

Malaclemys terrapin terrapin population study along Cedar Run Dock Road in West Creek,
Barnegat Bay, New Jersey

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Project Terrapin
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Overview

The goal of this study is to determine the population of northern diamondback terrapins along Cedar Run Dock Road. This study was initially piloted in 2016, and between the years 2016 - 2018, has observed and marked 326 new terrapins.

Methods

Six non-baited hoop traps with a diameter of about 1m and length of 2 m were positioned at various points along Cedar Run Dock Road, spanning from the cove, which is directly in the bay, to the inner creeks approximately 1.5 miles from the bay. A float was placed in all traps to allow a minimum of 30cm of surface airspace to prevent the drowning of captured terrapins. Traps were checked daily and removed on the fifth day of every week for maintenance and to reduce the chance of vandalism.

Patrols were conducted along approximately 3 miles (~2 km) of the roadway to capture terrapins traversing between marsh systems or going to and from nesting habitat.

Once captured, terrapins were scanned for a notch code and/or PIT tag, then weighed and measured for carapace length, width, height, and plastron length using a digital scale and 40cm tree caliper ($\pm 1\text{mm}$), respectively. Any shell or body deformities and injuries were also recorded. New captures were marked with a unique notch code and injected with a 12mm (134kHz) passive integrated transponder (PIT) tag.

Data collection began on May 28, 2019 and ended on July 12, 2019. These dates were dependent on the start and length of the nesting season, which can vary slightly each year.

Results and Discussion

Capture Summary

During the 2019 field season, a total of 648 terrapins were captured, of which 166 were recaptures. Of recaptures, 74 of these were captured within the same season (38 were new this year and were caught again the same season). The percent recapture was 14.2%, excluding “trap happy” terrapins that were recaptured multiple times within the same season (Table 1). Out of those captures, 72% were captured on the road and 28% were caught in traps.

Table 1. 2019 Capture summary of new and recaptured terrapins by sex and capture type. Of the terrapins captured, 97% were female, 2% were male, and 1% were juveniles. 74% of the females

were caught on the road, returning from or going to nesting habitat. Almost all of the males and all of the juveniles were caught in a trap.

	Female	Male	Juvenile	Total
Total Capture	627	16	5	648
New	468	10	4	482
Recapture	159	6	1	166
Trap Capture	162	14	5	181
Road Capture	466	2	0	468

The seven-week field season of 2018 yielded 349 new terrapins and 78 recaptures and prior years yielded a total of 288 turtles (Figure 1). The seasons of 2018, 2017, and 2016 yielded a percent recapture of 23%, 6%, and 2% respectively. In former years, the percent recapture was calculated including terrapins recaptured multiple times within the same year. For comparison, the 2019 percent recapture including “trap happy” turtles was 26%. We mentioned this to provide a direct comparison to last year’s data. However, for population modeling, the number of terrapins captured among years is more important than including within year recaptures. However, knowing which terrapins with seasons return provides us valuable information about the use of nesting habitat.

