Florida Field Naturalist

PUBLISHED BY THE FLORIDA ORNITHOLOGICAL SOCIETY

VOL. 30, NO. 3 SEPTEMBER 2002 PAGES 77-109

Florida Field Naturalist 30(3):77-82, 2002.

INFLUENCE OF VEHICLE TRACKS ON LOGGERHEAD HATCHLING SEAWARD MOVEMENT ALONG A NORTHWEST FLORIDA BEACH

MARGARET M. LAMONT, H. FRANKLIN PERCIVAL,
AND SHEILA V. COLWELL[1]
Florida Cooperative Fish and Wildlife Research Unit
University of Florida
P.O. Box 110485, Gainesville, Florida 32611

Abstract.—Upon emerging from the nest, loggerhead turtle (*Caretta caretta*) hatchlings face many threats, therefore expeditious seaward movement is critical. Obstacles along the beach may halt or impede hatchling movement, increasing time on the beach and energy expenditure. One obstacle that may impede hatchling seaward movement is vehicle tracks. Our objectives were to investigate the impacts vehicle tracks might have on loggerhead hatchlings. During the 1994 and 1995 hatching seasons (August-October) along Cape San Blas, Florida, an experimental arena was formed in which vehicle tracks of 10-15 cm (1994) and 5-10 cm (1995) depth were created. A control arena was also used and was left smooth. In 1994, all 20 hatchlings in an experimental group crawled into the vehicle depressions and were unable to crawl out within the arena. In 1995, half (20) of the hatchlings in the experimental group were unable to crawl out of the tracks within the arena. Hatchlings that traversed the tracks successfully in 1995 took an average one and one-half minute longer than those in the control group. These results suggest vehicle tracks are a significant obstacle and may increase energy expenditure and time on the beach. Tracks 10-15 cm deep are common on beaches with loose, coarse-grained sand, therefore efforts should be made to restrict beach driving where loggerhead turtles nest.

The most cosmopolitan of all sea turtle species is the loggerhead turtle (*Caretta caretta*). Because of its wide distribution, this species encounters many threats to survival, including incidental capture in trawling vessels, recreational development of nesting beaches, poaching, and destruction of foraging grounds (Pritchard 1997). Threats may

[1]*Current Address: National Park Service, Southeast Support Office, Atlanta Federal Center 1924 Blvd., 100 Alabama St. SW, Atlanta, GA 30303.*

impact individuals throughout their life cycle, however loggerhead hatchlings face significant and unique challenges.

In Florida, female loggerhead turtles come ashore to nest from May through August. Each female spends approximately 1.5 hours digging a flask-shaped cavity, depositing an average 110 eggs, and then retreating to the sea (Pritchard 1997). Although a female may return to the nesting beach throughout the season to lay multiple clutches, she provides no parental support. Her hatchlings must emerge from the nest, travel to the water, and move offshore with no protection or parental guidance.

Upon emerging from the nest, turtle hatchlings are exposed to many threats including predation by crabs, birds, and mammals; dehydration from sun exposure; human disturbance; and disorientation caused by human-made structures. Expeditious seaward movement is critical for survival. Obstacles along the beach may block a hatchling's path or slow its travel, thus increasing time on the beach and energy expenditure. Many natural obstacles are impossible to prevent, such as downed trees, crab holes, or plant roots, however reduction of man-made obstructions may help increase the success of hatchling seaward movement.

One set of obstacles that may delay hatchling seaward movement is vehicle tracks. Vehicle tracks vary greatly in dimension depending upon substrate and vehicle characteristics, although it is common to have tracks as deep as 10-15 cm (Hosier et al. 1981). Tracks of this depth may be a significant impediment to seaward-bound hatchlings by entrapping, inverting, or delaying their progress. Few studies have quantified the impacts of tracks on hatchling movement (Hosier et al. 1981).

Vehicular traffic is permitted on several sea turtle nesting beaches in Florida. In northwest Florida, the greatest density of loggerhead turtle nesting occurs along Eglin Air Force Base (AFB) property on Cape San Blas, where beach driving is allowed. From 1994 to 2000, an average 11.3 nests per kilometer were documented on Eglin AFB property (Lamont et al. 1997; Lamont pers. obs.). Public use of the beach continues to increase as development in adjacent coastal areas expands. As public use increases, so does the potential to affect sea turtle hatchlings. This project was designed to assess the impact that vehicle tracks may have on loggerhead hatchlings in this area.

Methods

We conducted experiments during the 1994 and 1995 loggerhead hatching seasons (August-October) on Eglin AFB property along Cape San Blas. A 15 × 15 m experimental arena and a 15 × 15 m control arena were set adjacent to the Gulf of Mexico on the east side of the cape spit. Control and experimental arenas were separated by a one-meter buffer zone, and each arena was raked smooth. In 1994, we created vehicle depressions of 10-15 cm depth in the experimental arena. During the 1995 season, vehicle tracks of 5-10 cm were created. To form depressions, a 4x4 Chevrolet S-10 pick-up truck was driven once through the experimental arena parallel to the water. If needed, we removed additional sand from the depressions to create the desired depth and then drove one pass through the tracks again. The control site during both years was left smooth.

