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Population Structure and Nest Success of Gopher Tortoises (Gopherus polyphemus), and Vegetative Response to Prescribed Burning in Northeast Florida

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Population structure and nest success of gopher tortoises (*Gopherus polyphemus*), and vegetative response to prescribed burning in northeast Florida

by

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I would like to dedicate my Master's thesis to Alexandra A. Legeza, who started out as an undergraduate volunteer and ended up being one of the best scientists and friends I have ever known. I would also like to thank Asher A. Williams for everything from help in the field to being the calm voice of reason at home when I felt overwhelmed.

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Abstract

A gopher tortoise population on the campus of University of North Florida is part of an ongoing study initiated during the early 1990s, and this project presents data on this population collected during the 2009-2011 field seasons. The project has three major objectives: 1) measure population demographics including density and structure to assess long-term viability and recruitment, 2) evaluate decadal growth rates of individuals by comparing measurements of tortoises captured and marked in the 1990-1994 study done at the same site with those tortoises recaptured during the current study, and 3) assess the effect of prescribed burning on vegetation. In total, 141 individuals were caught from 2009-2011: 32 adult females, 28 adult males and 17 young adults, 43 juveniles and 21 hatchlings. Of these, 39 are recaptures from the research performed in the early 1990s. Adult burrow aprons were probed using a wire survey flag in an attempt to locate nests. In 2010 we found two intact nests with this technique and recorded two other depredated nests that were unassociated with any burrow. In 2011 we found one nest and a clutch that was laid on the ground's surface. Four 100m transects were established before prescribed burning began. Vegetation analyses were done bi-monthly and all plants were recorded as well as their percent of each plot. The most abundant plant was milkpea. Preliminary analysis of post-burn response has indicated increased groundcover in all burned transects.

Introduction

The gopher tortoise is found in six states east of the Mississippi River, including Florida. Florida has the largest number of gopher tortoises with populations in every county (Auffenberg and Franz, 1982). In 2007, the gopher tortoise was elevated from a Species of Special Concern to Threatened status in Florida (FWC, 2007) and is being considered for federal Threatened listing throughout the range (FWC, 2010). Gopher tortoises require well-drained, sandy soils for burrowing, an abundance of herbaceous ground cover for food, and a generally open canopy that allows sunlight to reach the forest floor (Landers, 1980; Auffenberg and Franz, 1982). The gopher tortoise has been referred to as a keystone species because its burrow is refuge to numerous other animals and its foraging habits help to disperse vegetation (Eisenberg, 1983).

Auffenberg and Franz (1982) estimated that the gopher tortoise population has experienced an 80% decline due to habitat loss in the last 100 years. Historic gopher tortoise habitats were fire-maintained savannahs and xeric grasslands that covered the Atlantic Coastal Plain from eastern Texas and eastward throughout Florida (Watts, 1983; Ashton and Ashton, 2008). This habitat is also attractive to humans for use in agriculture, forestry and housing, and escalating use of these areas has led to increasing fire suppression (Auffenberg and Franz, 1982; Ashton and Ashton, 2008). In the absence of fire, hardwoods dominate the vegetation, and competition among forbs and grasses for light increases, causing species richness to decline (Abrahamson and Hartnett, 1990). Prescribed burning helps open the canopy and clear litter to provide the sunlight necessary for plant growth and gopher tortoise nest incubation (Cox et al., 1987; McCoy and Mushinsky, 1988). The amount of herbaceous ground cover has been shown to

positively correlate with tortoise population densities, movement patterns and growth rates (Auffenberg and Iverson, 1979; Landers et al., 1982; Mushinsky et al. 1994; Aresco and Guyer, 1999), so prescribed burning may positively affect these variables. Diemer (1986) outlined various management practices to enhance tortoise populations in Florida, and stressed the value of prescribed burning as a management tool. In natural and planted longleaf pine stands, frequent burning is the most important maintenance practice (Landers and Speake, 1980).

Cox et al. (1987) suggested that to be viable and offset potential inbreeding, tortoise populations must be composed of at least 40-50 breeding individuals. An obstacle for gopher tortoises, however, is that no vertebrate species in Florida, humans included, takes longer to reach reproductive maturity. Growth to sexual maturity takes from nine to 21 years with northern populations being slower and delayed sexual maturity limits gopher tortoise population growth and recovery (Iverson, 1980; Landers et al., 1982; Mushinsky et al., 1994; Aresco and Guyer, 1999). However, size rather than age is a better indication of maturation (Cox et al., 1987). Genetic and environmental factors can produce varying average growth rates in different gopher tortoise populations (Landers et al., 1982). Slower growth extends the juvenile stage of gopher tortoises, which increases the time spent susceptible to predation and reducing survival rates and recruitment (Auffenberg and Iverson, 1979; Butler and Sowell, 1996; Aresco and Guyer, 1999). Determining population age structures is a valuable tool for assessing population growth and potential for recovery.

The objectives of this study were to 1) measure population demographics, including density and structure, to assess long-term viability and recruitment, 2) evaluate

decadal growth rates of individuals by comparing measurements of tortoises captured and marked in the 1990-1994 study done at the same site with those tortoises recaptured during the current study, and 3) assess the effect of prescribed burning on vegetation.

Materials and Methods

Study Site. The study site is a 13 ha area located in the southwestern quadrant of the University of North Florida (UNF) campus, Jacksonville, Duval County, Florida, which has an active gopher tortoise population. A chain-link fence borders the site to the west, slough to the east, and dense saw palmetto (*Serenoa repens*) to the north and south. It is a sandhill ecosystem dominated by turkey oak (*Quercus laevis*) instead of longleaf pine (*Pinus palustrus*), which Myers (1990) attributes to changes in natural fire regimes that historically controlled hardwood encroachment onto the sandhill.

The understory includes dense saw palmetto and blueberry (*Vaccinium corymbosum)*, while the ground cover consists of wiregrass (*Astrida stricta*), dog fennel (*Eupatorium capillifolium*), milkpea (*Galactia floridana)*, greenbrier (*Smilax* spp.*)*, bracken fern (*Pteridium aquilinium*) and several species of bluestem (*Andropogon* spp.*)* and blazing star (*Liatris* spp.*)*.

Fire management practices for this area prior to 1969 are unknown, but the first recorded prescribed burn occurred in 1982 and was incomplete. No burning occurred in 1983, but the initial burn was completed in winter 1984. One interpretation is that all areas of the campus were burned between 1982 and 1984. The study site was burned in 1991 (Butler et al., 1995), and partial campus burns, which likely included the study area,

occurred in 1997 and 2003. The study area was recently burned in sections in a series of four fires, which took place in July and December 2009 and January and February 2010.

The main goal of UNF's prescribed burning program is to return the oak sandhill area to an earlier successional stage more appropriate for fire dependent flora and fauna such as gopher tortoises. A canopy with less than 60% cover is most suitable for gopher tortoise habitat (Diemer, 1986; Cox et al., 1987). The fires of winter 2010 were done under drier conditions than burns performed in the summer in an effort to enhance mortality of turkey oak and other broadleaf trees. Still, the initial burns did not affect some of the turkey oaks. In summer 2011, UNF began girdling some trees to help clear the canopy of some of the oaks that would not be greatly affected by the burns (Chuck Hubbuch, UNF Preserve Curator, personal communication).

This study includes data collected from October 2008 through October 2011. Vegetation transects were established and pre-burn vegetation analysis was performed in October 2008. An initial burrow survey was completed in 2009 and newly discovered burrows recorded throughout the study. Tortoises were trapped during all three activity seasons (April through October 2009 – 2011). Nests were probed for nests during 2010 and 2011 only, and bimonthly post-burn vegetation analyses done from June 2009 through October 2011.

Locating Burrows. Corridors were 25m wide and spanned the length of the 13ha site. I located burrows using the method described by Ashton and Ashton (2008) where at least three researchers walk at arm's length across corridors searching for burrows. I designated burrows as active if plastron slides or tracks were present on the apron,

inactive if debris or leaves were found on the apron or in the mouth, or abandoned if the entrance was blocked by logs or caved in (Cox et al., 1987).