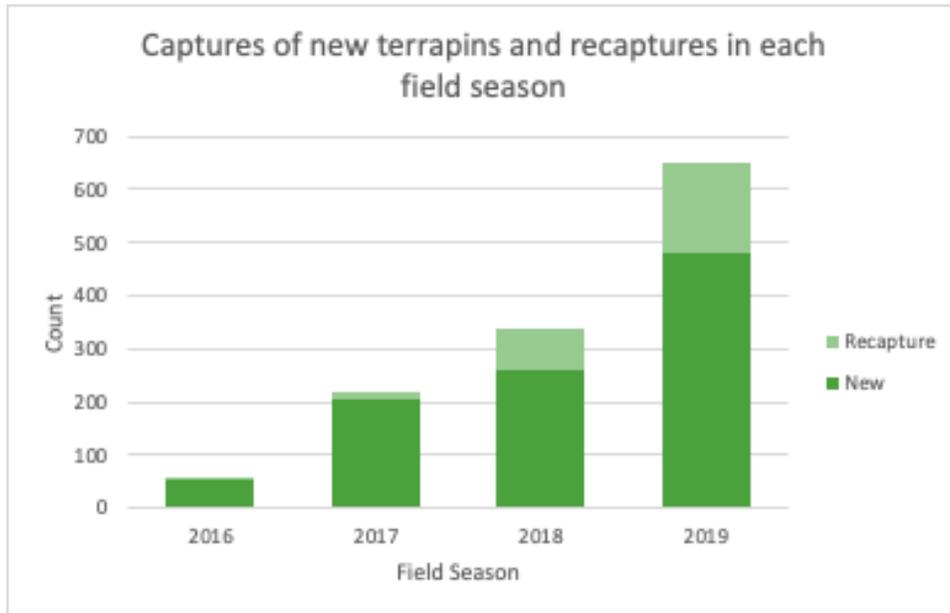


Figure 1. Number of terrapins caught per year since 2016. Includes “trap happy” turtles (those that are found multiple times within the same season).

The height capture of the season occurred between June 5 and June 12, 2019 followed by a smaller waves of captures (Figure 2). The average capture was 22 terrapins per day. In general, turtles were caught with highest density north of the third hoop trap (second, northern-most trap. This indicates that the terrapins are crossing at the creeks (Figure 3).

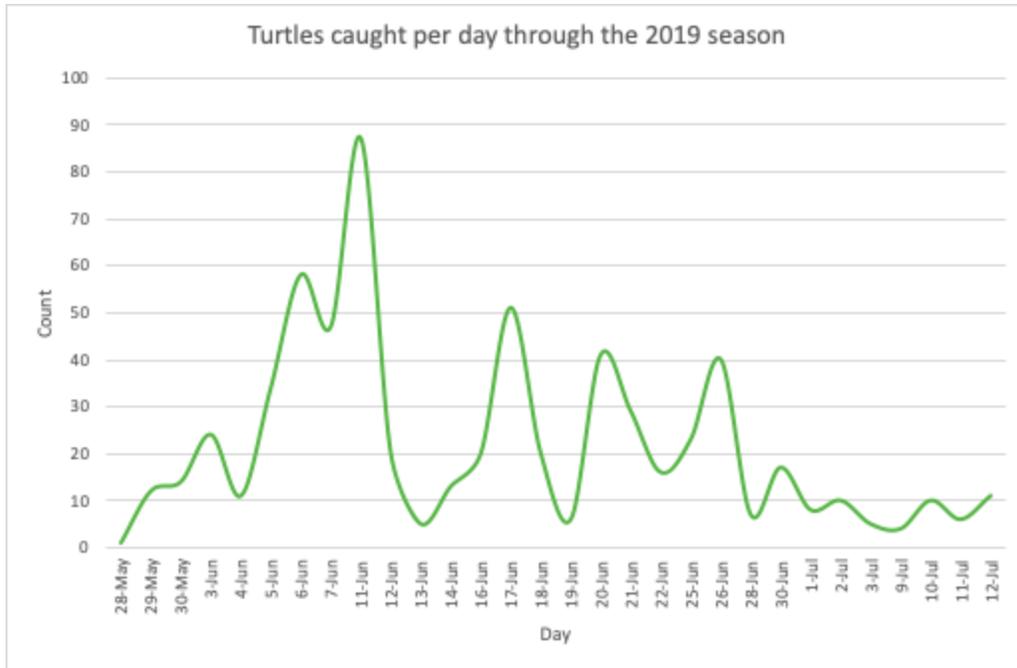


Figure 2. Number of turtles caught per day throughout the 2019 season.

