted in 1989 designated 536 km of 1283 km of Florida coastline as beach erosion problem areas (CLARK, 1989). Because of continued recreational and development interests along Florida coasts, the proportion of shoreline designated as problem areas will continue to grow. Eroded conditions are made worse because less sand is available offshore to naturally build up beaches (CLARK, 1989). The increasing eroded conditions will have both economic and recreational impacts on coastal areas.

In addition to threatening recreational and economic interests, beach erosion has significant ecological impacts. Among the most seriously impacted organisms are sea turtles that utilize the beach environment for nesting. The beaches of the eastern coast of Florida are some of the most important sea turtle nesting beaches in the world. In addition to leatherback, *Dermochelys coriacea,* and green turtles, *Chelonia mydas,* these beaches support one of the largest loggerhead, *Caretta caretta,* nesting populations in the world (NATIONAL RESEARCH COUNCIL, 1990). All of these species are classified as either threatened or endangered, and preservation and stabilization of their nesting habitat is critical to their future survival.

The peak nesting season for loggerhead sea turtles in Florida occurs during the summer months, June through August (WITHERINGTON, 1986). During this time, females crawl onto the beach, select a nest site, and excavate an egg chamber approximately 50 cm in depth (HENDRICKSON, 1995; DODD, 1988). The female then deposits her clutch of about 115 eggs into this chamber where they incubate for approximately 50–55 days (WITHERINGTON, 1986; HIRTH, 1980).

According to MONTAGUE (1993), beach instability and erosion can diminish sea turtle nesting success in several ways: (1) steep escarpments in the beach can hinder females from emerging onto the beach to nest; (2) removal of sand from the beach and creation of a rocky substrate or a shallow layer of sand can prevent nest excavation to a suitable depth; and (3) the washing out of nests that are incubating in the beach can expose eggs to predation and desiccation. Additionally, beach erosion is a problem because sea turtles are known to have strong nesting site fidelity, continually returning to their natal beaches to nest (BOWEN, 1995; CARR and CARR, 1972). Thus, beaches that have established nesting colonies must be preserved and maintained.

97084 received 11 July 1997; accepted in revision 5 October 1997.

Figure 1. The STABLER® disc system before it is buried (upper illustration shows three discs between pilings instead of the standard four discs between pilings). The pilings remain above the surface of the beach after the discs are buried (lower illustration). We simulated these exposed pilings in our study.

Because beach erosion threatens both public and private property as well as tourism along the coast, much attention is currently focused on nourishment of beaches with severe erosion problems. The effects of beach nourishment on sea turtle nesting are not completely known, and continued work is needed to fully understand how to nourish and stabilize beaches in a manner more compatible with sea turtle populations (CRAIN *et al.,* 1995). One important aspect to investigate is the effect of structures installed on the beaches for nourishment and stabilization projects. In many locations throughout Florida, structures, such as sea walls, have been installed in attempts to "armor" the beach against erosion. Often these structures prove detrimental to the ability of sea turtles to nest successfully. Therefore, it is important to evaluate what types of structures may be installed in nesting beaches so that impact on sea turtle populations is limited.

We examined one such system in which structures are installed in the beach for stabilization. The STABLER™ Disc System (Shoreline Reclamation Inc., Manasquan, NJ) consists of a series of 318 kg concrete discs (1.22 m wide, 18 cm thick) linked together creating a chain (Figure 1). The discs are arranged edge to edge, forming 90° angles between adjacent discs and 45° angles between disc faces

