Effects of nest age and local nest density on predation rates for *Chrysemys picta* nests in northern Wisconsin

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Abstract

Fifty-one painted turtle *(Chrysemys picta)* nests were checked regularly for predation in order to evaluate the effects of both a nest's age and its spatial relationship to other nests in determining its risk of predation. These factors may explain aspects of turtle nesting behavior and offspring survivorship, which are not well understood. From 17 June to 7 July, 2002, we flaged nests distributed along a 10-mile route at the University of Notre Dame Environmental Research Center in northern Wisconsin. We checked the nests daily for 3 days following egg deposition, and rechecked them after 1 and 2 weeks. Forty-five percent of the nests were depredated, with 69.6% of those depredated within 24 hours of nest completion. All observed occurrences of nest depredation transpired within one week of nest construction. This data is consistent with the findings of most past studies. Also consistent with previous studies, we found no correlation between spatial distributions of nests and depredation rates.

Introduction

Understanding the factors that influence predation of turtle nests may provide improved insight into turtle nesting behavior, offspring survivorship, and protection of endangered turtle species. Several studies have shown that high percentages of turtle nests are depredated, some with depredation rates over 90%.. In a 1986 study of sea turtles (*Caretta caretta*), as many as 97% of the observed nests were depredated

(Ratnaswamy and Warren 1998). Despite such high frequencies of nest depredation, most studies concerned with nest survivorship have focused on how nest site characteristics, such as geographical features (Packard et al. 1993), soil temperature (Steyermark and Spotila 2000), or moisture (Packard et al. 1999), directly affect offspring survivorship. Few studies have examined the factors affecting nest predation rates (Burke et al. 1998, Spencer 2002). The objective of our study was to better understand factors influencing the predation risk of painted turtle (*Chrysemys picta*) nests. We chose painted turtles as the subjects of our study because little is known concerning their nesting behavior and offspring survival rates.

Based on our own observations and those of other studies, we expected that the risk of nest predation would decrease as the age of a nest increased (Foley 2000, Spencer 2002). However, both of these studies examined different turtle species. A study similar to our own using painted turtles found contrary results, suggesting that the majority of nests preyed upon were depredated after 72 hours following egg deposition (Snow 1982). To test our hypothesis we measured depredation rates over a two-week period.

Another factor that may affect depredation risk is the proximity of other turtle nests. Nests in areas of lower nest densities might be better protected from predation because the odds of their discovery by a predator would be lower. Alternatively, nests in locations with a high density of other nests may experience better protection from predation, because a predator discovering many nests in one location may be satiated before predating all of the nests. Previous studies of the effects of density on nest predation have yielded highly varied results (Burke et al. 1998). Most studies showed no correlation between nest density and predation rates (Burke et al. 1998), but a study of

the common snapping turtle, (*Chelydra serpentina*), showed that nests within 1 m of one another were predated significantly more often than others, (Robinson and Bider, 1988) and the same relationship was discovered for nests of the diamondback terrapin (*Malaclemys terrapin*) (Burger, 1977). No similar study has been performed using painted turtles. Therefore, we examined the predation rates on groups of nests versus those deposited apart from other nests.

Methods

Our study was conducted on the property of the University of Notre Dame Environmental Research Center, located in Vilas County, WI, and Gogebic County, MI. We observed 51 painted turtle nests for the frequency of predation from 17 June to 7 July, 2002. Each day from 16:00 to 22:00, we drove the same route of approximately 10 miles around the property in search of nests (Figure 1). When we found a turtle in the process of nesting (Figure 2), or a nesting site was determined to be laid that evening, (it was still damp and had not been seen earlier that evening), we placed a flag directly across the road from the nest, to avoid disturbing the nesting female, and recorded the date and time of discovery. We checked a marked nest for predation once a day for the first 3 days following its discovery, and if it survived this period, we checked it once a week for predation for the following 2 weeks. We recorded the date that we discovered a nest was depredated. If a nest had not been depredated after 2 weeks, we recorded it as surviving predation.