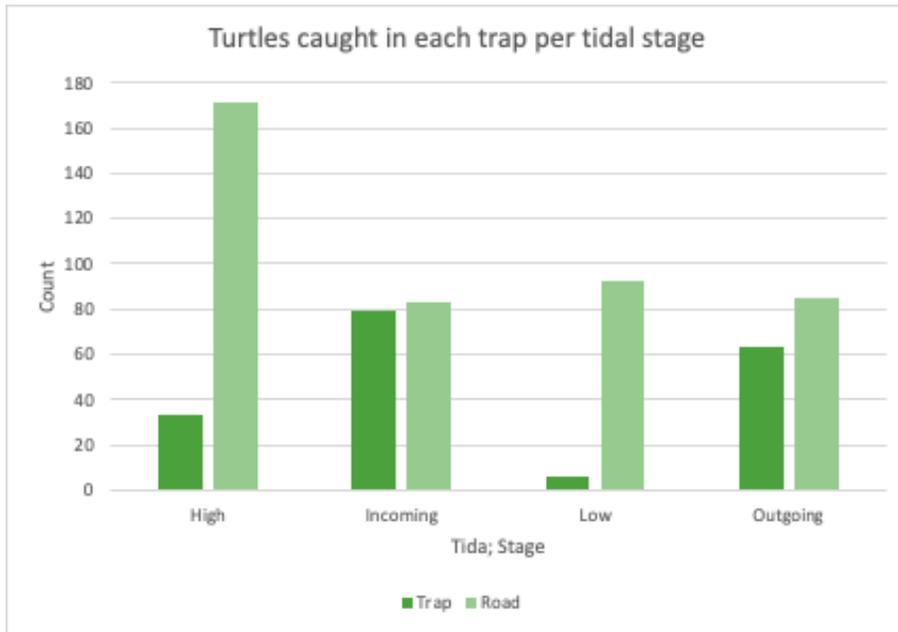
Captures and Tides

The tidal stage during capture was recorded for each turtle caught, in addition to whether or not it was a spring or a neap tide. Spring tides occurred on June 3, June 17, and July 2, 2019. Neap tides occurred on June 10, June 25, and July 9, 2019.

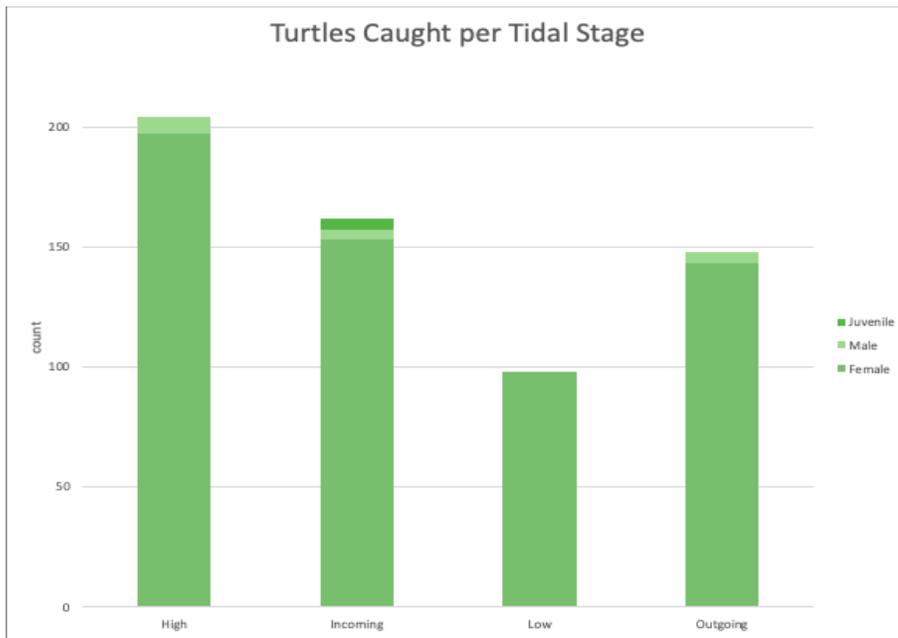
The greatest number of terrapin captures were during high tide, and most of these were females captured on the road before or after nesting (Figure 4a).