I estimated population density using the number of active and inactive burrows and multiplying by the correction factor 0.614 (Auffenberg and Franz, 1982). I ran a chi-squared test between the number of observed versus expected total tortoises and adult tortoises. I then compared this population estimate to a site-specific correction factor, which was found by dividing the total number of tortoises captured by the number of active and inactive burrows. The site-specific correction factor assumes that all tortoises on this site were captured.

I recorded burrow locations with a handheld GPS (Garmin GPSMap76) and marked them with a numbered aluminum tag. I recorded the date, GPS coordinates, burrow number and activity status of each burrow.

Trapping and Demographics. I trapped tortoises from April through October when gopher tortoises are most active (Diemer, 1992) and trapping protocol followed Cox et al. (1987). I ceased trapping adult burrows between May 15 and June 30 to allow for nest deposition in aprons. I buried 19l plastic buckets with 3mm diameter holes drilled in the bottom for drainage. Wet sponges were put into the buckets at active adult burrows to prevent tortoise desiccation. I planted the buckets in aprons, and bucket openings were covered with newspaper and camouflaged by debris and sand. I checked traps twice daily for tortoises until capture. I measured carapace length (CL), plastron length (PL), total length (TL), carapace width (CW) and height (CH) to the nearest 0.1mm with tree calipers, and tortoises were then weighed to the nearest 0.10kg using a hand-held Pesola

scale. I determined sex of the tortoises using plastral concavity characteristics and classified them as adults, young adults or juveniles based on body measurements (Ashton and Ashton, 2008). There is variability in age class measurements based on tortoise location, variability in climate, and habitat quality (Diemer and Moore, 1994; Aresco and Guyer, 1999), so age classes were sorted by finding the range from all studies of gopher tortoises in the southeastern United States and using the maximum carapace length values (Ashton and Ashton, 2008). Ranges for each age class are: hatchlings 0 – 50mm, juvenile 51 – 150mm, young adult 151 – 180mm, adult male >180mm , and adult female >210mm (Rostal and Jones, 2002). A size class distribution chart was also made using maximum carapace lengths for 18 different size classes from a study done by Witz et al. (1992). I marked all trapped tortoises by drilling marginal scutes using Cagle's (1939) numbering system and then released the tortoises at the capture site.

Long-Term Growth Rates. I compared tortoise size measurements between the current study and the study performed in the 1990s using the von Bertalanffy equation for interval growth rate and compared this to logistic growth rate equations. These equations only require data from recaptures at specific times and do not require knowledge of age (Fabens, 1965; Frazer and Ehrhart, 1985; Aresco and Guyer, 1999). I fitted recapture data to each equation using nonlinear, least squares regression. The von Bertalanffy growth interval equation is:

$$L_2 = a - (a - L_1)e^{-rd} \qquad (1)$$

and the logistic growth interval equation is:

$$L_2 = aL_1/[L_1 + (a - L_1)e^{-rd}], \qquad (2)$$

where L_1 is carapace length at first capture, L_2 is carapace length at recapture, d is time in years between capture and recapture, *a* is asymptotic size and r is characteristic growth parameter (Fabens, 1965; Frazer and Ehrhart, 1985; Schoener and Schoener, 1978; Aresco and Guyer, 1999). Asymptotic carapace length (*a*), and the characteristic growth parameter (r) were estimated for each equation from non-linear regressions of von Bertalanffy and logistic growth interval equations for gopher tortoises. Residual Mean/Sum Square (RSS) and Aikike's Information Criteria (AIC) values were used to measure the relative goodness-of-fit of both the von Bertalanffy and logistic models, with the lowest value belonging to the more appropriate model. I used SAS to calculate RSS and its error value. The AIC value was calculated using the equation:

$AIC = n * \ln (RSS/n) + 2 * K$ (3)

where n is the number of observations, RSS is the residual sum of squares and K is the number of parameters in the model.

To assess demographics and future viability of this tortoise population I constructed a life table. Three different mortality rate equations were compared for this population. The Lorenzen mortality rate estimate changes based on tortoise size (Lorenzen, 2000). The Lorenzen equation for mortality is:

$M_a = (M_r * L_r)/L_a$ (4)

where M_a is mortality at length 'a', M_r is mortality at a reference length, L_r is a reference length, and L_a is a chosen length.

The next mortality rate equation was applied by Witz et al. (1992) and used an initial equation to find the mortality rate of tortoises using the average number surviving past their first year (Alford, 1980). This was done by using Iverson's (1979) criteria of

23cm CL for reproductive females, an average of five eggs per female per year, and assumes an equal sex ratio and a stable, age-specific mortality rate. The equation to determine average annual egg production is:

$A_f * 5 = b$ (5)

where A_f is the number of adult females in the population and five is the average number of eggs per female per year (Iverson, 1979). Then b can be used in the following mortality rate equation, which is:

$(b - c)/b = d$ (6)

where b is the average annual egg production and c is the mean number of individuals in the size classes from 6.6 – 19.2cm. This mortality rate (d) was then used in the Lorenzen model as M_r.

The last model used was Jensen's (1996) mortality estimate, which remains constant through all age classes. Mortality is found by the equation:

$M = 1.5*(r)$ (7)

where r is the growth rate from the more appropriate interval growth model (von Bertalanffy or logistic).

The size class distribution in this study was tested using descriptive statistics to find kurtosis and skew values. Negative kurtosis (platykurtic) values explain a relatively flat distribution with a lower, wider peak around the mean. Positive skews mean that the distribution clusters to the left of the mean at lower values. All statistical growth and demography tests were performed using SAS 9.2.

Reproductive Success. I probed aprons of adult burrows during nesting season in May and June with a wire survey flag to locate nests (Smith, 1995; Butler and Hull, 1996). I recorded clutch size as we removed the eggs from the nest for measurement. With a Sharpie, we marked the uppermost surface of each egg in order to assure their proper orientation when returned. I recorded two egg diameter measurements, roughly at right angles to one another, because the eggs are not perfectly spherical. I kept the eggs shaded while being weighed and measured. I returned the eggs to their original position in the nest, reburied them, and covered the nest with hardware cloth nest boxes to prevent predation and so we could collect hatchlings as they emerged. Nests with at least one hatchling emergence were considered successful (Walde et al., 2006) and I also recorded the number of eggs within each nest that hatched.

Vegetation Analyses. I established four 100m transects (T1-T4) and collected data before the burn in the fall (October and November) of 2008, then bimonthly after the burn for one (T2 and T3) and two (T1 and T4) years. At each 10m point along transects I placed a 1m square quadrant and counted and identified all plants within the quadrant to genus or species when possible. I also estimated percent canopy cover using a densiometer, and visually approximated percent groundcover to the nearest 10% (Ashton and Ashton, 2008). Records at each point were averaged for each data collection event, and these means were used in statistical tests. I evaluated habitat suitability by following the guidelines given by Florida Fish and Wildlife Conservation Commission (2007) for optimum gopher tortoise habitat in Florida sandhill/upland pine forests, which are:

1. Maximum Percent Canopy Cover = 50

2. Minimum Percent Ground Cover = 40

With paired t-tests I compared pre- and post-burn vegetation data sets for percent groundcover, species richness and percent open canopy ($p < 0.05$). I used a Bray-Curtis dissimilarity index to compare diversity and community composition between all pre- and post-burn data. This index ranges between 0 and 1; 0 means the two transects share all species, and 1 means the two sites share no species. To assess if percent open canopy had any effect on percent groundcover, I compared values of open canopy and ground cover percentages recorded during the same analysis using Pearson's Correlations. However, since percent open canopy at one time might affect percent groundcover at a later time, I also compared percent open canopy of one data set to percent groundcover of the following data set. Correlations size values range between -1.00 to 1.00 and indicate the strength and direction of the relationship between two variables. A correlation of -1.00 indicates a perfectly negative relationship, a correlation of 0 indicates no relationship, and a correlation of 1.00 indicates a perfectly positive correlation. To interpret values between 0 and 1.00 Cohen (1988) suggests the following guidelines:

small $r = .10$ to $.29$

medium $r = .30$ to $.49$

large $r = .50$ to 1.0

These guidelines apply regardless of whether the correlation is positive or negative and refer only to the strength of the correlation. The Bonferroni Correction factor was applied to all t-tests for percent groundcover, species richness and percent open canopy to account for the number of tests performed. All statistical tests on vegetative comparisons were performed using IBM SPSS Statistics 19.

