

FALSE CRAWLS BY LOGGERHEAD SEA TURTLES IN
PALM BEACH COUNTY, FLORIDA

By
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This thesis was prepared under the direction of the candidate's thesis advisor, Dr. James Wetterer, and has been approved by the members of her supervisory committee. It was submitted to the faculty of The Wilkes Honors College and was accepted in partial fulfillment of the requirements for the degree of Bachelor of Arts in Liberal Arts and Sciences.

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ABSTRACT

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In Florida, loggerhead sea turtle (*Caretta caretta*) nesting populations are in decline, and human presence on beaches during nesting season can create an array of problems for the sea turtles. Volunteers and workers from the Loggerhead Marinelifelife Center collected nesting data from 2001 to 2005 along a 9.7 km stretch of Jupiter and Juno Beach, in Palm Beach County, Florida. Using these data, I found that human presence appears to have a negative impact on false crawl rates. The rate of false crawl was significantly higher on weekends than on weekdays ($\chi^2 = 6.3$, $p < 0.05$), and in areas with continuous public access than in areas with no public access ($\chi^2 = 69.0$, $p < 0.0001$). However, there was no significant difference in the number of nests laid on weekends versus weekdays ($\chi^2 = 0.6$, $p > 0.05$), although there are still other, less obvious negative effects caused by false crawling, and even nesting, while humans are in the vicinity. Even though it is impractical to try to keep people off the beach at night, it is important to increase awareness of the negative impacts that human presence may have on sea turtle nesting in order to help reverse the decline in the population of loggerhead sea turtles.

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Introduction

In Florida, loggerhead sea turtles (*Caretta caretta*) lay ~50,000 clutches eggs each year (Johnson et al. 1996). The beaches of Southeast Florida host the largest aggregation of *C. caretta* nesting females in the United States, second in the world only to the beaches of Oman (Meylan et al. 1995). Nonetheless, Florida nesting populations are in decline (FWS 2007).

Caretta caretta will only nest on beaches if the conditions are right. Otherwise, sea turtles may “false crawl,” i.e., emerge from the ocean onto the beach but return to the ocean without nesting. Human presence and activity on nesting beaches could possibly increase the number of false crawls. For my thesis, I used data collected by the Loggerhead Marinelife Center (LMC) between 2001 and 2005, to investigate the crawl patterns of *C. caretta* in Palm Beach County. The results of this analysis will may help point to some of the reasons for the decline in *C. caretta* populations, and actions that can be taken to improve the population size by making nesting attempts more successful.

Human presence on beaches creates a host of problems for *C. caretta*, including negative impacts on nesting, egg incubation, and hatchling emergence (Aureggi et al. 2004). Demetropolous and Hadjichristophorou (1995) found that the most significant human impact on *C. caretta* nesting behavior is human presence that disturbs nesting females, causing them to false crawl. Therefore, I examined the LMC data to find out if the rate of false crawls has any correlation to the day of the week. I hypothesize that on days that there is generally a greater human presence, i.e. weekends (Friday and Saturday), there will be higher rates of false crawls.

Additionally, although many studies have pointed out the issues with human presence and turtle crawls, Talbert et al. (1980) and Baldwin and Lofton (1940) found that some of the sea turtles that false crawled on nights with a lot of human activity returned on subsequent nights to nest. The disturbed turtles are forced to return to nest as soon as possible, because they are heavily egg bound. Because of this, I investigated to find out if there is a higher overall rate of crawls on the nights following high levels of human presence on the beach. I therefore hypothesize that on days that follow those with high rates of false crawls, there will be a higher number of *C. caretta* crawls.

Even though human presence may have a significant effect on false crawls, it was implied by Mann (1977) that females did not necessarily avoid nesting on beaches with lighting in preference of those beaches that were undeveloped and dark, although the hatchlings were very disoriented by beachfront lighting. However, Mann (1977) only studied nests, and did not take into account rates of false crawls. Therefore, I examined the LMC day of the week data to find out if there is a difference in number of nests on weekends versus weekdays in order to determine if the turtles perhaps return on the same night, or the next night, to nest. My third hypothesis is that there is no significant difference in the number of nests laid on weekends versus weekdays.