Figure 3. Map of captured terrapins across Cedar Run Dock Road in 2019. Yellow dots indicate road captures and green dots indicate the locations of hoop traps.



a.



b.

Figure 4. (a) Turtles caught in the trap and on the road during each tidal stage. (b) Total terrapins caught during each tide.

During neap tides, the highest number of captures occurred at low tide, whereas during spring tides, the highest number of captures occurred at high tide (Figure 5). During the neap tides, most terrapins were hand captures, and only 13 were caught in the traps. During the spring tide, 132 were hand captures and 48 were caught in the traps. This may be the result of the ability of terrapins to travel within the vast creek system at Cedar Run. During spring low tide events, some of the creek bottoms are exposed. However, there is a more uniform water level in the creek systems throughout a neap tide cycle.

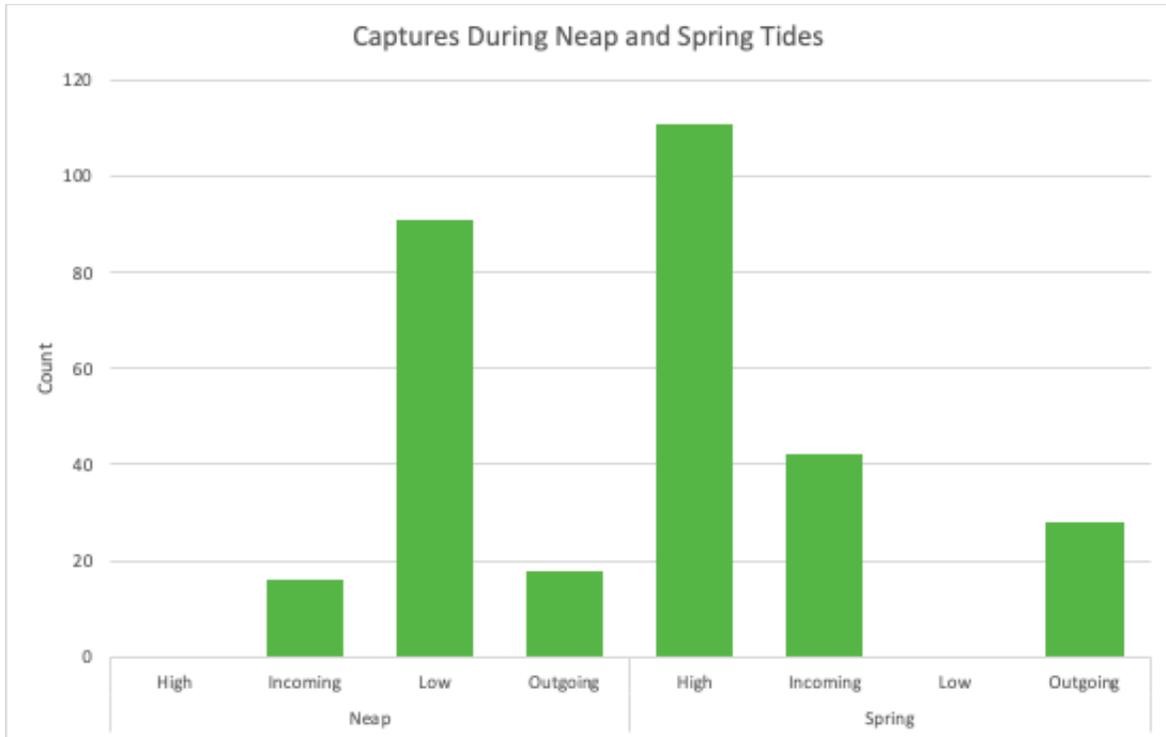


Figure 5. Terrapins captured during neap and spring tides at Cedar Run Dock Road during the 2019 study. .

