Reviewed: 7/27/2021

Site Fidelity and Range of an Island population of Diamondback Terrapin (*Malaclemys terrapin)* in West Galveston Bay, Texas

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Introduction

Diamondback terrapin display variable levels of home range and site fidelity. Previous studies have found that on a larger scale, high site fidelity can limit terrapin's ability to re-colonize abandoned creeks (Tucker et al 2001). Similar studies show 5.7% migration rates with a maximum range of 0.7 km (Gibbons et al 2001). In these studies, female migration rates and range are higher than males (Gibbons et al 2001, Tucker et al 2001, Butler 2002, Hogan 2003). Migration rates are most likely correlated with dietary needs, reproduction, and habitat selection, and are most likely dependant on the habitat available and ease of movement.

Terrapin habitat selection is largely influenced by sexual dimorphism and diet. Sexually dimorphic traits such as gape size are exemplary of habitat and resource partitioning, as females (with larger gapes) are able to predate upon larger periwinkle snails and crabs, while males are restricted to smaller snails. Since larger periwinkle snails are often found further from creeks, females have been observed to move farther inland than males (Tucker et al 1995). Larger females have also been found to swim further into open water, and distance from shore is positively correlated with plastron length (Roosenburg et al 1999). In this study, we analyzed the range and movement trends of Diamondback terrapin over a three-year period. Our data was collected on South Deer Island, which has a total area of 29.56 ha.

Table 1. Range area calculated in GIS from polygon of outermost GPS locations of captures. Percentage was calculated: [range area ÷ total island area(29.56 ha)×100]. Excludes capture events<4.

Notch Number	Sex	Number Capture Events	Range Area (ha) (Corrected)	Percent of Island
25	F	16	2.92	9.90
43	F	4	87.5	296.61
80	F	4	107.9	365.76
114	F	8	3.3	11.19
116.1	F	4	40.86	138.51
169	F	11	11.06	37.49
96	M	8	1.8	6.10
119.1	M	8	4.68	15.86
122	M	4	8.38	28.41
137	M	5	0.309	1.05
223	M	4	11.97	40.58

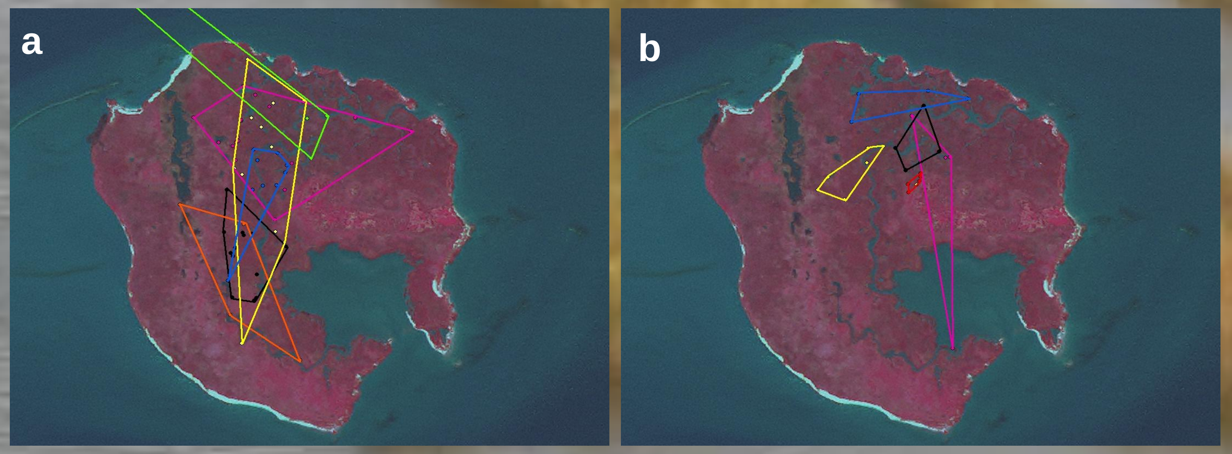


Figure 1.Map of capture events of (a) female and (b) male radiotagged terrapin (caught by hand and radiotracking).

Radio tagged terrapin.