I also examined spatial data to find out if there was a difference in rates of false crawl between the various sections of the beach, which have varying levels of public access. My fourth hypothesis is that there is a significant difference in the rates of false crawls that is dependent on the available beach access.

Methods

Loggerhead Marinelife Center (LMC) volunteers gathered nesting information for *Caretta caretta* along Juno and Jupiter Beaches in Palm Beach County, Florida from 2001 – 2005. In the 9.7 km study area the beach is split into eleven segments with the north end of the study area (Zone 1) beginning near the Jupiter Reef Club and the south end (Zone 11) ending at the northern border of MacArthur Beach State Park (Wood 2004). From Zone 1 through Zone 5 there is continuous public access, along with roadside parking adjacent to the beach (Wood 2004). Zones 6, 7 and 8 have limited public access every 300 meters, and are bordered by private homes and condominiums (Wood 2004). Zone 9 is bordered by a golf course and has no public access, nor do Zone 10 and 11, which are bordered by private homes (Wood 2004).

I used chi-squared frequency statistical analysis to determine if there were significant differences in false crawls on weekends (Friday and Saturday) versus weekdays (Sunday, Monday, Tuesday, Wednesday, and Thursday), total attempted crawls by day of the week, and false crawls and total crawls by zone. I then compared this information to the amount of public beach access in each zone. Weekends were determined to be Friday and Saturday because it is the nighttime activity that is important; on Friday nights people tend to go out because generally people do not have to go to work on Saturday mornings, whereas Sunday night can be treated more like a weekday, because the work-week starts the following morning.

Results

In the 2001-2005 nesting seasons, there were 37,590 *Caretta caretta* emergences resulting in 17,588 (46.8%) nests and 20,002 (53.2%) false crawls. The overall false crawl rate varied among the years, from a low of 47.0% in 2002 to a high of 59.5% in 2004 (Fig. 1). The overall increase in rate of false crawls through the entire study period was ~2% per year. In addition, the number of nests decreased from 4,760 in 2001 to 2,360 in 2005, for a total decrease of ~50.4%.

I found that overall, from 2001 – 2005, when the day of the week data was combined into weekend (Friday and Saturday) and weekdays (Sunday, Monday, Tuesday, Wednesday and Thursday), there was a significantly higher rate of false crawls on weekends than on weekdays ($\chi^2 = 6.3$, $p < 0.05$) (Fig. 2). This pattern was reflected in each year's individual data for 2001, 2004 and 2005, but for 2002 and 2003 weekends versus weekdays had no effect on false crawl rates (Fig. 3). Even though there was a significant difference in the rate of false crawls between weekends and weekdays, the number of nests laid on weekends and weekdays is not significantly different ($\chi^2 = 0.6$, $p > 0.05$) (Fig. 4).

Regardless of whether or not the individual false crawled or nested, it is evident that the day of the week has a significant impact on the number of emergences onto the beach ($\chi^2 = 49.7$, $p < 0.0001$). On Fridays, there were 347 (6.5%) more emergences than expected, and Sundays and Mondays had a great deal fewer than expected (219 (4.1%) and 275 (5.1%), respectively) (Table 1).

The different zones also showed significant differences in false crawl rates (Fig. 5). Zone 9, which borders a golf course and has very little human access, had a

significantly lower rate of false crawls when compared to the rest of the zones ($\chi^2 = 44.6$, $p < 0.0001$). On the other hand, Zones 1, 3 and 5, which all have high degrees of public access, had higher rates of false crawls than expected (Table 2). When the data were combined into three categories, reflecting the level of public access, the results followed the same trend ($\chi^2 = 69.0$, $p < 0.0001$): there were significantly more false crawls than expected in the high public access zones (1-5), and significantly fewer false crawls in the no public access zones (9-11). Zones 6-8, which have public access only every 300 meters had very little deviation from the expected (Table 2).