Size and Age Summary

Age of terrapins was determined by counting the rings on the costal and/or plastral scute and then ranked on a scale of confidence (1 = confident, 2 = moderately confident, 3 = low confidence). Only turtles whose age ranked 1 and 2 are used in this analysis. On average, adult females captured were nine years old (from 357 individuals), males were six years old (from 14 individuals), and juveniles were six years old (from 5 individuals). The table below summarizes the size data of each sex (Table 2).

Table 2. Average size of females, juveniles, and males (mm average \pm stdev).

Parameter	Female (n=357)	Juvenile (n=5)	Male (n=14)
Carapace length (mm)	176.15 \pm 5.82	126.80 \pm 2.92	122.50 \pm 8.28
Carapace width (mm)	134.78 \pm 5.00	100.00 \pm 2.74	90.875 \pm 5.31
Carapace height (mm)	75.06 \pm 5.18	52.00 \pm 1.87	48.63 \pm 3.82
Weight (g)	954.14 \pm 94.63	347.80 \pm 36.81	299.38 \pm 94.67

Gravid and Nesting Females

Of the 627 females captured throughout the season, 79% were gravid. Of total gravid females, 75% (373 individuals) were new captures. On the road, 77% of gravid females were captured (Figure 6). There was no significant difference in the size of gravid versus non-gravid females.

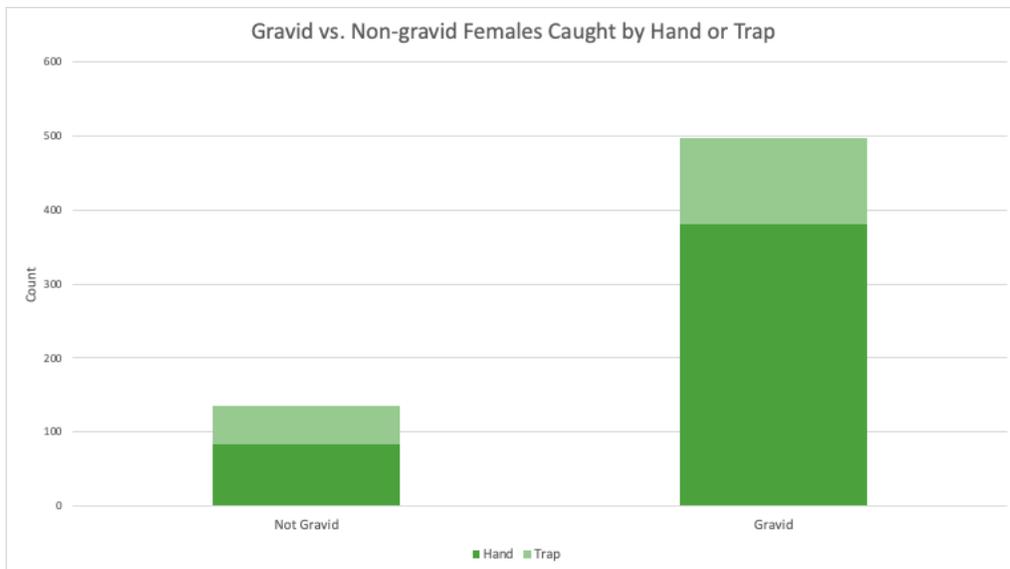


Figure 6. The number of gravid females vs. non-gravid females by type of captures, 497 of females captured were gravid. A total of 381 gravid females were captured by hand and 115 were captured in the hoop trap.

Injuries and Abnormalities

Captured turtles were checked for natural abnormalities and injuries. Injuries were either from a boat strike or from an unidentifiable source. Abnormalities include scute deformities, a kyphotic shell, bacterial infection, fungal infection (new and old), and barnacles (Figure 7).