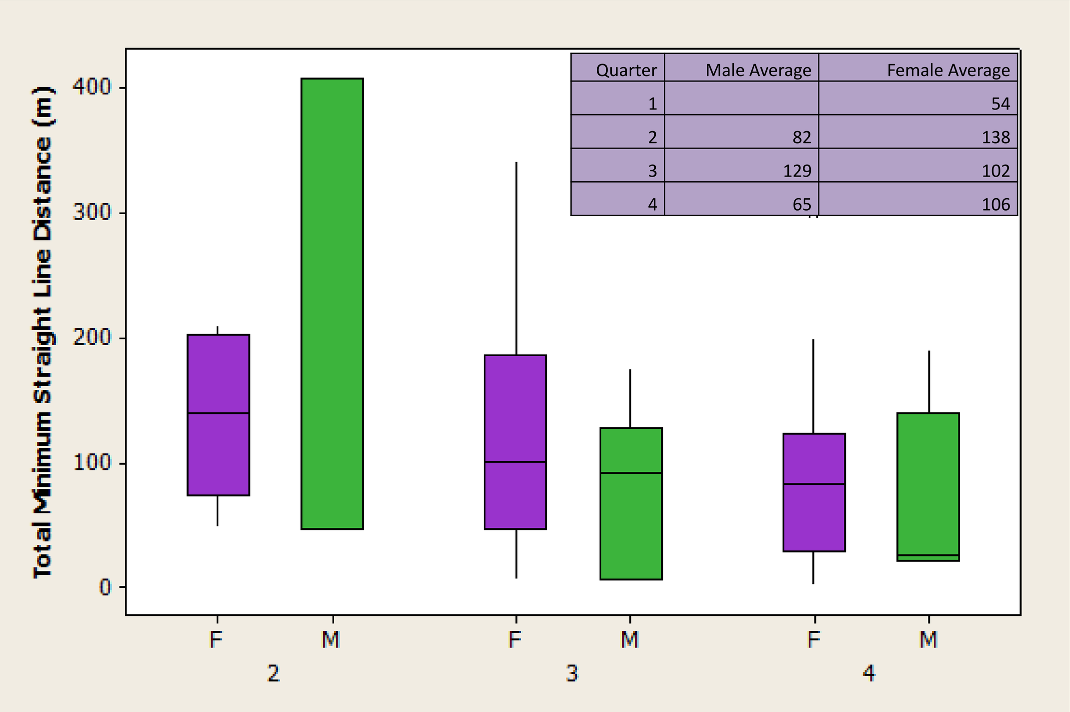


Figure 2. **Mean distance moved over yearly quarters.** Mean distance (m) terrapins move in quarter 1 (Dec-Feb), quarter 2 (March-May), quarter 3 (June-Aug), & quarter 4 (Sept-Nov). Not enough data for quarter 1 statistics. Radio captures only. A 2-way ANOVA comparison of distance to sex and quarter showed no significance.

Methods

In this study, we calculated average range and minimum straight line distance movement of the Texas Diamondback Terrapin (*Malaclemys terrapin littoralis*). We utilized land searches by hand capturing and processing terrapin on the North and South Deer Islands in Galveston Bay, TX, from 2008 until the present. Terrapins with radio transmitters were tracked by radio telemetry using ATS model R2000 receiver which monitors radio frequencies within a range of 2 MHz. When captured, terrapin meristics and GPS locations were recorded. For any terrapin caught more than four times (which includes only radio tagged terrapin captured by both methods), we layered the GPS points in ArcGIS and made a polygon Minimum convex polygon by connecting the outermost capture points. We corrected for sample size bias by using Barrett's (1990) bethod of dividing the polygon area by 0.257 ln(n) – 0.31. This polygon represents the range area of each terrapin. By dividing the area in this polygon by the area of the island, we were able to calculate the percentage of the island each terrapin covered. To obtain the distance moved, we measured the distance between successive capture locations. Because we cannot account for any distances between two consecutive capture points, we acknowledge these as minimum straight line distances. These distances were totaled and averaged, and compared to season, sex, and meristic traits.