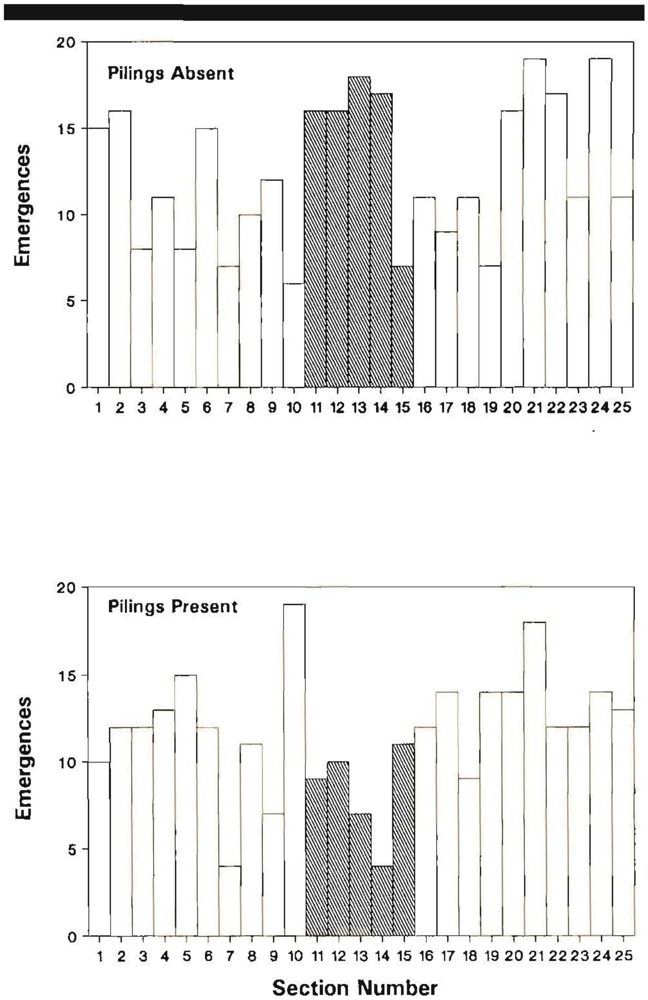

Figure 2. The total number of loggerhead and green turtle emergences in the 1250-m study area at Melbourne Beach, Florida, that occurred on 17 control nights when pilings were absent and on 16 experimental nights when pilings were present. Each section is 50 m and is located in either the northern control region (sections 1–10), the experimental region (11–15), or the southern control region (16–25). The shaded columns highlight the number of emergences in the experimental region. The number of emergences in the experimental region when pilings were present was significantly less than that of the same region when pilings were not present (Mann-Whitney U test, p = 0.011). The density of emergences was significantly less in the experimental region than in the control regions when pilings were present (Kruskal-Wallis test, p = 0.027).

and the beach. At every fourth disc, the system is attached to a piling that anchors the system during storms. The distance between pilings is 5.2 m (center to center). This chain of discs and pilings is placed parallel to the beach at the mean high water line so that it is struck during storms or periods of unusually high waves. The waves flow over the angled discs, the energy is dissipated, and sand suspended in the water is deposited around the discs. This repeated action builds the level of the beach and eventually covers the discs (Figure 1).

Studies have demonstrated the efficacy of the STABLER™ Disc System to prevent beach erosion (HERRINGTON, 1995). If the system operates correctly, the discs are buried except during periods of very high surf activity. Because sea turtles nest above the mean high water line, the buried discs should not pose a problem to nesting females. However, the pilings always remain approximately 1 m above the beach surface (Figure 1). The objective of this project was to evaluate the effects of exposed pilings on sea turtle nesting activity.

Table 1. *Number of loggerhead and green turtle emergences on control nights (n = 17) when artificial pilings were absent in the experimental region of the study area and on experimental nights (n = 16) when pilings were present. Statistical values, U and p, are from Mann-Whitney U tests comparing treatment means. SD is standard deviation.*

Region	Pilings Absent	Pilings Present	U	p
Northern Control			115.5	0.458
Mean ± SD	6.4 ± 2.9	7.2 ± 3.5		
Median	6.0	8.0		
Range	2–13	2–14		
Experimental			68.0	0.011
Mean ± SD	4.4 ± 2.8	2.6 ± 1.8		
Median	3.0	2.5		
Range	0–12	0–8		
Southern Control			124.0	0.664
Mean ± SD	7.7 ± 3.9	8.3 ± 3.8		
Median	8.0	8.5		
Range	1–17	2–17		

METHODS

Field work was conducted from 11 June through 1 August 1996. A study area along Melbourne Beach, Florida, that was visually uniform for 1250 m and typified the beach profile of the region was selected. The study area was divided into a northern control region of 500 m, a central experimental region of 250 m where the artificial pilings (AP) were deployed, and a southern control region of 500 m. The entire 1250-m stretch was divided into 50-m sections for data collection and analyses.