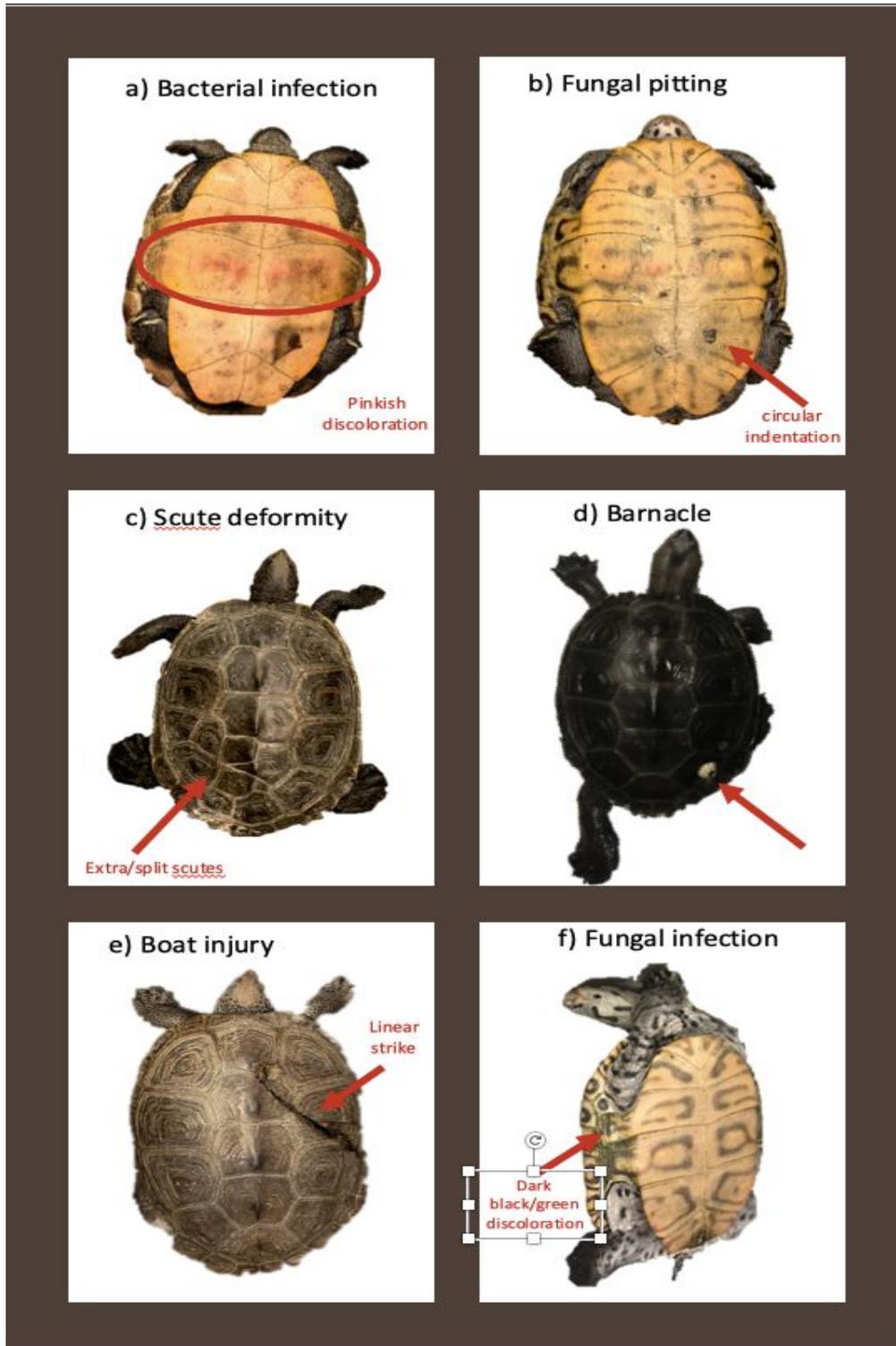


Figure 7. Images of each of the abnormalities found on captured turtles, as well as a description of how they are identified.