Figure 1: We drove a 10-mile route in search of painted turtle nests on the property of the University of Notre Dame Environmental Research Center in Vilas County, WI and Gogebic County MI.

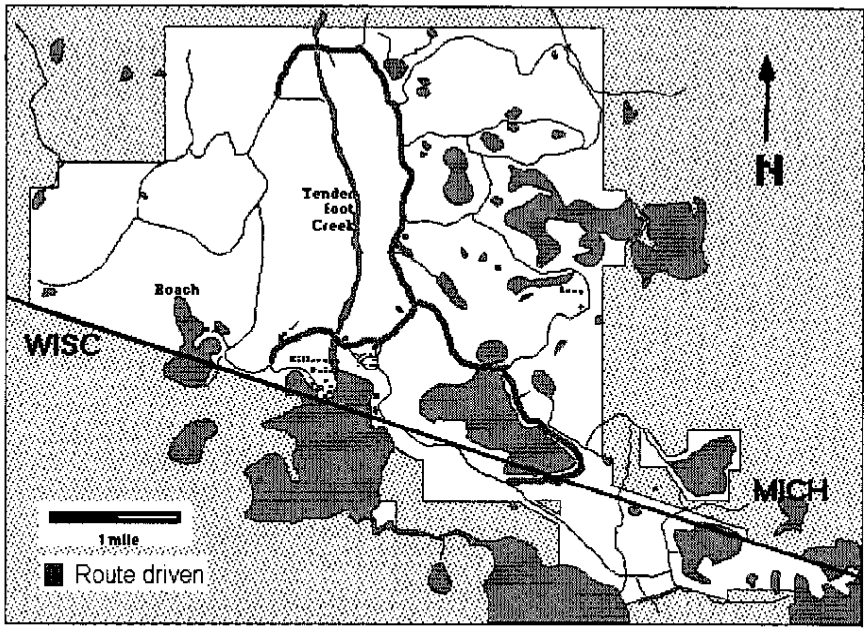
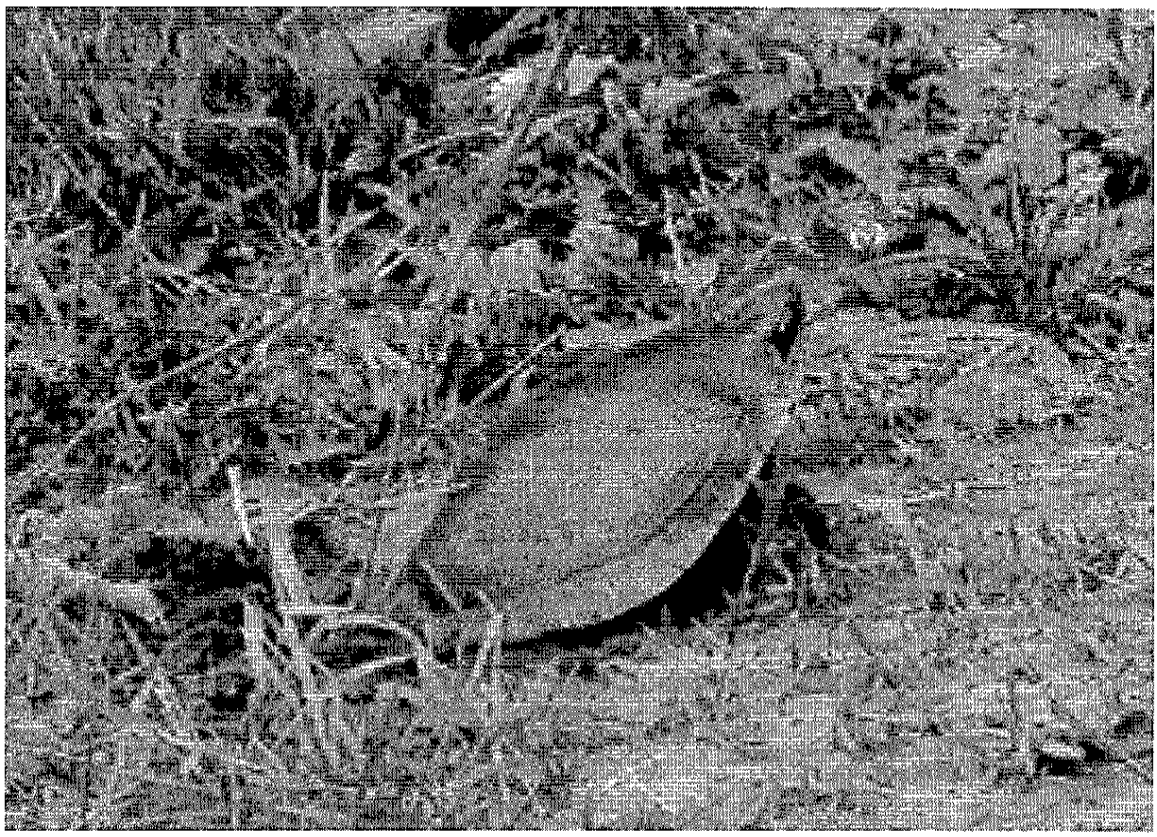