Demographics Results

Burrows

I found 323 burrows on this site, of which 266 were active or inactive, the rest were abandoned. Applying the Auffenberg and Franz (1982) correction factor of 0.614, the population estimate is 163 tortoises. Of the 266 active and inactive burrows, 159 were adult burrows thus I estimate 98 adults for this site (Fig. 1). The chi squared test for association between actual and estimate tortoise and adult numbers was not significant for either test (total tortoises: critical = 174.1 > calculated = 2.7; adult tortoises: critical = 79.1 > 13.9). Based on the number of tortoises captured (141) divided by the number of active and inactive burrows (266), the site-specific correction factor would be 0.53. The adults on this site that were captured (60) divided by the number of active and inactive adult burrows (159) results in an adult correction factor of 0.38. With these calculations I am assuming that all tortoises were caught.

Demographics

In this study (2009 – 2011), I captured 141 different tortoises: 21 hatchlings, 43 juveniles, 17 young adults, 32 adult females and 28 adult males (Fig. 2). Adults made up 42.5% of this tortoise population. Of 169 tortoises trapped in a previous study at the same site (1990 - 1994), 39 were recaptured in the current study, making the recapture ratio 27.5% (ratio = 39/141). I calculated the long-term recapture rate by dividing the number of marked tortoises captured in the current study by the number of all previously marked tortoises, thus the recapture rate is 23.1% (39/169). The sex ratio of this population is 1:1.14 males to females.

Long-Term Growth Rates

The von Bertalanffy and logistic interval models adequately described the growth patterns of gopher tortoises ($p < .0001$ for both). Because the logistic model had a lower residual mean square value, it described the growth patterns better (Table 1: 10.1 vs. 8.9). When an AIC was performed to measure the relative goodness of fit, the logistic model again described the growth rates of this population better (Table 1). These evaluations were done by looking at both variables, mean square and residual sum of squares, with the lower value belonging to the best model for both.

For this study, the average CL for males (216.6mm) and females (256.9mm) was smaller than the predicted asymptotic size for both the von Bertalanffy (269.4mm) and logistic (266.7mm) models (Table 1). The asymptotic CL estimate was close between the models, varying by 2.7mm (Table 1). While the mean CLs of adult male gopher tortoises did not fit within the 95% confidence interval for either model, mean CLs of adult females fit within both (Table 1). Gopher tortoises displayed a von Bertalanffy growth pattern of rapid growth as juveniles, followed by little to no growth after reaching sexual maturity (Figs. 4 and 5).

The size class distribution of CLs in this population (Fig. 6) is platykurtic, meaning it has a relatively flat distribution. Platykurtosis occurs when the kurtosis value is negative; the kurtosis value in this study was -0.706. The skewness statistic for this data was positive (0.393) meaning the data clusters to the left of the mean at lower values. Only one tortoise had a CL of less than 48mm and no tortoises were greater than 318mm. Seventy-two percent of all tortoises were between 120mm and 318mm CL. The modal CL size class was 264 – 282mm and the mean was 181.4mm.

Thirty-nine tortoises first marked in the 1990 – 1994 study were recaptured in the current study. Two tortoises were not included in current size calculations. The remaining 37 tortoises consisted of all age classes (Table 2); 22 were classified as adults at both times and 15 were not adults when first marked. Of those 15, six were males, seven were females and two were undetermined.

The Lorenzen mortality rate varies depending on the size of the tortoise and yielded a decreasing mortality rate that fit this population well. I used a reference mortality (Mr) for this equation of 0.99 (99%) based on the probability of egg/hatchling survival, taking predation into account. A 55mm carapace length was used for the reference length (Lr) and a decreasing mortality rate was produced based on that assumption (Fig. 3).

The second mortality rate equation was used by Witz et al. (1992) by using a separate equation to estimate the average number of young surviving past the first year (Alford, 1980). Based on the presence of 32 adult females and a mean clutch size of 5 (Iverson, 1979), the average annual egg production for this population is estimated to be 160 (32 females * 5 eggs per female; Witz et al., 1992). A mortality estimate was produced by using the mean number of individuals in the size classes between 66 – 192mm CL (x = 101.3mm) to estimate the average number of tortoises surviving past their first year. The mortality estimate for this population using the method from Alford (1980) and Witz et al. (1992) is 93.7% [(160 – 10.13)/160]. This rate was then applied to the Lorenzen equation as Mr, and the 55mm CL was used (the average length of tortoises surviving past age one). The mortality at length *a* was then graphed and is almost

identical to the first Lorenzen equation using the assumption of 99% mortality in hatchlings (Fig. 3).

The Jensen mortality rate estimate is based on growth rates and remains constant. The logistic growth rate was applied to this equation since this fit the population better than the von Bertalanffy equation. While the estimate using the Jensen equation is very different from the previous two equations for juveniles, it is only slightly higher than the adult mortality estimates of the Lorenzen and Witz estimates (Fig. 3).

Reproduction

During the current study, four nests were found. I found two nests in each of the two years. Both nests hatched in 2010 and neither nest hatched by the end of the field season in 2011. The average clutch size was 6.25 with a range of four to eight eggs (Table 3). Average horizontal and vertical egg length for all eggs found on this site were similar (41.17mm and 41.19mm, respectively). Average egg weight was 39.37g (n=25) with a range of 26.8 – 48.0g (Table 3). In both years, I found eggshells on the surface of the ground unassociated with any burrows or apparent nests (total = 3); these were not counted in the above totals. In 2011, I found one clutch of five intact eggs deposited on the surface unassociated with a burrow or apparent nest. I buried these in a nearby burrow apron, and this was counted as one of the 2011 nests.

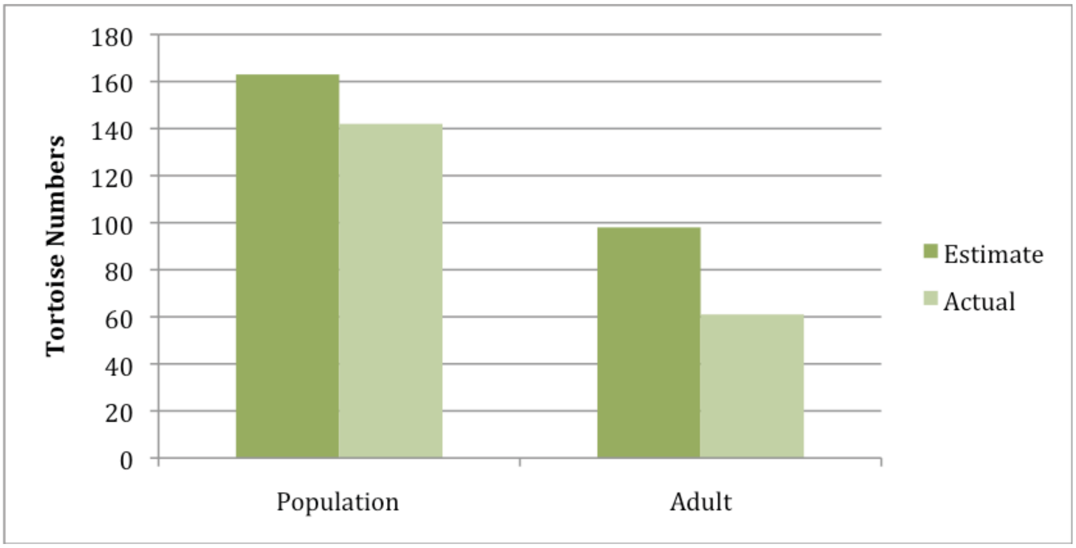

Figure 1: Population and adult tortoise numbers versus estimates.