Of terrapins captured throughout the course of the season, 92 turtles were injured or had old injuries and 435 had natural abnormalities.

Table 3. Summary of abnormalities in turtles caught. These results were calculated by counting the number of turtles that had each type of abnormality. Thus, some individuals may be included in more than one of the abnormality categories.

	Natural Abnormalities					Injuries	
	Scute Deformity	Kyphotic	Bacterial Infection	Pitting (Fungal infection)	Barnacle	By Boat	Unknown Cause
Total	112	4	98	217	4	42	50
% of total capture	17%	1%	15%	33%	<1%	6%	8%

Injuries. Of the total number of terrapins captured, 14% had old and/or new injuries. These would include abrasions or scarring on the shell and body and occasionally missing limbs. Of the 92 injured turtles, 42 (6% of total capture) had a distinct boat injury from a boat propellor. The other 50 turtles (8% of the total capture) had injuries from an unidentifiable cause, which may include predation, boat strike, dredging, etc (Figure 8).

In addition, there were two road mortalities. Since the number of turtles with definitive road-related injuries was less than 0.01% of the total and both cases experienced mortality, these turtles are included in the capture summary, but are excluded from any further analysis or visual representation. Compared to several other roads in nearby marshes, this is a low number of road mortalities. This could be related to the low density of traffic on Cedar Run Dock Road and terrapin awareness of locals and residents.

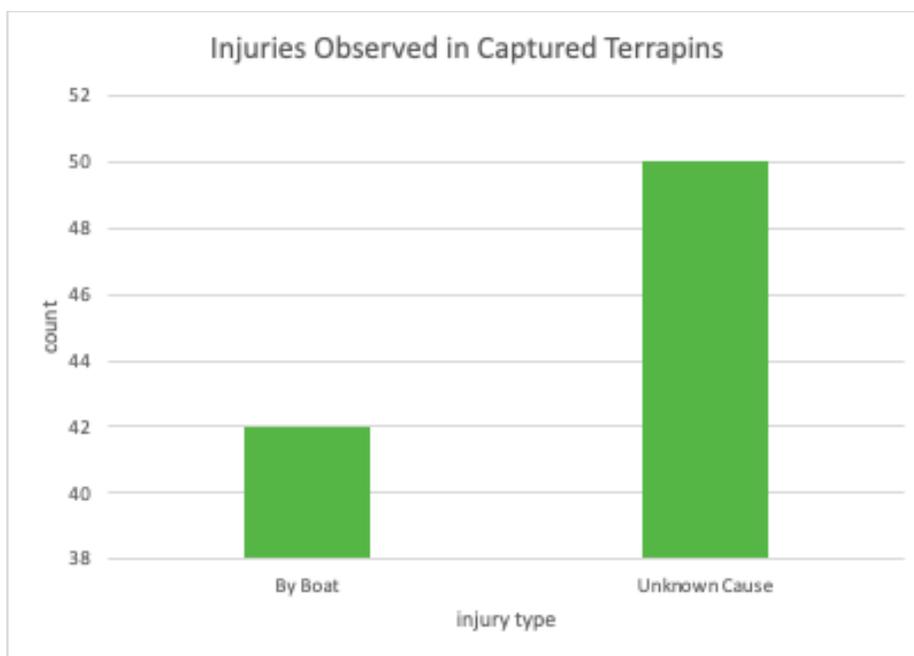


Figure 8. Number of terrapins with boat injuries ($n=42$) and with injuries from an unknown cause ($n=50$).

Natural abnormalities. 67% of turtles caught this season had natural abnormalities (Figure 9). 17% of turtles captured throughout the season had scute deformities to either the carapace or plastron. There were 15% of the terrapins that had a bacterial infection, indicated by a pink or reddish discoloration on shell or skin. Surprisingly, 33% had a fungal infection, indicated by black or shiny discoloration on the shell or by pitting scars from an old infection. Approximately 1% were kyphotic and <1% had barnacles. The high percentage of turtles with fungal infections may be an indication that terrapins are spending more time in lower salinity areas along Cedar Run (Jacobsen et al. 2000).