Discussion

The level of human presence on the beach appears to have an impact on the rate of false crawls of *Caretta caretta*. The rate of false crawls is significantly higher on weekend (Friday and Saturday) nights than weekdays (Sunday, Monday, Tuesday, Wednesday and Thursday), when more people are expected to be on the beach. The chi-squared value is not extremely high; however, it indicates that there is a significant negative impact on nesting loggerhead sea turtles. There was a higher rate of false crawls on Thursdays than any other day, although the reason for this is currently not discernable. The significantly higher rate of false crawls on weekends than on weekdays, along with the fact that overall, from 2001-2005 there were not significantly different numbers of nests on weekends versus weekdays suggests that some of the loggerheads that false crawl might return to nest on the same night. This is supported by the 347 (6.5%) more than expected emergences on Friday nights, combined with the high rate of false crawl but similar number of nests as weekdays. Although Talbert et al. (1980) and Baldwin and Lofton (1940) found that some of the turtles returned the next night, the fact that they have to lay their eggs as soon as possible would force the turtles to try again as soon as they can. In the case of Talbert et al. (1980) and Baldwin and Lofton (1940), the soonest chance that the turtles had to crawl again could have been the next night.

Unfortunately, even if the number of nests is not significantly different between weekends and weekdays, there are still negative effects to nesting behavior due to the human presence. Johnson et al. (1996) found that when guided groups went to observe females nesting under specific guidelines to reduce the impact on the nesting turtles, the female generally proceeded to lay eggs, but spent significantly less time camouflaging

the nest, which could leave the nest more prone to predation. Additionally, the turtles crawl onto the beach when they are ready to lay the eggs, and if they are forced to return to the water due to some kind of disturbance, there could be unseen negative side effects on the eggs and/or hatchlings. This kind of negative effect is seen in some colonial breeding bird species – human disturbance can lead to premature fledgling, reduce body mass of hatchlings and altered foraging patterns that are not immediately seen when a human causes a bird to flush (Rodgers and Smith, 1995; Rodgers and Smith 1997).

Through the five-year study period, the overall rate of false crawls increased from 47.2% to 57.4%, for an overall increase of 10.2%. Although the rate of false crawls increased, the actual number of false crawls fluctuated between above and below average for the time period. During the five years there was 51.4% decrease in *C. caretta* nests (4,760 in 2001 to 2,362 in 2005), which parallels the overall trend from around the state (FWRI 2007). Data provided by the Florida Fish and Wildlife Conservation Commission (FFWCC) Index Nesting Beach Survey provides yearly summaries for the Jupiter and Juno Beach survey area from 1993 to 2005 (FWRI 2007). These data emphasize the extreme, state-wide, downward trend in loggerhead nesting occurrences in the area: from 1995 to 2006 there was a 57% decline in successful nesting attempts.

There are many factors that can contribute to the increasing rate of false crawls and the decreased numbers of nests, including increasing human populations. False crawls increased from 2001 –2005, and between 2000 and 2006, which are the only estimates available, the human population of Jupiter increased by an estimated 27% (PBC 2007).

Another factor that is sometimes thought to cause an increase in false crawls is hurricanes, although the FFWCC suggests otherwise: nesting turtles should not be effected by hurricanes, since the nesting season and hurricane season do not overlap (FWRI 2008). Additionally, the hatchling populations that would be effected by the recent hurricanes will not reach maturity and be ready to nest for another 20-30 years; thus, the current nesting population should not be affected (FWRI 2008).

In addition, the hypothesis by Demetropolous and Hadjichristophorou (1995) that the most significant human impact on *C. caretta* nesting behavior is human presence that disturbs nesting females, causing them to false crawl, is supported in the analysis of the zone data. Even though day of the week has a significant effect on false crawl rates, it is not as great as the significant differences in rate of false crawl by zone.

In the zones that have continuous public access there is also an increased rate of false crawls, and where there is no public access there is a decreased rate in false crawls. Following this trend, in the zones that have a moderate level of public access, there is very little difference between the rate of false crawls that was observed and expected. The very high chi-square value ($\chi^2=69.0$, $p < 0.001$) is an indication that public access to the beaches, perhaps even regardless of the day of the week, has an enormous impact on sea turtle false crawls. The only real exception to the pattern was Zone 11, which had a high rate of false crawls, even though it is in an area with a low level of public access. A possible explanation for this is its proximity to MacArthur Beach State Park – the park has a large raccoon population, and it has been found that during nesting season, raccoons generally spend a lot of time on the beach predated the turtle eggs (Engman et al. 2004). Since Zone 11 is next to the park, it may be that some of the raccoons on the beach would

venture into Zone 11, and if a loggerhead encounters a raccoon while it is crawling onto the beach, there is a strong possibility that it will false crawl.