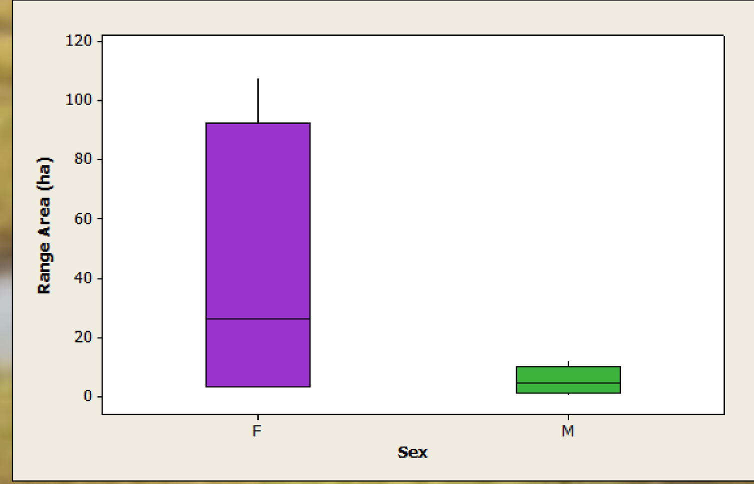
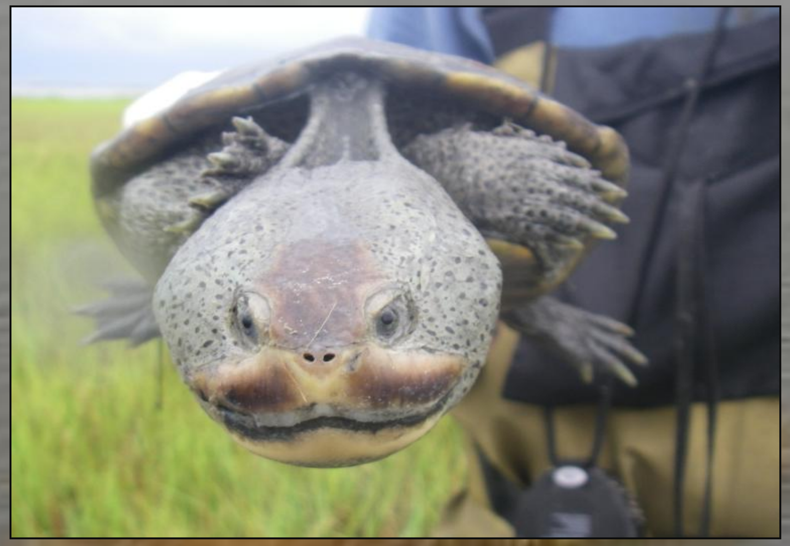


Figure 3. Differences in range area between sexes. Before the range correction (Barrett 1990), the correlation between sex and range had p-value of 0.026. After the correction, the t-test p-value was 0.107 due to higher variance. These minimum convex polygons were calculated using only radiotagged terrapin using both hand capture and radiocapture.