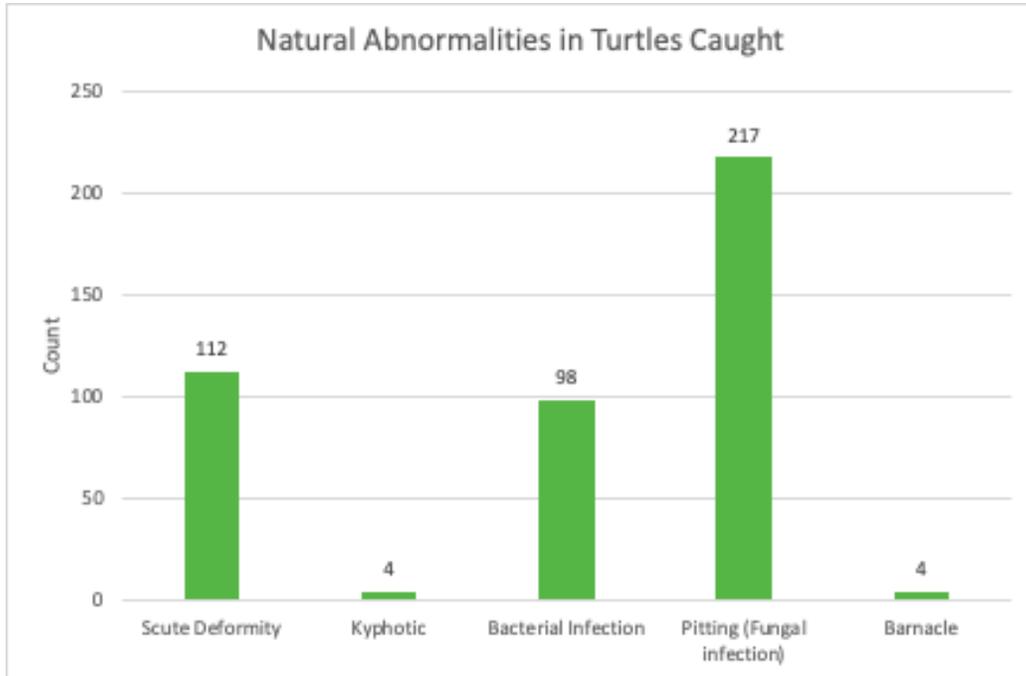


Figure 9. Natural abnormalities in captured terrapins as part of the Cedar Run Dock Road 2019 study.

Summary and Conclusion

With a percent recapture rate of 14.2% (26% including “trap happy” turtles), it is now possible to begin running a population analysis on females. Further collection of males is needed, as the data is highly female-biased. In general, more terrapins (particularly road captures) were captured during high tide than any other tidal stage. This would make it beneficial to increase the frequency of road patrols during high tide. There was a high number of terrapins captured with abnormalities. It may be an interesting future study to determine where these turtles are spending the majority of their time (fresh versus salt water, etc.) or to conduct genetics studies to determine the causes of scute deformities (Dominy 2015). Our boat injury rate was consistent with research conducted at the Edwin B. Forsythe Refuge, Barnegat Division several years ago through a research program coordinated by Drexel University and Earthwatch Institute where terrapins had boat propeller injuries (Lester 2012). We see the need for more nesting areas along Cedar Run Dock Road. As a result of Climate Change, which results in sea level rise, Cedar Run Dock Road is experiencing increased water levels that threaten potential terrapin nesting areas. Thus, we need to provide alternate nesting areas in existing upland locations. We also need to work with homeowners who may want to provide nesting habitat on their properties. One such family has filled their yard with sand to provide terrapins with a viable nesting site. Bulkheading and hardened shoreline projects will negatively impact terrapins (Winters 2013).

Acknowledgements

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