Although there are many variables that could account for the results found, it appears that human presence and increasing levels of public access play the greatest roles in increasing the rate of *C. caretta* false crawls. This does not mean that other factors, such as development, do not play a role in increasing false crawls: it is imperative to the survival of loggerhead sea turtles to maintain and enforce regulations to reduce the impact of development, such as beachfront lighting policies. It will be impossible to completely negate the effects of humans on increased rates of false crawls; however, it seems like a logical step to increase awareness of the negative impacts of the presence of people on the beaches at night, during sea turtle nesting season, in our increasingly fragmented Florida landscape.

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Table 1. Chi-squared analysis of *Caretta caretta* emergences by day of the week

	Observed	Expected	(Observed – expected)²/expected
Sunday	5151	5370	8.9
Monday	5095	5370	14.1
Tuesday	5403	5370	0.2
Wednesday	5515	5370	3.9
Thursday	5371	5370	0.0
Friday	5717	5370	22.4
Saturday	5338	5370	0.2
			49.7

Table 2. Chi-squared frequency analysis by level of public access

OBSERVED	Nests	False Crawls	Total
Open Access Zones 1-5	5327	6756	12083
Access Every 300 m Zones 6-8	4990	5726	10716
No Public Access Zones 9-11	7271	7520	14791
	17588	20002	37590
EXPECTED	Nests	False Crawls	Total
Open Access Zones 1-5	5653.5	6429.5	12083
Access Every 300 m Zones 6-8	5013.9	5702.1	10716
No Public Access Zones 9-11	6920.6	7870.4	14791
	17588	20002	37590
X²	Nests	False Crawls	Total
Open Access Zones 1-5	18.9	16.6	
Access Every 300 m Zones 6-8	0.1	0.1	
No Public Access Zones 9-11	17.7	15.6	
		Total X²	69.0