Table 2. *Density (emergences/km/night) of loggerhead and green turtle emergences on control nights (n = 17) when artificial pilings were absent in the experimental region and on experimental nights (n = 16) when pilings were present. Statistical values, H and p, are from Kruskal-Wallis tests comparing the three regions of the study area. SD is standard deviation.*

Pilings	Northern Control Region	Experimental Region	Southern Control Region	H	p
Absent				2.28	0.320
Mean	12.7	17.4	15.4		
SD	5.7	11.3	7.7		
Median	12.0	12.0	16.0		
Range	4–26	0–48	2–34		
Present				7.21	0.027
Mean	14.4	10.3	16.5		
SD	7.1	7.2	7.5		
Median	16.0	10.0	17.0		
Range	4–28	0–32	4–34		

The AP were constructed from 25-cm diameter green PVC pipe and stood 1 m high. The AP dimensions were designed to mimic the pilings used in the STABLER™ Disc System. On experimental nights, 49 AP were placed upright along the mean high water line at 5.2-m intervals (center to center). These were deployed at dusk and removed at dawn. On control nights, no pilings were deployed. These two treatments (pilings absent and pilings present) were deployed in a randomized sequence within 2-day blocks. The project was not conducted on Friday and Saturday nights to avoid conflicts during nights of high tourism activities on the beach. Data were not included for nights on which exceptionally high tides resulting from storms overwashed the beach.

Every morning following both experimental and control nights, the 1250-m study area was patrolled to record number of tracks made by sea turtles (loggerheads and green turtles) that had emerged the previous night and crossed the pilings line. Data were collected for each 50-m section. Statistical analyses, including the Mann-Whitney U and Kruskal-Wallis tests, were conducted using SPSS Software version 7.0.

RESULTS

A total of 601 emergences were recorded for 17 control nights and 16 experimental nights (Figure 2). The effect of pilings on sea turtle emergences was evaluated in two ways by comparing the number of emergences between treatments for each region and by comparing the number of emergences between experimental and control regions for each treatment. The mean number of emergences per night for the central experimental region with pilings was significantly less than the same region when pilings were not present (Mann-Whitney U test, $p = 0.011$, Table 1). There was no difference in activity in the northern 500 m control region (Mann-Whitney U test, $p = 0.458$) or the southern 500 m control region ($p = 0.664$).

The emergence activity for each region of the study area was standardized for a 1-km region so that the number of emergences could be compared among the three regions of the beach (Table 2). The numbers of emergences in the three regions of the beach on control nights were not significantly different (Kruskal-Wallis test, $p = 0.320$). The numbers of emergences on the three regions were significantly different on experimental nights (Kruskal-Wallis test, $p = 0.027$). When comparing the three regions of beach on experimental and control nights, there was significantly less nesting activity in the experimental region on nights when pilings were present, and no effect when pilings were not present.

DISCUSSION

The presence of pilings placed along the mean high water line reduced sea turtle nesting activity in that portion of the beach by 41%. This decreased nesting activity, however, should not preclude further consideration of these structures. First, nesting activity was not fully eliminated, as some females continued to nest when pilings were present. Second, the presence of pilings probably displaced nesting females to outside the experimental area and did not prevent the females from nesting successfully. Therefore, when suitable nesting beaches for sea turtles are threatened, the installation of stabilizing structures located near the mean high water line may be a viable option. If exposed structures such as pilings are deployed, factors known to disturb nesting females, such as the presence of people and lights on the beach (WITHERINGTON, 1992; NATIONAL MARINE FISHERIES SERVICE and U.S. FISH AND WILDLIFE SERVICE, 1991) should be minimized to encourage as much nesting as possible.

Before any structures associated with exposed pilings are installed on sea turtle beaches, additional information is needed on the effects of exposed pilings on hatchling orientation. Exposed pilings may have an effect because the presence of silhouettes is known to play a role in hatchling orientation (SALMON *et al.,* 1992). If further research does not indicate significant adverse effects, the installation of structures, such as those associated with the STABLER™ Disc System, may be a possible solution to beach erosion. Preventing beach erosion is essential to protect nests throughout the incubation period and to preserve the beach for future nesting.

ACKNOWLEDGEMENTS

We thank Gary Pieringer and Shoreline Reclamation Inc. (Manasquan, NJ) for providing the funding for this project. We also thank Llewellyn Ehrhart of the University of Central Florida and his students for their cooperation during this study, and the Florida Department of Environmental Protection for issuing us a permit to conduct the study. The manuscript benefitted from the constructive comments of Clay Montague. We are grateful to Ray Carthy for his advice and to all individuals who assisted with deployment of pilings throughout the summer. Laurie Walz drafted the illustrations.

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