In each arena, we centrally placed a release mechanism three meters from the landward edge of the arena. The mechanism consisted of a 3-m long aluminum pole with a clip at the top through which a 6-m long cord was threaded. The cord was attached to an inverted black plastic flowerpot, and then drawn back behind the arena. Individual hatchlings were placed under the pot. We then retreated outside the arena to pull the cord and release each hatchling.

Loggerhead hatchlings were removed from nests on Eglin AFB property just prior to their emergence. Hatchlings were placed in a black bucket and transported to the release site approximately one hour after sunset. Individual hatchlings were released simultaneously in the control and experimental sites. We monitored the progress of the hatchling in the arenas by crawling 5-6 m behind the hatchling and marking the path it had taken with small wooden dowels. If the hatchling did not exit the arena within 20 min, the trial was stopped. We recorded the following variables: total distance traveled, direction, time, and success at reaching the water. If the hatchling entered and exited a vehicle depression, we also recorded the depth of the depression at the exit spot.

We used McNemar's test (Fleiss 1981) to determine if the proportion of hatchlings successfully reaching the water differed between control and experimental groups. We also used a 2-dependent sample t-test to analyze 1995 data. For 1995 data, we tested if the distance traveled to the water and the time required to reach the water differed between control and treatment hatchlings.

RESULTS

Vehicle depressions 10-15 cm in depth. During the 1994 season, we released 40 hatchlings that had been removed from five nests (Table 1). Twenty hatchlings were used in the experimental arena and 20 in the

Table 1. The number of loggerhead sea turtle hatchlings that successfully negotiated vehicle tracks along Cape San Blas in northwest Florida. Turtles were successful if they reached the water while remaining inside the arena. If they were unsuccessful, they either exited the arena along a side boundary before reaching the water or became caught inside a depression and could not continue traveling. The large number of turtles that exited along the side of the arena in 1995 may have been influenced by lights from the increased number of residential houses east of the experimental site in 1995.

	Total no. of turtles	Depth of depression	No. successful	No. exited/side of arena	No. caught in depression
1994					
control	20	10-15 cm	14	0	6
experimental	20	10-15 cm	0	17	3
1995					
control	40	5-10 cm	17	23	0
experimental	40	5-10 cm	20	12	8

control arena. All hatchlings in the experimental group crawled into the vehicle depressions and were unable to crawl out within the arena and reach the water. Three fell onto their back as they crawled into the first depression, and the remaining hatchlings traveled along the first depression until they exited to the side of the arena. Of the 20 control hatchlings, 14 reached the water without leaving the arena. The remaining control hatchlings exited the side of the arena before encountering water. Success (reaching the water within the arena) was dependent upon the absence of vehicle tracks ($\chi^2 = 12.1$, 1 df, $P = 0.001$).

Vehicle depressions 5-10 cm in depth. During the 1995 season, we released 80 hatchlings that had been removed from four nests. Forty hatchlings were released in the control arena and 40 in the experimental arena. Half (20) of the hatchlings released into the experimental arena were unable to successfully reach the water. Of those 20 that were unsuccessful, eight crawled into the vehicle depressions and were unable to crawl out before they exited the arena. The remaining 12 negotiated the depressions, but then exited the arena before reaching the water. The hatchlings that were able to crawl out of the depressions did so at points that varied from 5-9.5 cm deep. In the control arena, 17 hatchlings reached the water without leaving the arena. Probabilities of reaching the water within the arena did not differ between the experimental and control groups ($\chi^2 = 0.27$, 1 df, $P > 0.1$).

We further tested 1995 data because of the confounding effect of residential lighting east of Air Force property during those releases. All hatchlings that did not successfully reach the water (except those that were trapped in vehicle tracks) exited the east side of the arena just before reaching the water. We believed that lighting was attracting them eastward out of the arena before they could reach the water, and we negated that effect by counting an eastward exit as successful. We then retested these data, and found a difference did exist between the experimental and control groups ($\chi^2 = 8.1$, 1 df, $P = 0.005$).

Of the paired releases in which the hatchlings in the control group and experimental group successfully reached the water (n = 11), hatchlings in the treatment group traveled farther than those in the control group ($t = 2.13$, 10 df, $P = 0.02$). The average distance traversed was 15.3 m for the treatment hatchlings and 11.9 m for the control hatchlings. The time for each hatchling to reach the water also differed ($t = 2.12$, 10 df, $P = 0.02$), with the treatment group averaging 84 s longer than the control group.

Discussion

Our research suggests vehicle depressions of 10-15 cm pose a serious barrier to loggerhead turtle hatchlings traveling to the sea. A single depression is sufficient to delay hatchlings, which may increase their risks to predation and desiccation. In addition, depressions as shallow as 5-10 cm may impact sea turtle hatchling seaward movement. If a hatchling is able to negotiate this obstacle, the turtle may become disoriented thus increasing the amount of time on the beach resulting in greater energy expenditure and potential for predation.