Figure 2: A painted turtle in the process of nesting..



We used descriptive statistics to describe the frequencies of nest depredation in relation to the age of the nest. We also compared our data set for the depredation rates of solitary nests to our data set for nests in groups of two or more. We used the non-parametric chi-square test to compare the frequency of nest depredation in nests located alone to the frequency of depredation of a group of nests.

Results

Of the 51 nests we observed, 45% were depredated (Table 1). Almost 70% of the depredations occurred within the first day.

Table 1: The total number of nests depredated grouped according to their age at the time of depredation following nest completion. The percentages of the total number of nests depredated at each age are given.

Age of nest	1 day	2 days	3 days	4-7days	2 week	not predated
Total	16	0	4	3	0	28
Total nests studied						51
Total nests destroyed						23
% of total nests Depredated						45.1%
% of Depredated nests destroyed on Day 1						69.6%
% of Depredated nests destroyed on Day 2						0
% of Depredated nests destroyed on Day 3						17.4%
% of Depredated nests destroyed on Days 4-7						13.0%
% of Depredated nests destroyed on Days 8-14						0

The 51 nests observed for depredation frequency during our study were placed into groups based on their proximity to each of the other nests observed in our study. Nests were considered to be in a group if they were found in approximately the same location, which was defined to be when they were within sight of each other, typically about 50m.

Nests were found to be in groups of 2, 3, 4, 6, and 13 nests (Table 2). Taking the averages of the predation frequencies for each of the different group sizes, the groups of 4 and 6 nests had the lowest rate of predation, whereas the groups of 1, 2, 3 and 16 nests all had a frequency of predation over 0.5. We used a chi-square test to analyze these numbers (Table 3). With a degree of freedom of one, the chi-square was found to be 0.2768, corresponding to a p-value > 0.05, $p \leq 1$.

Table 2: The mean frequency of nest depredation, and the standard deviation for these frequencies, among the total number of groups containing 1, 2, 3, 4, 5, 6, and 13 nests in a single location.

Number of Nests in Group	1	2	3	4	5	6	13
Total # of Groups	8	5	2	2	0	1	1
Mean Frequency of Nest Depredation	0.75	0.5	0.834	0.25	0	0	0.462
Standard Deviation of Nest Depredation Frequencies	0.463	0.5	0.235	0.356			

Table 3: Numbers used in the chi-square test. We compared the total number of depredated and undisturbed nests that were found alone to the total number of depredated and undisturbed groups of 2 or more nests.

	Single	Group of 2 or More
Depredated	6	7
Undisturbed	2	4

Discussion

The rate of nest survival is often studied in relation to the physical properties of the nesting habitat and the roles these properties play in nesting site selection by females of a variety of different turtle species. Often, these studies are conducted in an effort to learn more about the nesting behavior of a particular species of turtle in order to formulate the most effective methods for population protection for a species whose population appears to be threatened and declining. Although predation is almost always acknowledged as a factor decreasing rates of offspring survival, it is rarely studied for its direct relationship to the survival of an individual nest.