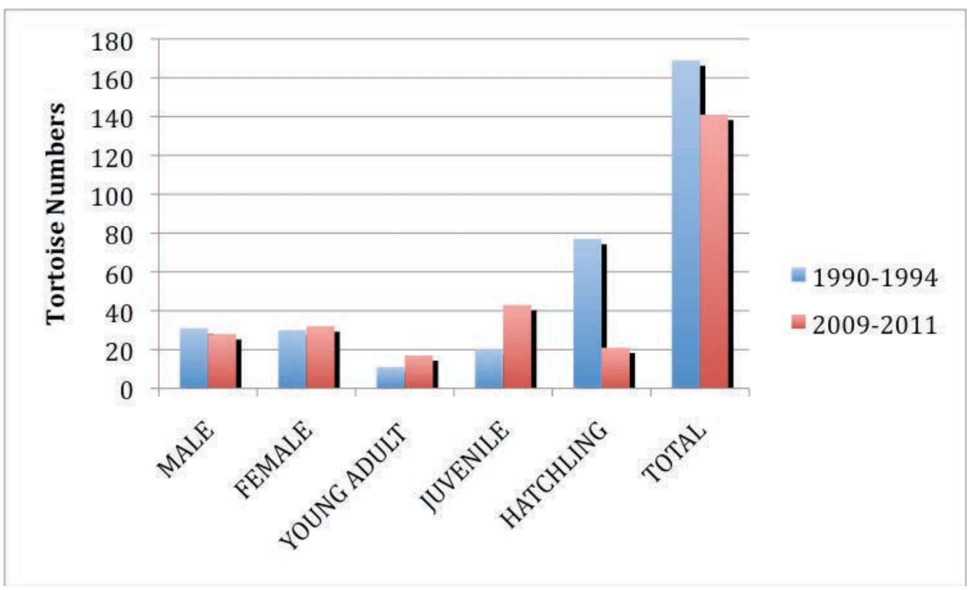

Figure 2: Population data from 1990-1994 versus from 2009-2011.

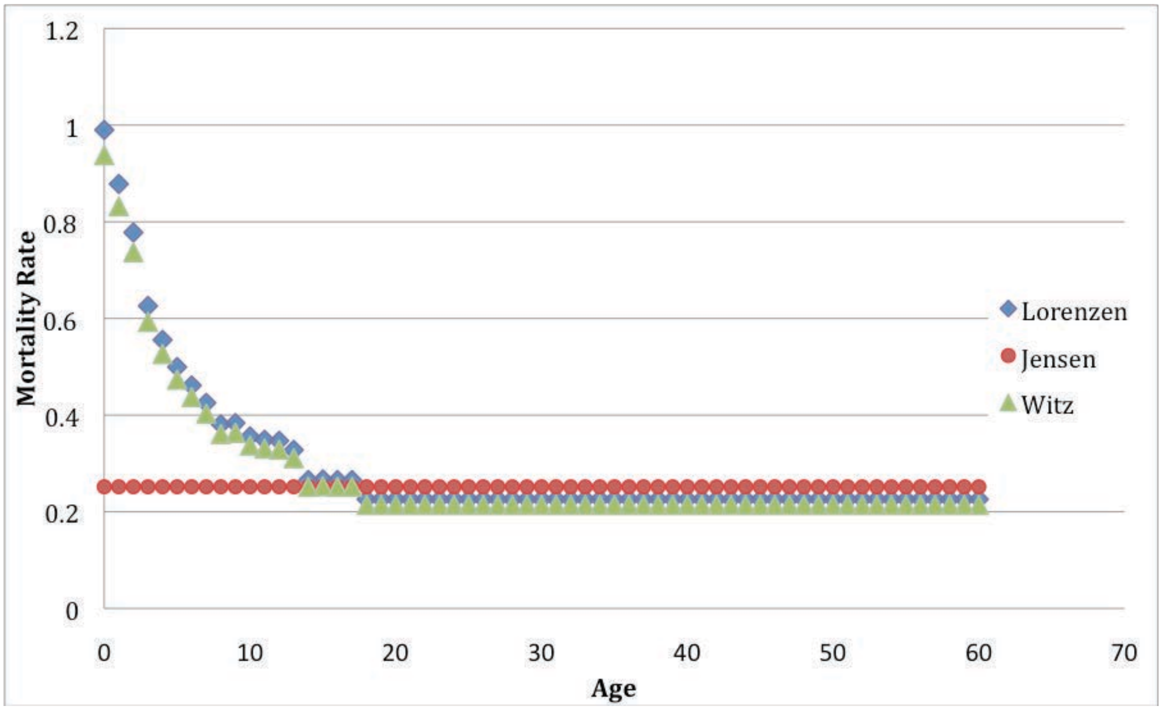

Figure 3: Lorenzen, Jensen and Witz mortality rate estimates for the UNF gopher tortoise population.

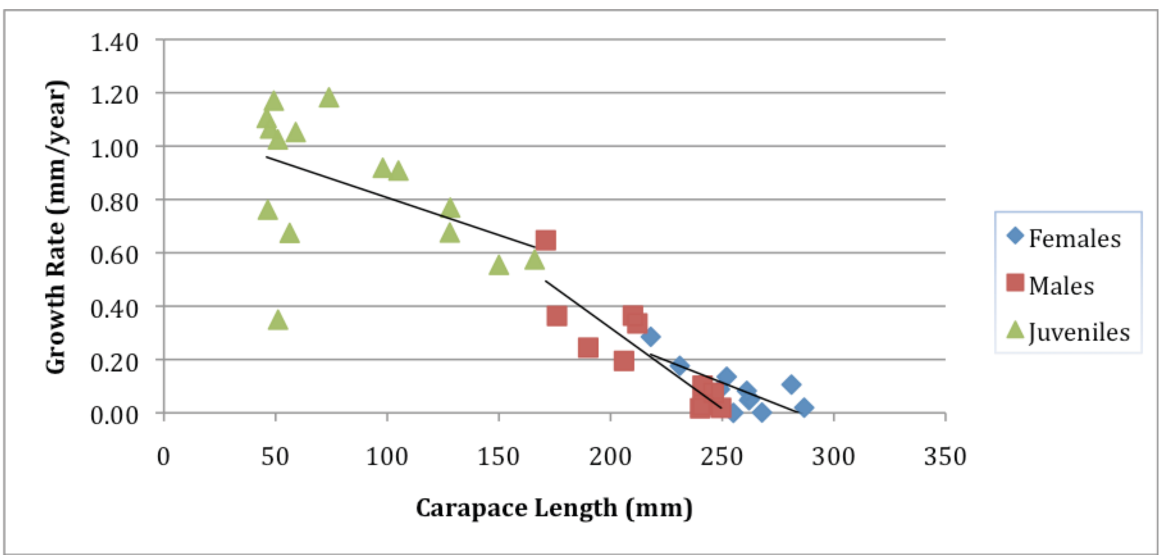

Figure 4: Mean annual growth rate plotted against carapace length at first capture (1990-1994) with a trendline for each class.

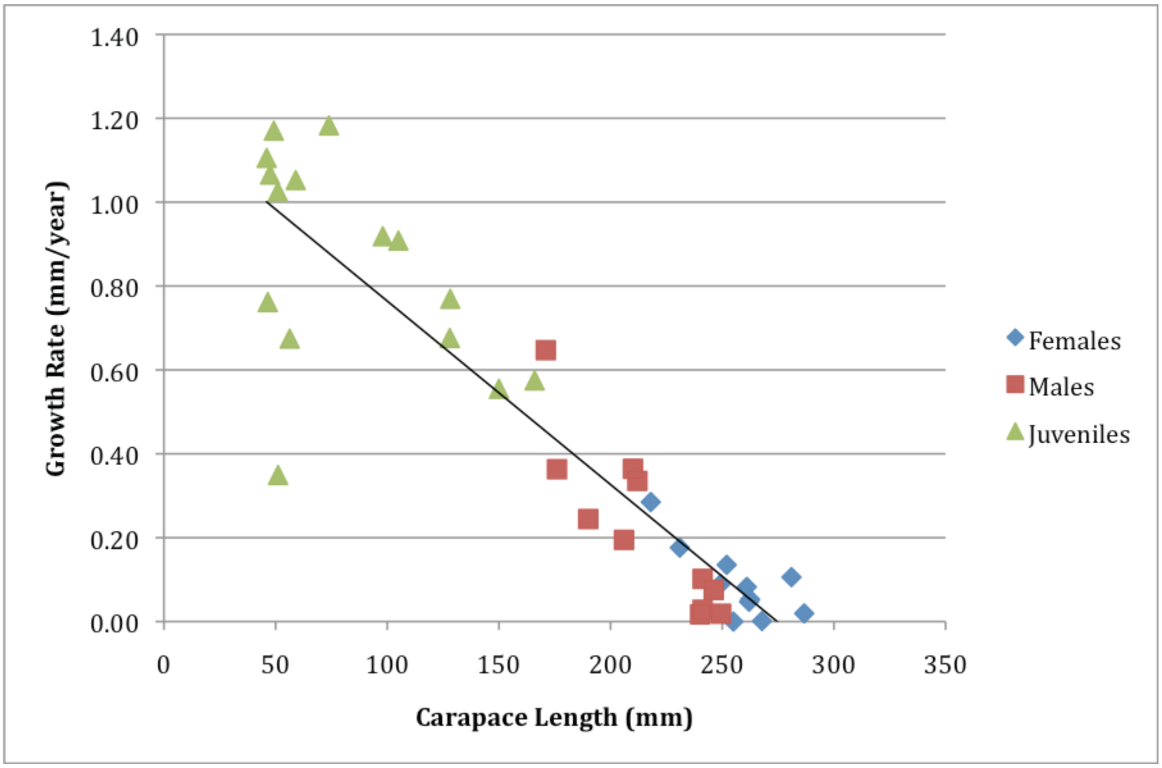

Figure 5: Mean annual growth rate plotted against carapace length at first capture (1990-1994) with an average trendline.