In addition to disorienting hatchling turtles, vehicle tracks may slow forward progress and increase distance traveled to reach the water. Turtles that successfully negotiated the depressions traveled nearly 4 m farther than those in the control arena. Moving this extra distance causes hatchlings to expend greater amounts of energy. Emergence from the nest cavity instigates a period of high activity during which hatchlings enter the sea and swim away from land (Lohmann et al. 1997). Hatchlings must traverse the beach, negotiate incoming waves, and establish and maintain an offshore course. If energy reserves are depleted while traversing the beach, the hatchling may not have the strength to survive incoming waves or to travel far enough offshore to establish a migratory course.

Depressions of 10-15 cm are common along Cape San Blas, particularly in areas where sand is loose. Cox et al. (1993) noted an increase in deep ruts (>15 cm) along Cape San Blas during the dry months of July and August, and on the eastern edge of the cape spit where windblown sand accumulates. In addition to deep tracks, many sets of vehicle tracks may be encountered. In summer 1993, the mean daily number of vehicles driven on Cape San Blas was 6.2 (Cox et al. 1993). This number increased to 9.1 during the weekends. Each vehicle leaves four individual tracks (one set driving onto the beach and one set driving off), therefore six vehicles per day would result in 24 tracks left on one day. Without rain or wash-over from high tides, vehicle tracks may accumulate on the beach. Thus, during one 5-day week, an average 120 tracks may accumulate on Cape San Blas beaches, and during one average weekend (Saturday and Sunday), 72 tracks may result. If only 10% of these tracks are greater than 10 cm in depth, approximately 20 deep tracks would exist per week in which loggerhead turtle hatchlings must cross for successful movement to the water.

Our research suggests that one set of 10-15-cm deep vehicle tracks increased the hatchling's travel time by 1.5 min. Negotiating one set of vehicle tracks may not significantly lower a hatchling's energy reserves. However, immediately negotiating a second set of tracks may be more difficult, therefore a greater amount of energy would be expended and the second set of tracks may take longer to traverse than the first. With energy reserves lowered by the first and second set of tracks, a third set would be even more difficult and require greater energy expenditure and time. Most likely this pattern of increased difficulty and time would continue so that when a hatchling reached a tenth set of deep vehicle tracks its energy reserves would already be low and it would take greater time and effort to travel through the tenth set of tracks than it did the first set. Upon reaching the water, the hatchling may have very little energy left for offshore migration. It appears the depth and number of vehicle tracks present on the beach may significantly influence hatchling seaward movement.

The results of this work illustrate the detrimental effect of vehicle tracks on hatchling survival, particularly in areas where the substrate consists of loose or course-grained sand. For this reason, an effort to reduce or restrict driving along beaches where loggerhead turtles nest is warranted.

Acknowledgments

We are grateful to Rick McWhite and Carl Petrick at Eglin Air Force Base and Don Lawley at BAE Systems Incorporated on Cape San Blas. We thank Eric Egensteiner, David Huetter, and Melinda Schaefbauer for assistance in data collection. This project was conducted under Florida Fish and Wildlife Conservation Commission permit #TP094. Funding for this research was provided by the Natural Resources Division of Eglin Air Force Base, U.S. Department of Defense, and the Florida Agricultural Experiment Station Journal Series R-08165.

Literature Cited

Cox, J., H. F. Percival, and L. G. Pearlstine. 1993. The Cape San Blas Ecological Study. United States Geological Survey, BRD/Florida Cooperative Fish and Wildlife Research Unit, Technical Report #36. 45 pp.

Fleiss, J. L. 1981. Statistical methods for rates and proportions. Second ed. John Wiley & Sons, New York.

Hosier, P. E., M. Kochhar, and V. Thayer. 1981. Off-road vehicle and pedestrian track effects on the sea-approach of hatchling loggerhead turtles. Environmental Conservation 8:158-161.

Lamont, M. M., S. V. Colwell, H. F. Percival, L. G. Pearlstine, W. K. Kitchens, and R. R. Carthy. 1997. The Cape San Blas Ecological Study. United States Geological Survey, BRD/Florida Cooperative Fish and Wildlife Research Unit, Technical Report #57. 210 pp.

Lohmann, K. J., B. E. Witherington, C. M. F. Lohmann, and M. Salmon. 1997. Orientation, navigation, and natal beach homing in sea turtles. Pages 107-136 *in* The Biology of Sea Turtles (P. L. Lutz and J. A. Musick, eds.). CCRC Press LLC, Boca Raton, FL.

Pritchard, P. C. H. 1997. Evolution, phylogeny, and current status. Pages 1-28 *in* The Biology of Sea Turtles (P. L. Lutz and J. A. Musick, eds.). CCRC Press LLC, Boca Raton, FL.