Of the 51 nests observed over a two-week period, 23 were depredated. The majority (70%) of these nests were destroyed within the first day following nest completion (Table 1). Similar rates of predation have been found to occur within the first 1-3 days of nest completion in studies conducted with other turtle species (Foley 2000, Spencer 2002). As in these studies, we found that the rate of nest predation drops off considerably after the first day following egg deposition. Snow (1982) proposes contrary results in his similar study of painted turtles in the upper Michigan peninsula. Examining predation rates in 81 nests, Snow (1982) found that of the 33 depredated, the majority (55%) were over 72 hours old. Whether this figure is significant, however, is unknown. One possibility for the discrepancy in results might be that the 81 nests were observed in an area of 1 ha, containing 14 small kettle lakes. This smaller area lacks ground space for nesting, which might cause newer nests to be laid on top of older ones. If a predator found the new nest, it would necessarily have dug up the underlying older nest as well, causing a greater number of older nests to be depredated than may normally occur.

The different rates of predation for each of the time periods we studied indicate predators are most likely to discover nests if they are less than a day old. We predicted that this would happen because as a nest ages, any evidence indicating its location fades, such as scent, soil disturbance, dampness, or a trail that was left by the female turtle. As part of his study, Spencer (2002) tested predator detection of nests and found that foxes discovered nests of the freshwater turtle (*Emydura macquarii*) by chemical detection of eggs and slight soil disturbance, characteristic of a fresh nest site. An area for further study would be to explore similar factors that are most likely to lead a predator, raccoons in particular, to discover the location of a nesting site and how this relates to the risk of predation of a nest depending on its age.

Unfortunately, 51 individual nests did not provide a large enough sample size for us to answer our question about the effects of group size on depredation rates of individual nests. Although it is impossible to predict whether these differences in predation frequencies are significant due to our small sample size, future studies building on this one would be able to determine if a nest in a group of 3 to 6 nests has an improved chance of escaping predation than does a nest alone, in a group of two, or in an extremely large group of nests. Nests located alone or in very small groups might have an increased chance of being depredated due to the fact that, if found by a predator, their chance of being destroyed is close to 100%. Nests located in extremely large groups might have a higher risk of depredation because of the greater chance that a predator will be attracted to a particular nesting location, and the increased chance that the predator will repeatedly return during the nesting season to feed on the continuous supply of nests.

The predation rate of an individually located nest was compared to that of a group of nests by summing up the numbers of depredated and undisturbed single nests and the numbers of depredated and undisturbed groups of two or more nests. The results of the chi-square test indicated that the rate of predation of individually located nests is not statistically different from the rate of predation of groups of two or more nests located in a single area. One study using several turtle species (*Kinosternon subrubrum, Pseudemys concinna, and Trachemys scripta*) has suggested a similar lack of correlation between predation rates and nest site densities (Burke et al. 1998). Perhaps a more definite relationship between predation frequency and nesting site density can be established for the painted turtle by expanding on our study with a larger sample of the different nest cluster sizes.

The high rate of predation by raccoons of nests deposited by a variety of different turtle species has previously been documented (Burke et al. 1998, Ratnaswamy and Warren 1998, Foley 2000). Few studies, however, have considered the relationship of the risk of nest predation to the age of a nest or to the nesting site density in which a nest is located. An increased understanding of nesting behavior, rate of nest survival, and chances of offspring survival might be gained through a better comprehension of these factors affecting predation frequency. We have shown that the risk of nest predation is drastically higher during the first three days following nest deposition, but that no correlation could be shown to exist between the risk of predation and nesting site density. These results coincide with those of parallel studies conducted on turtle species other than the painted turtle (Burke et al. 1998, Wilson 1999, Foley 2000, Spencer 2002), but contrasted with a similar study on painted turtles (Snow 1982).

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