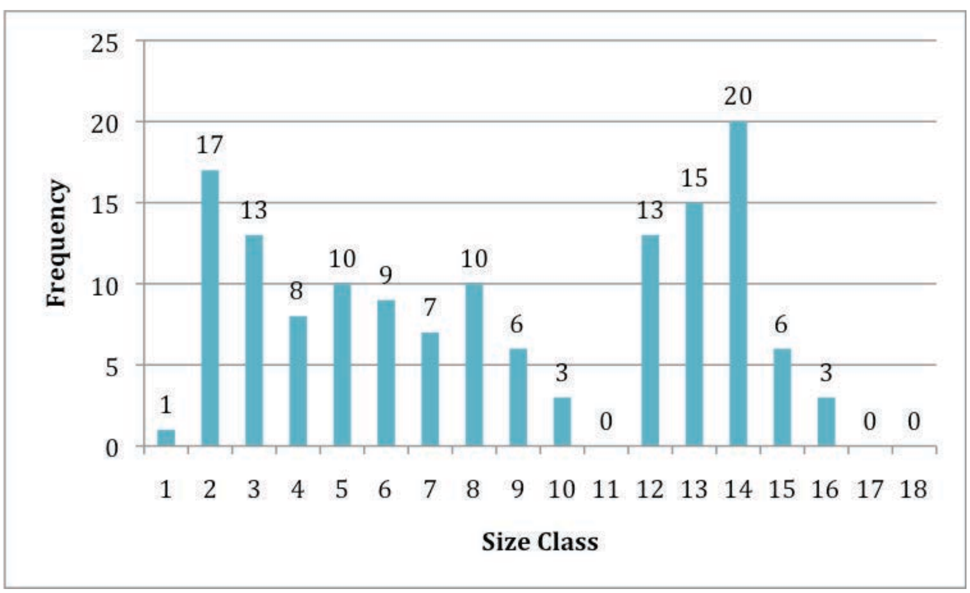

Figure 6: Distribution of carapace lengths of 141 gopher tortoises. Class designations follow Alford (1980) and indicate the following maximum carapace lengths (mm) in each class: 1-48; 2-66; 3-84; 4-102; 5-120; 6-138; 7-156; 8-174; 9-192; 10-210; 11-228; 12-246; 13-264; 14-282; 15-300; 16-318; 17-326; 18-344. Number above each column represents the number of individuals in that size class.

Table 1: Comparison of von Bertalanffy and logistic growth interval models of gopher tortoises. Variable *a* is asymptotic carapace length (mm), variable *r* is characteristic growth rate, MS is residual mean square and AIC is Akaike's Information Criteria. The 95% confidence intervals are in brackets and standard errors are in parentheses.

Model	**Asymptotic CL (*a*)**	**Growth Parameter (*r*)**	**MS**	**AIC**
von Bertalanffy	269.4 (0.931)	0.097 (0.019)	10.1	468.13
	[250.5 – 288.2]	[0.057 - 0.137]		
Logistic	266.7 (0.659)	0.169 (0.017)	8.9	459.04
	[253.5 -280.3]	[0.134 - 0.204]		

Table 2: Mean and range of carapace lengths (mm) for each age class at first capture (1990-1994).

Age Class	**n**	**Average Carapace Length (mm)**	**Range**
Hatchling	9	53.39	46-73.9
Juvenile	3	110.4	98-128.2
Subadult	3	148	128-166
Male	11	216.65	171-249.5
Female	11	256.91	218-286.7

Table 3: Mean egg length measurements and ranges (mm) and mean weights and ranges (g) for 2010-2011.

Burrow #	**Clutch Size**	**Horizontal Length**	**Vertical Length**	**Weight**
22	8	39.94 (39.2 - 41.2)	40.21 (39.6 - 41.6)	37.89 (36.5 - 39.0)
305	8	41.65 (38.2 - 45.6)	41.41 (39.0 - 43.2)	41.3 (33.0 - 45.0)
219	5	43.1 (42.2 - 44.6)	43.26 (41.9 - 44.8)	46.4 (44.0 - 48.0)
241	4	40 (38.5 - 40.8)	39.9 (38.9 - 41.7)	31.9 (26.8 - 36.9)
Mean	6.25	41.17	41.19	39.37

Table 4: Review of gopher tortoise egg characteristics from studies throughout the tortoise's range.

State	Hatch Success	Mean Clutch Size	Mean Egg Diameter (mm)	Mean Egg Mass (g)	Reference
FL	100% -2010 0% - 2011	6.25	41.18	39.37	Current Study
FL	80.60%	5.04	42.2	37.7	Butler and Hull (1996)
FL		5.8			Diemer (1986)
FL		5.18	43.3	41.0	Iverson (1980)
FL		7.46		38.11	Demuth (2001)
FL	[1] 77%	[2] 8.9		[1] 36.0	[1]Burke et al. (1996) [2]Burke (1987)
FL	92%		43.5		Arata (1958)
FL			41.6		Hallinan (1923)
FL	28%			38.1	Linley and Mushinsky (1994)
FL	67-97%				Smith (1995)
GA	86%	7.0	44.8	44.5	Landers et al. (1982)
GA	86.96% 81.22%	6.52 4.52		42.6 40.7	Rostal and Jones (2002)
SC		3.8	43.3	39.4	Wright (1982)
LA **MS**		5.6 5.5			Smith et al. (1997)

Demographics Discussion

Burrows

Applying the Auffenberg and Franz (1982) correction factor (0.614) to calculate population size may result in overestimation (Burke, 1989) or underestimation when tortoises are crowded into areas by landscape changes. The total population would be overestimated by a factor of 1.16 and the adult population by a factor of 1.6. Several gopher tortoise studies have suggested habitat or even site-specific correction factors are much more reliable (Burke, 1989; Breininger et al., 1991; Witz et al., 1992). My correction factor (0.53 total population; 0.38 adults only) is similar to that reported by Witz et al. (1992) and recommended by Mushinsky et al. (2006) for sandhill habitats (0.44 and 0.50 respectively). I arrived at my correction factor estimate after 16 months of bucket trapping. Another study done on UNF's campus at the same site used a robotic camera to search 50 adult tortoise burrows over a four-day period, and their correction factor was 0.4 (Ally Legeza, personal communication). The similarity in correction factors between those two studies suggests my correction factor and population estimate are accurate. Further, the use of advanced technology such as the robotic camera could alleviate the effort and time spent trapping, and the uncertainty associated with correction factors and population estimates. Although the general correction factor of 0.614 resulted in an overestimation, a chi squared test proved that there was not a significant difference in the number of actual versus expected total tortoises and adult tortoises. Correction factors seem to be adequate ways to assess population numbers but my calculated correction factor supports Burke's suggestion for site-specific estimations.