Figure 1. False crawl and nesting percentages for *Caretta caretta* 2001 – 2005

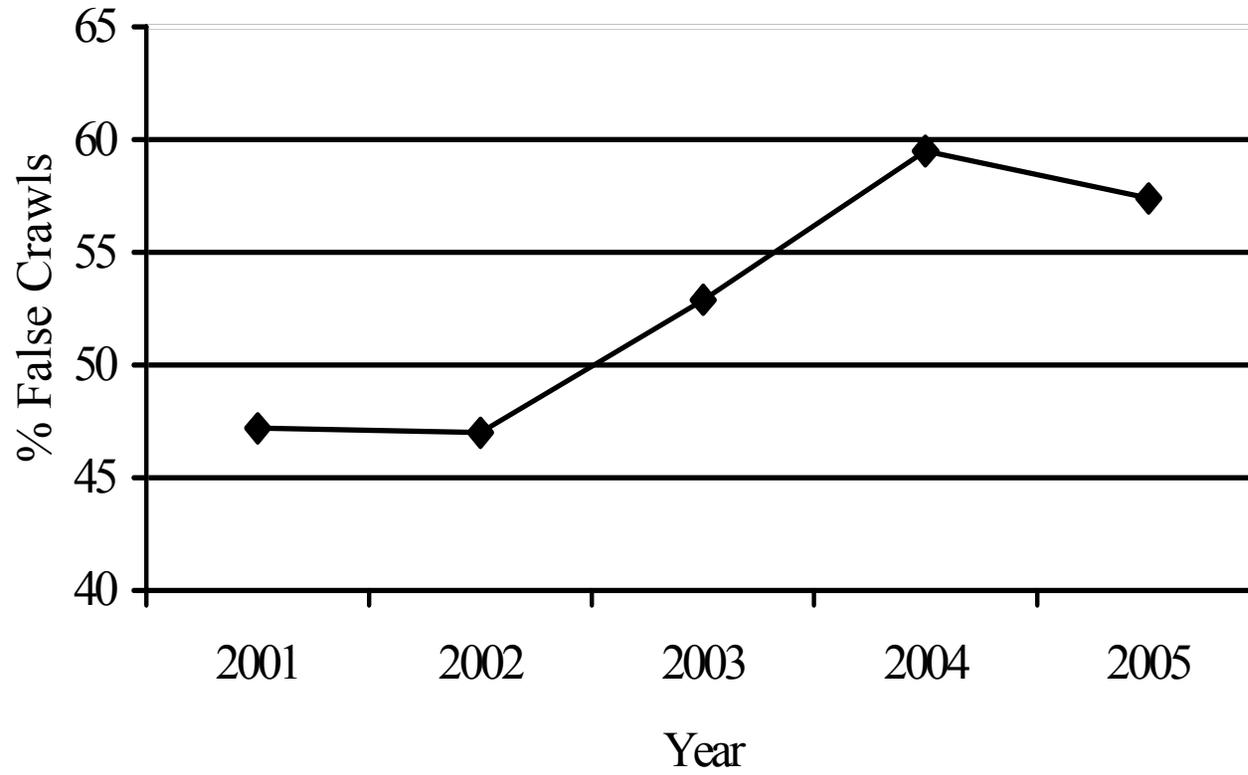


Figure 2. Percentages of *Caretta caretta* false crawls by day of the week 2001-2005

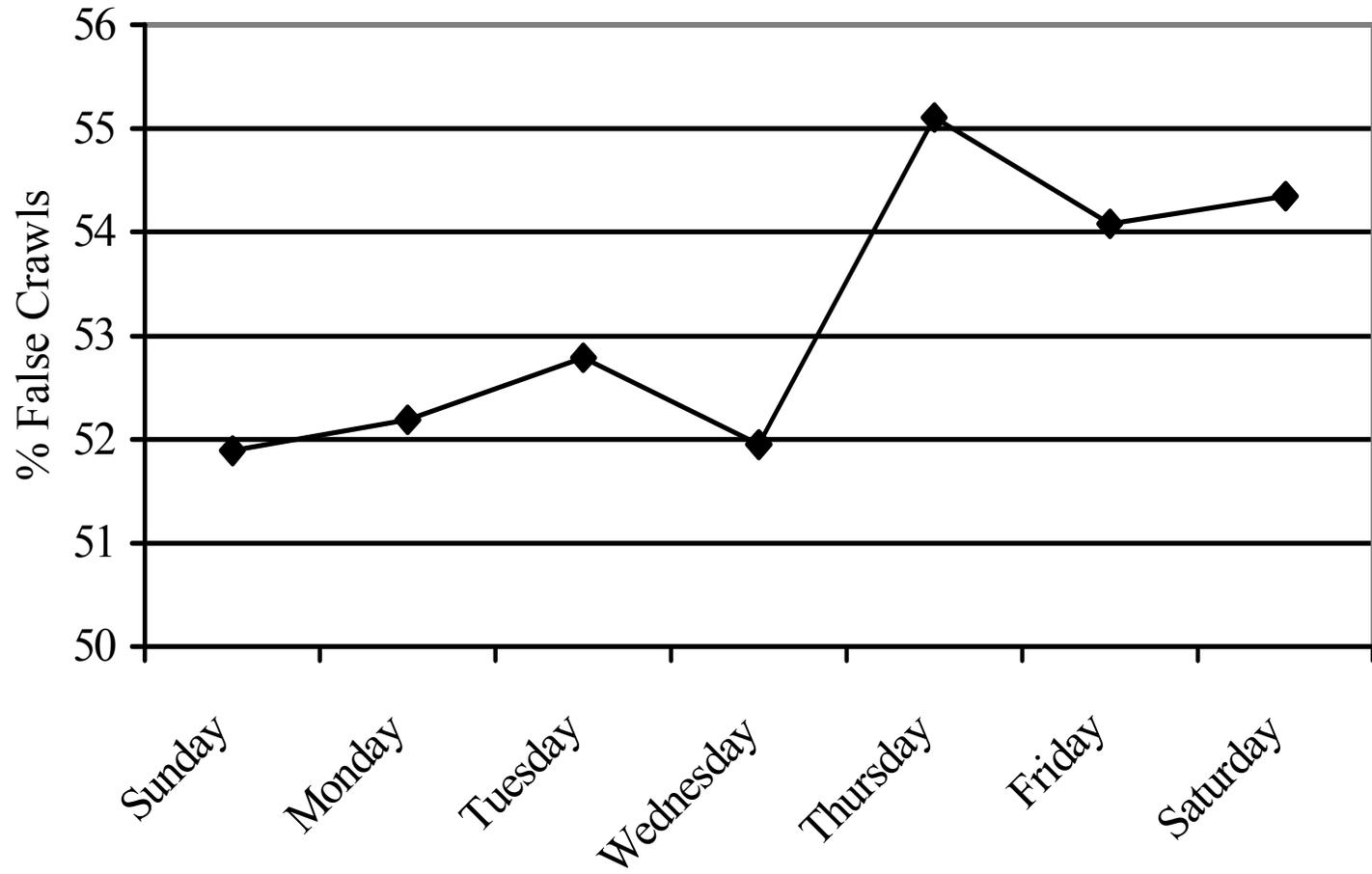


Figure 3. Rates of *Caretta caretta* false crawls on weekends versus weekdays 2001-2005