Above: Example of sexual size dimorphism
Below: Example of larger female gape



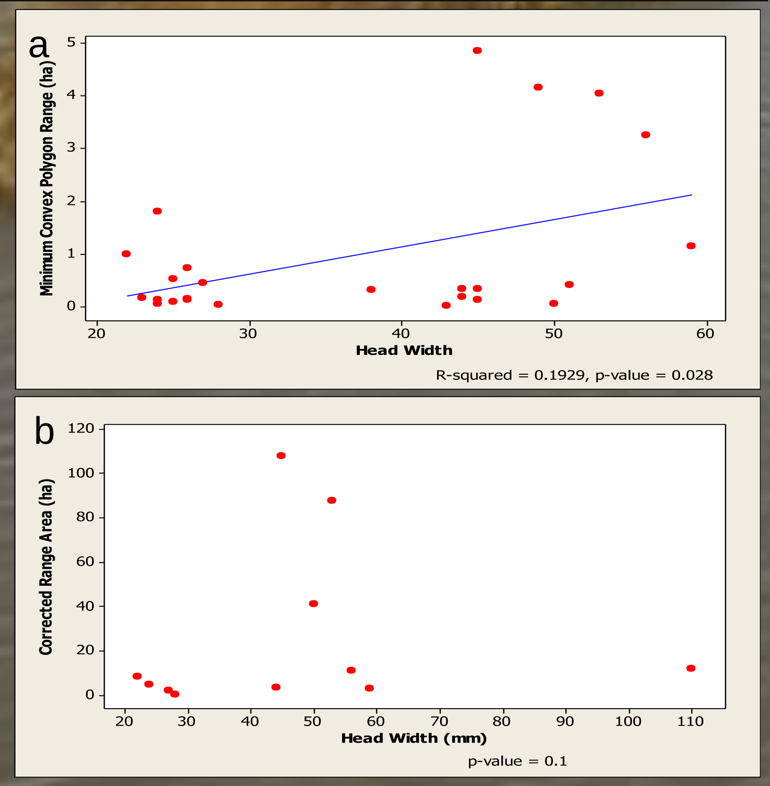


Figure 3. Range area as a function of head width. Total area was calculated using radio tagged terrapin that were captured using both methods. **A**. Before the range correction using Barrett's 1990 method, there was a significant correlation (p=0.028). **B.** After the range correction, the relationship is insignificant (p=0.1) but the trend may still be present. P-values obtained using a Pearson's correlation

Results

The range and minimum straight line distances moved were highly varied with little correlation. Habitat use, site fidelity, and seasonal movement were very similar between males and females. Visually, it appeared that terrapin did not display high fidelity to one tidal creek, however this is a statistically insignificant observation. Before range area correction using the 1990 Barrett method, the only significant correlation observed was between terrapin head width and total range area (p=0.028), and between carapace width and total range area (p=0.05). After the correction, these correlations were no longer significant (figure 3). Females tended to have a larger range and total straight line distance moved than males (p= 0.107 and 0.096, respectively). There was also a trend towards increase distances moved in the months of March – May (figure 2). The highest range observed was that of 107 ha, which is about three times the area of South Deer Island. The female with this range was one of the few that migrated between the two islands, North and South Deer. The smallest range observed was that of 0.31 ha, which translates to 1.05% of the island. While only terrapin captured greater than three times were included in statistical analysis, it is important to note several other terrapin caught only twice were observed moving between North and South Deer Island, which is a distance of 1.1 km. These terrapin had the longest minimum straight line distance observed (1.4 km). Initially, radio captured and hand captured terrapin data were treated separately due to the difference in capture probability, but all statistical analysis showed little difference between range area calculations, minimum straight line distances, and total movement between the two methods. Instead, number of capture events was a more significant factor in these parameters. In the case of range area, adding hand capture events to radio capture events increased the number of GPS locations and therefore the significance of the polygon.

Table 2. **Comparison between previous and present observed ranges.** Spivey (1998) and Butler (2002) ranges are both from mainland sites.

Study	N	Minimum Convex Polygon (ha)	Range (ha)
Spivey 1998	8	8.27 +/- 2.52	2.56-26.18
Butler 2002	10	14.91 +/- 22.46	0.31-67.02
Present	11	25.55+/- 37.6	0.31 - 107.9

Can you find the turtle?

Discussion & Future Work

This data shows a greater range and variation in movement and area of minimal convex polygons. This data suggests that the paradigm of site fidelity normally used to describe mainland habitat may not apply to island systems. Fidelity and range is restricted by the size of the island, and our data suggests that migration may be a density dependant factor affected largely by available resources in a confined area. Our data also supports that migration is influenced by factors mentioned earlier, including gape size and resource partitioning and female specific movements such as nesting. Our data has promising management implications in that it shows that terrapin may be recruited between distinct metapopulations such as island habitats in the case of stress or local extirpation. These metapopulations may not be as isolated as previously thought, but further research into isolated populations is necessary. We also hope to a more closely observe terrapin over short periods of time to see more precisely how much they move in a given amount of time and therefore have better estimates of range.

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Acknowledgments

We thank USFWS and the Houston Zoo for funding terrapin research in Galveston Bay. We also thank Jenny Wrast, Misty Shepard, and all of the countless graduate students and volunteers that have spent long hot days in the marsh capturing and releasing Texas Diamondback Terrapin.