Demographics

Twenty-eight fewer tortoises were found in the current study than in the early 1990's (unpublished data). In the earlier study on this site, tortoises recorded consisted of 77 hatchlings, 20 juveniles, 11 young adults, 30 adult females and 31 adult males. The number of adults between studies is similar, but there were more juveniles and young adults, and 56 fewer hatchlings in the current study. The adult numbers for this site are similar to a study from two sites in southeast Georgia (George L. Smith State Park [GLS]: 30 males, 38 females; Fort Stewart Army Reserve [FSAR]: 34 males, 41 females), but the young adult and juvenile numbers are drastically different (GLS: 16 young adults, 0 juveniles; FSAR: 8 young adults, 2 juveniles; Rostal and Jones, 2002). The adults on these two sites represented 75% and 79% of all captures for GLS and FSAR, respectively. The percentage of adults captured on my site (42.5%) is very similar to the one found by Diemer (1992) in a study in North Florida (40 – 54%), perhaps due to a difference in trapping effort. Intermediate sized individuals were better represented than very small and very large individuals. Low hatchling numbers was expected due to predation. Wilson (1991) documented high predation on tortoises less than five years old. Our data supports Alford's (1980) suggestions that there is high mortality during the first year of a tortoise's life.

The sex ratio for this study (1:1.14 males to females) is slightly different than other studies performed in north Florida in that more females were recorded than males. In other studies male to female sex ratios have been reported in north Florida of 1.07:1 and 1.2:1 (Butler and Hull, 1996; Demuth, 2001). Studies in southeast Georgia found sex ratios of 1:1.21 and 1:1.27 favoring females (Rostal and Jones, 2002) and Smith et al.,

(1997) had sex ratios of 1:1 in Mississippi and Louisiana. A higher number of females on this site probably helps limit male combat over potential mates.

Long-Term Growth Rates

Although the logistic growth model fits this population better, the von Bertalanffy model also fits the growth rates. The asymptotic size (*a*) estimate was very close between the models. Frazer et al. (1990) suggested that the asymptotic size should be larger than the average size of the larger adults in the population, which is the case for both models (Tables 2 and 3). Because sexual maturity in gopher tortoises is reached at certain sizes rather than ages (Diemer and Moore, 1994; Mushinsky et al., 1994; Aresco and Guyer, 1999) the point in which growth rates begin to slow can help predict size at sexual maturity (Aresco and Guyer, 1999).

In a study done in slash pine plantations in south-central Alabama (Aresco and Guyer, 1999), the von Bertalanffy model fit better. My study had a characteristic growth parameter (*r*) of 0.07 for males and 0.05 for females. The study on my site had von Bertalanffy *r* values of 0.12 for males and 0.10 for females. Aresco and Guyer (1999) believed that a lack of abundant, high quality forage may be what was missing to fuel a subadult growth spurt required for gopher tortoise growth to fit the logistic model. In a similar study done on a site managed by fire in central Florida the logistic model fit best (Mushinsky et al., 1994). The *r* value for my study was 0.169 for the logistic model, which is higher than the value Mushinsky et al. (1994) found in a central Florida population, as 95% confidence intervals between the two studies did not overlap. Habitat conditions and percent groundcover could be the causes for the increased growth parameter on this site.

There are only a few size classes that were poorly represented for my population, most of them occurring at the extreme low and high size classes (Fig. 6). My size distribution skewness is positive, with most tortoise CLs being less than the mean, suggesting high recruitment. Witz et al. (1992) suggested that populations with fewer intermediate-sized individuals and a large number of juveniles may be more susceptible to extinction due to predation. The Lorenzen mortality rate equation fits this population the best, especially when using Witz's survival-past-year-one estimate as the mortality rate reference. I feel confident in the mortality rate estimate of this population based on the similarity of adult mortality rates for all three equations.

Reproduction

Although my reproductive success appears low, our evaluation of reproduction in this population is inconclusive. Hatching success on my site for the current study was 100% in 2010 and 0% in 2011. While the clutch laid on the grounds surface in 2011 may have been infertile, Smith (1995) suggested that it might be preferable for females to lay eggs away from the apron since some predators may recognize aprons as potential nest sites. The earlier study on this site had hatching success of 80.6% (Butler and Hull, 1996). Other studies found a range of hatching success rates from 28 – 97%, with the high and low of the range occurring in Florida (Table 4). The current study provides data that suggest high recruitment.

Average clutch size for this site was 5.04 in the earlier study and 6.25 in the current study. Although fewer eggs were found on this site during the current study the average clutch size was not only higher than the earlier study, but also higher than most other studies performed. Butler and Hull (1996) found an average clutch size almost

identical to Hallinan (1923) and both studies were performed in Duval County. The current study site's average clutch size was higher than other north Florida studies, and slightly lower than those performed in the panhandle and central/south Florida (Table 4).

Average egg diameter for the current study was slightly lower than the earlier study on this site (41.18mm versus 42.2mm). These diameters are slightly less than other studies, but still very similar. Our mean egg diameter was closest to Hallinan's (1923). Mean egg mass in the current study was 39.37g compared to 37.7g in the earlier study on this site (Butler and Hull, 1996). Egg mass on this site is lower than several other studies (Table 4). Our mean egg mass was most similar to Wright (1982) (Table 4).

Vegetation Results

Percent Groundcover Analyses

When pre-burn data were compared with post-burn data sets for each of the four transects, all significant differences were due to an increase in percent groundcover except for after the initial post-burn analysis in T1. Percent groundcover for T1 was also significantly different between the pre-burn data and the first post-burn analysis done in July 2009, but this was the only significant difference due to a decrease in percent groundcover. The difference in percent groundcover was significant for T1 between the pre- and the post-burn analysis taken two years after the burn (July 2011; $p = 0.000$; $df = 9$) but not one year after the burn (July 2010; $p = 0.737$; $df = 9$) (Table 2). Percent groundcover in T4 was not significantly different one year after the burn (September 2010; $p=0.438$; $df = 9$), but was significantly different almost two years after the burn (July 2011; $p=0.005$; $df = 9$) (Table 2). The remaining transects did not have significant differences in percent groundcover one year after the burns (Fig. 1). Overall, burned transects increased in percent groundcover one to two years post-burn (Fig. 2). Percent groundcover was never less than 12% for any transect over the entire three-year study (Fig. 3). Minimum percent groundcover appropriate for gopher tortoises is suggested to be 40% (FWC, 2007), which was only reached in T4 two years post-burn (Fig. 1). Otherwise, overall averages by year or by transect for this study never yielded values greater than 40% for groundcover (Figs. 2 and 3). The species that composed the highest percent groundcover for this site was wiregrass (*Aristada* spp.).

Species Richness Analysis

Fifty-four different species were found representing 48 different genera and 27 different families for pre- and post-burn analyses (Table 1). Paired t-tests returned significant differences in species richness between some pre-burn data and post-burn analysis for T1 as a result of a decrease in species number. A significant decrease was found between pre- and five-month post-burn data for T2 and T3. No significant differences were found in T4 (Table 3). There was a decrease in species richness over time in T1, while T2 and T3 maintained relatively stable species numbers throughout the entire study (Fig. 4). Species richness in T4 decreased one year after the burn, but increased two years post-burn (Fig. 4). Average yearly species richness for this site from 2008-2011 is low, with the average number for all transects remaining under four (Fig. 5). Average species richness for each transect over the three year study remained less than three species (Fig 6). The Bray-Curtis dissimilarity index indicated that all burned transects were very similar to each other through time with the least similar value being 0.28 (T2 vs. T3) occurring two years post-burn and the most similar value being 0 for multiple comparisons (T1/T4, T2/T4) one and two years after the burn (Fig. 7 and Table 4). The species present in the vegetative community did not change much after the burns other than bracken fern being present immediately after a burn, but the amount of each species was greater than before the burn.

Percent Open Canopy Analyses

For all burned transects, all significant differences were due to increases in percent open canopy cover between pre- and post-burn data. In T1, there were significant

increases in open canopy in 10 of the 11 bimonthly analyses, with the only non-significant one occurring at the height of the growing season (July 2010) one year after the burn. For six out of seven analyses the percent open canopy cover for T2 was significantly different; for T3 four of seven analyses; and T4 was significantly different nine out of 10 analyses (Table 5). Percent open canopy was greater for all post-burned data than for any pre-burn analysis (Fig. 8 and 9). Open canopy greatly increased after the burns, but two years post-burn it was beginning to decrease (Fig. 9). Overall averages, by year or by transect, never reached an open canopy percentage of 50% or more which is suggested by FWC (2007) for suitable gopher tortoise habitat (Figs. 8, 9 and 10).