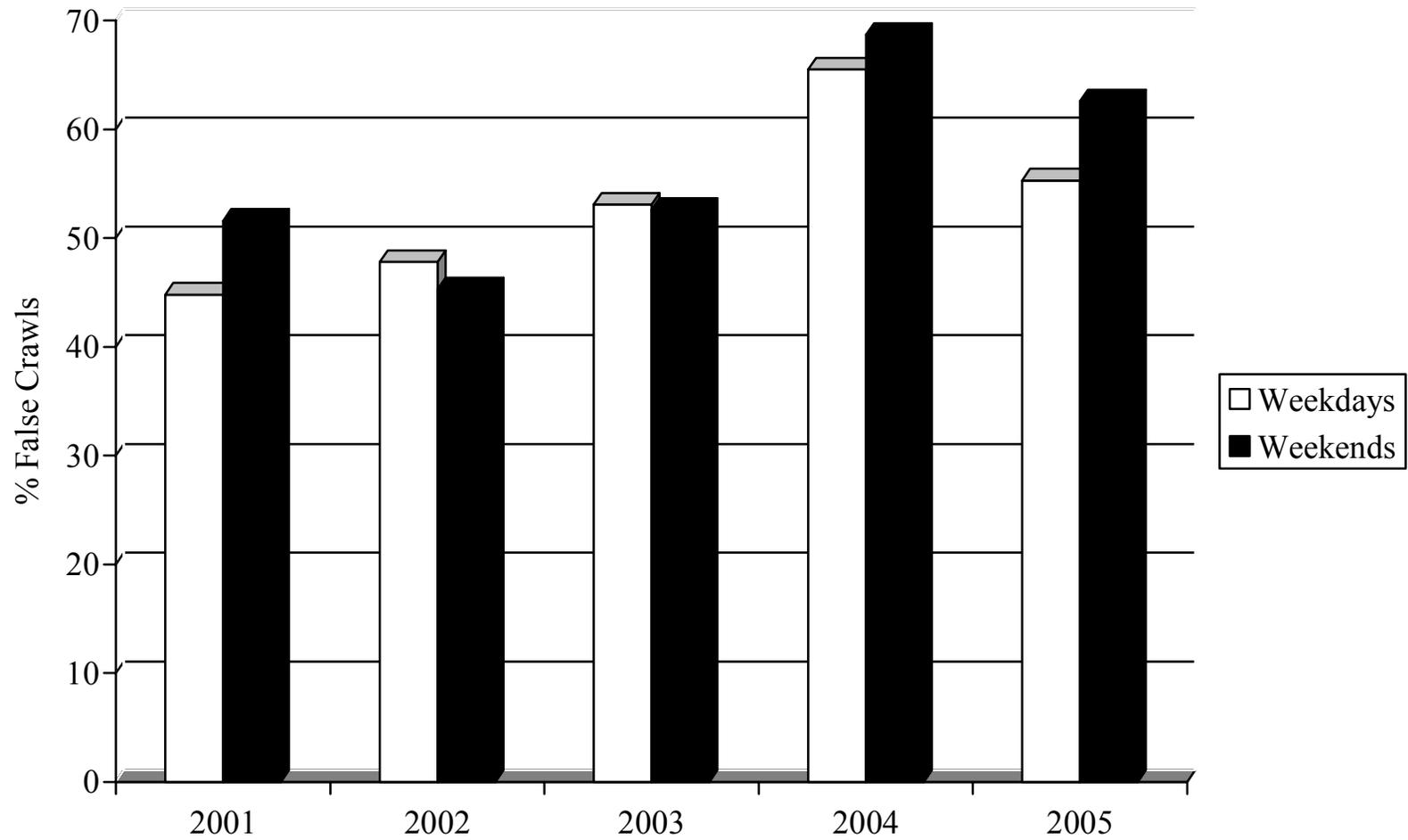


Figure 4. Nests laid by *Caretta caretta* by day of the week 2001-2005