Percent Open Canopy vs. Percent Groundcover

For each burned transect there were no more than two months in which open canopy correlated significantly with groundcover; the strongest significant correlation occurred in T3 with a correlation value of 0.838 on a scale of -1.00 to 1.00, and the lowest correlation value for these three values was 0.787 (T4) (Table 6). No negative correlations were found. For all significant correlations in all transects the values fall within the “large correlation” guidelines provided by Cohen (1988, pg. 79-81) (Figs. 11 – 16). The percent open canopy had little effect on the percent groundcover data of the following analysis performed two months later. Of 35 comparisons only three showed significant differences and no transect had more than one (Table 7).

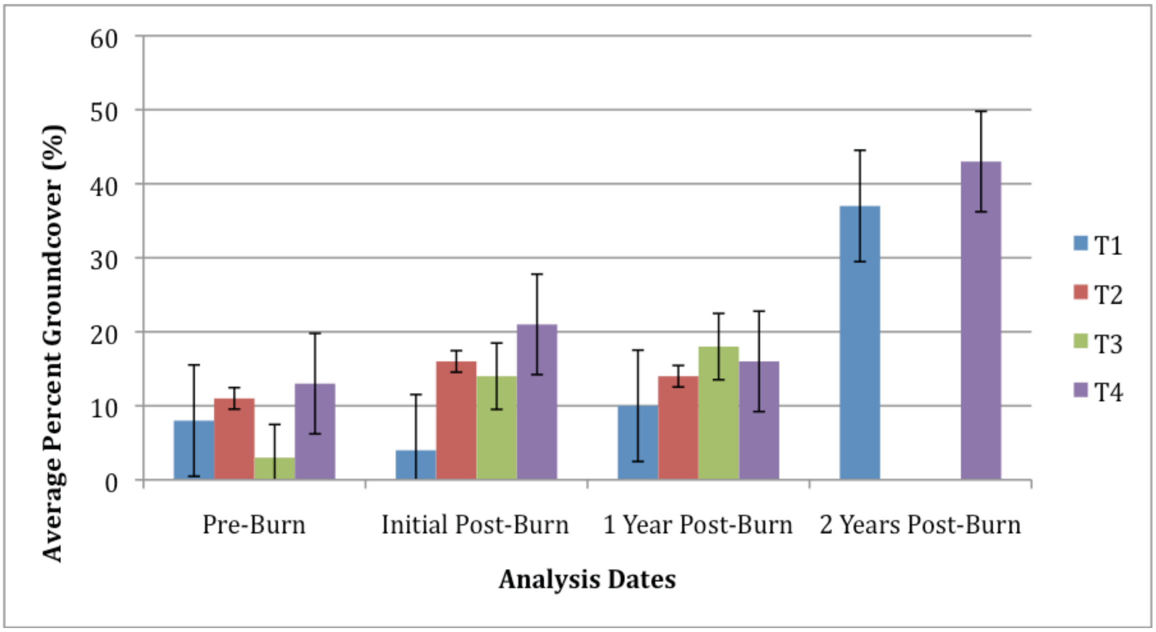

Figure 1: Average percent groundcover of experimental transects pre-burn, initial post-burn, 1 and 2 years post-burn.

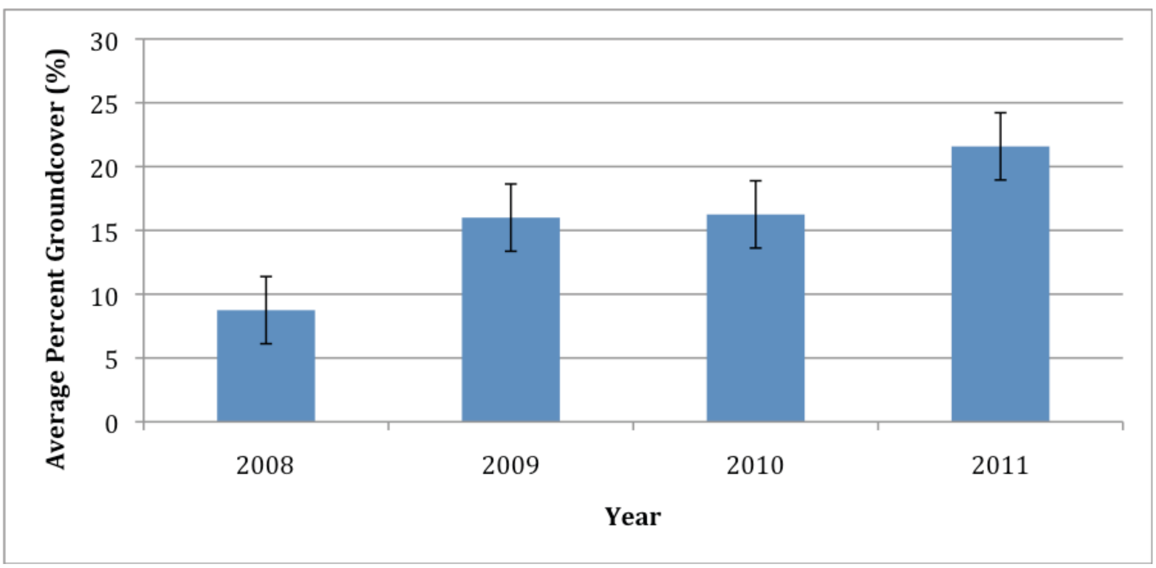

Figure 2: Average percent groundcover for all transects per year.

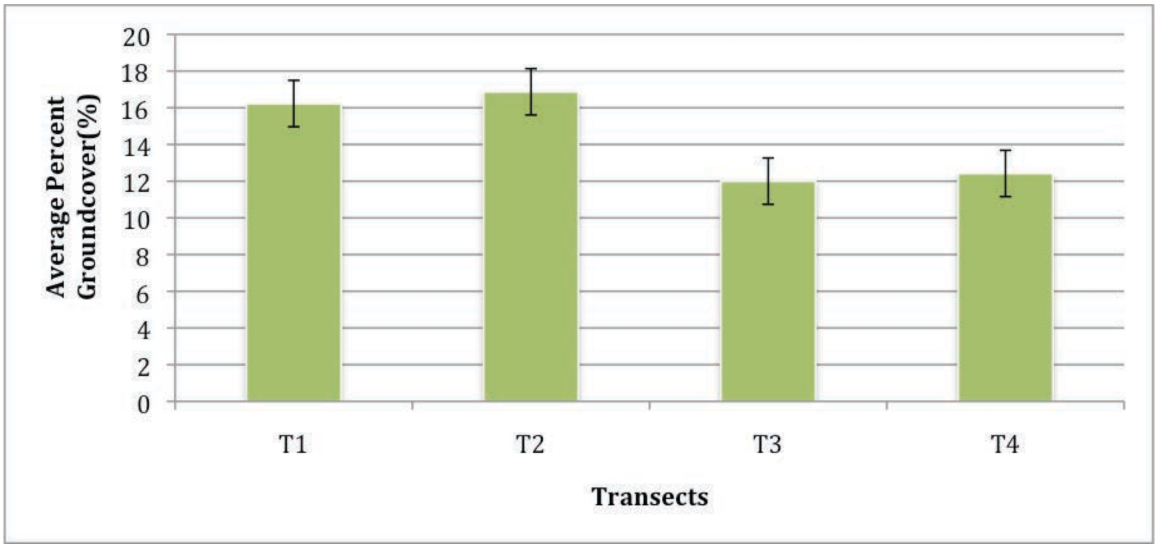

Figure 3: Average percent groundcover of each transect for all 1-2 year analyses.