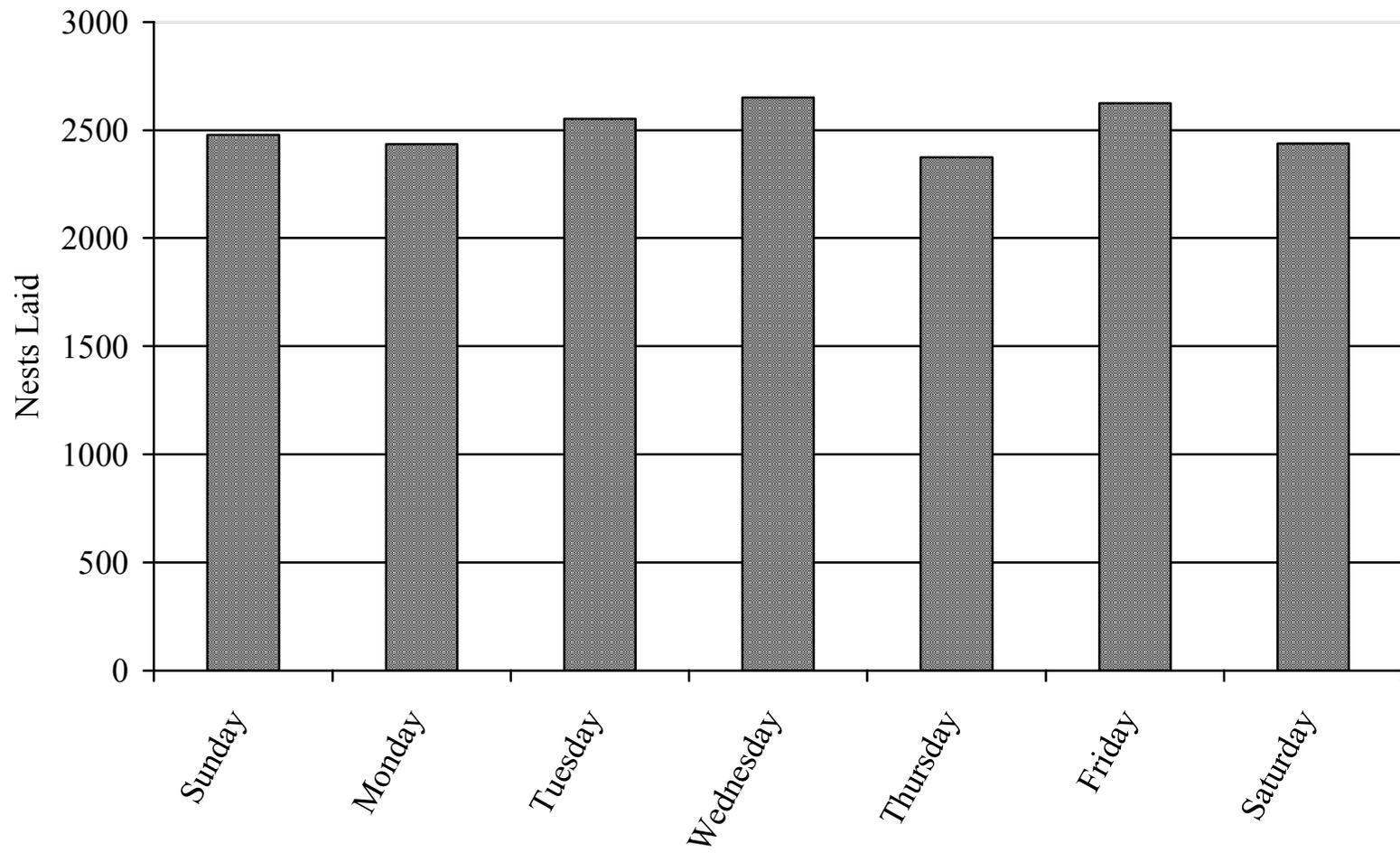


Figure 5. Rate of *Caretta caretta* false crawls by zone 2001-2005