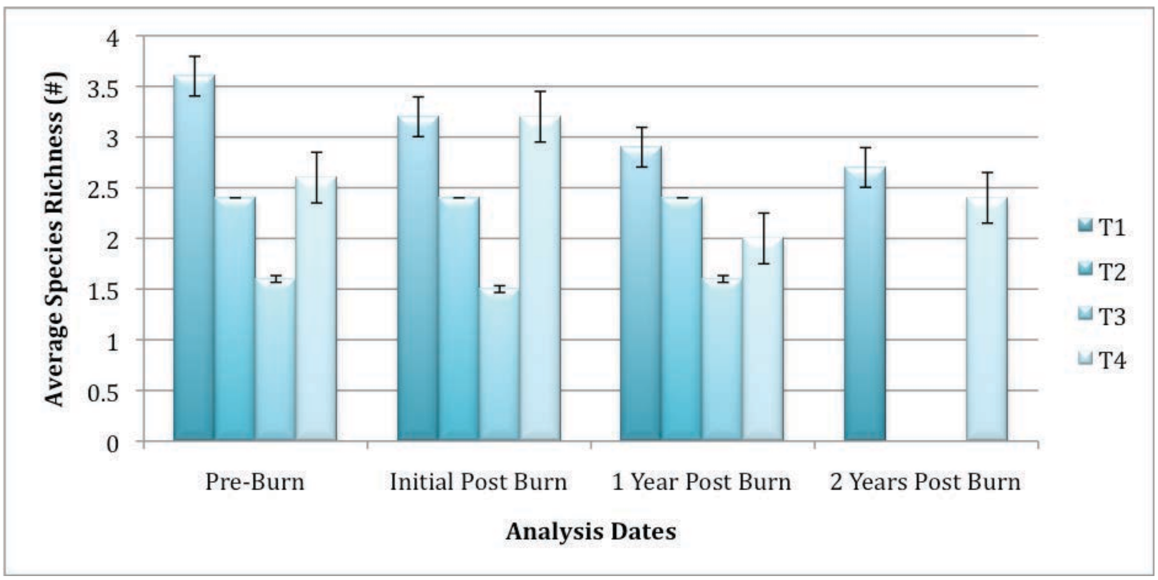

Figure 4: Average species richness of burned transects pre-burn, initial post-burn, 1 and 2 years post-burn.

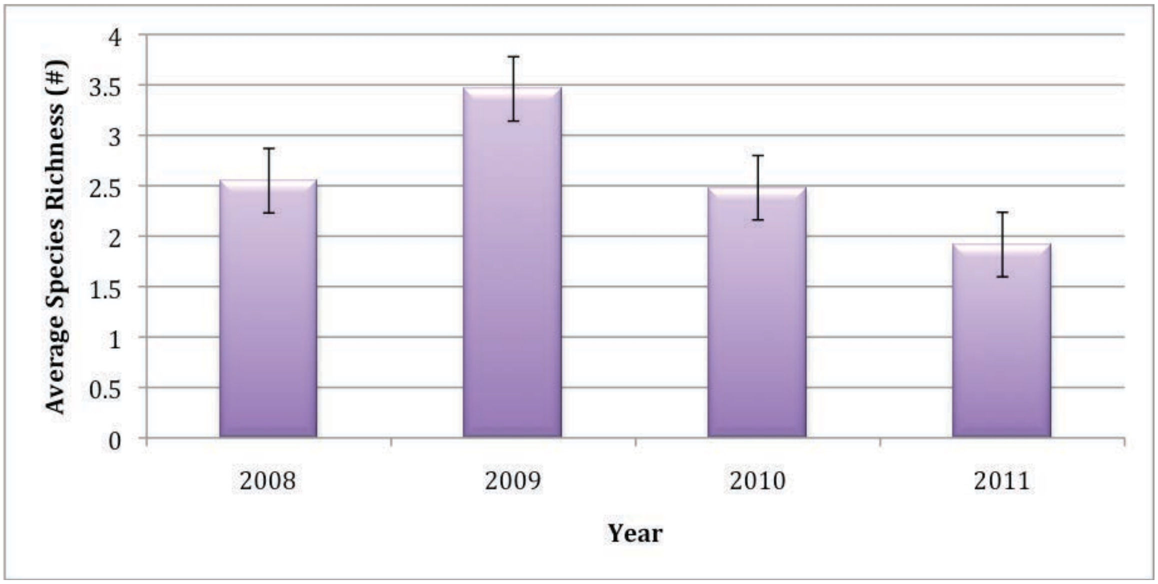

Figure 5: Average species richness for all transects per year.

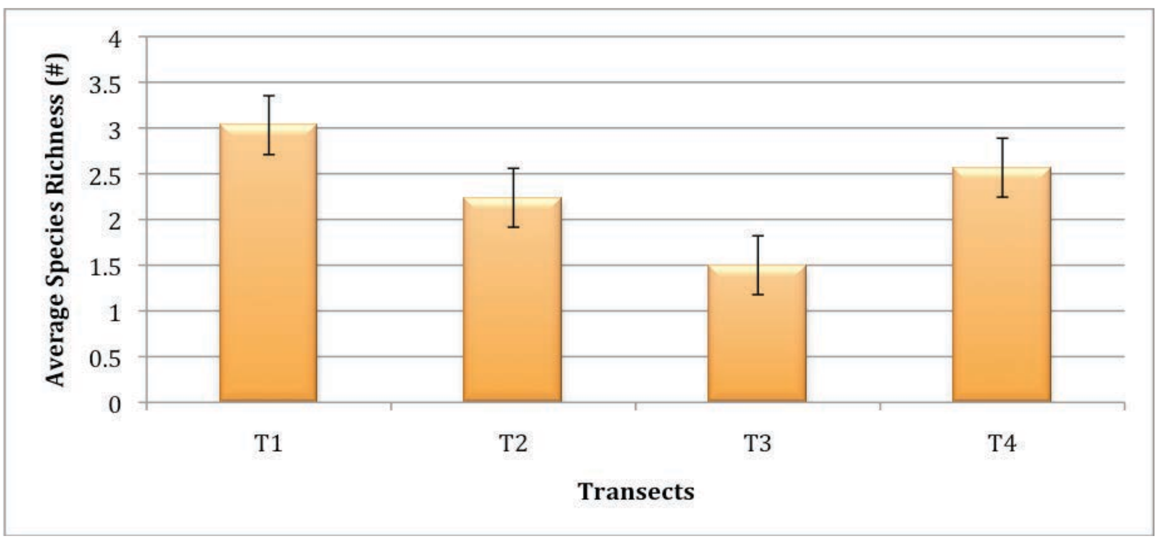

Figure 6: Average species richness of each transect for all 1-2 year analyses.

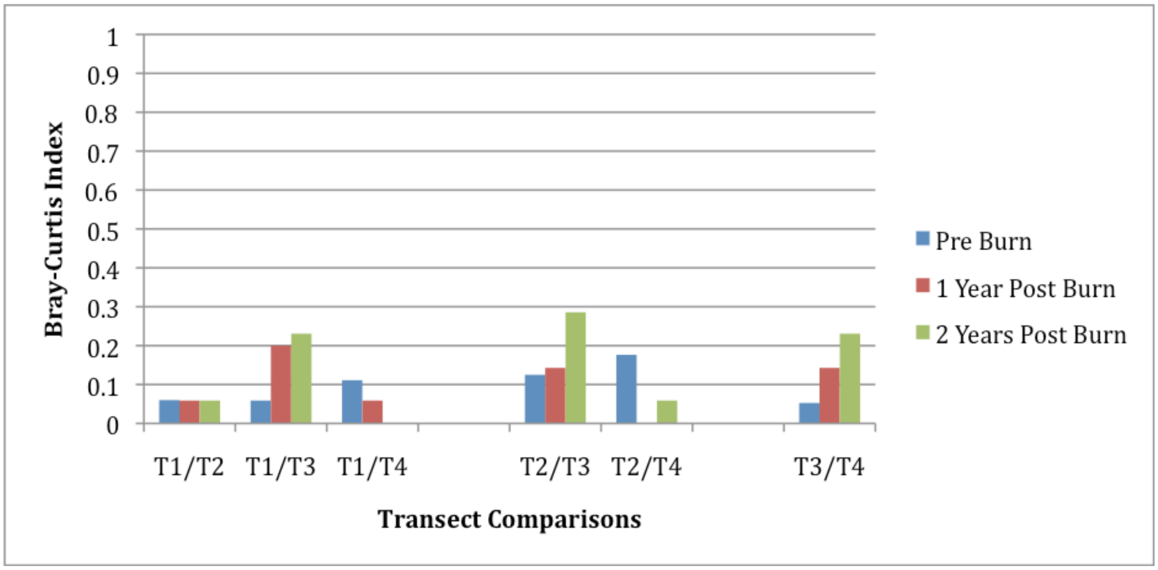

Figure 7: Bray-Curtis Dissimilarity Index between all transect combinations.

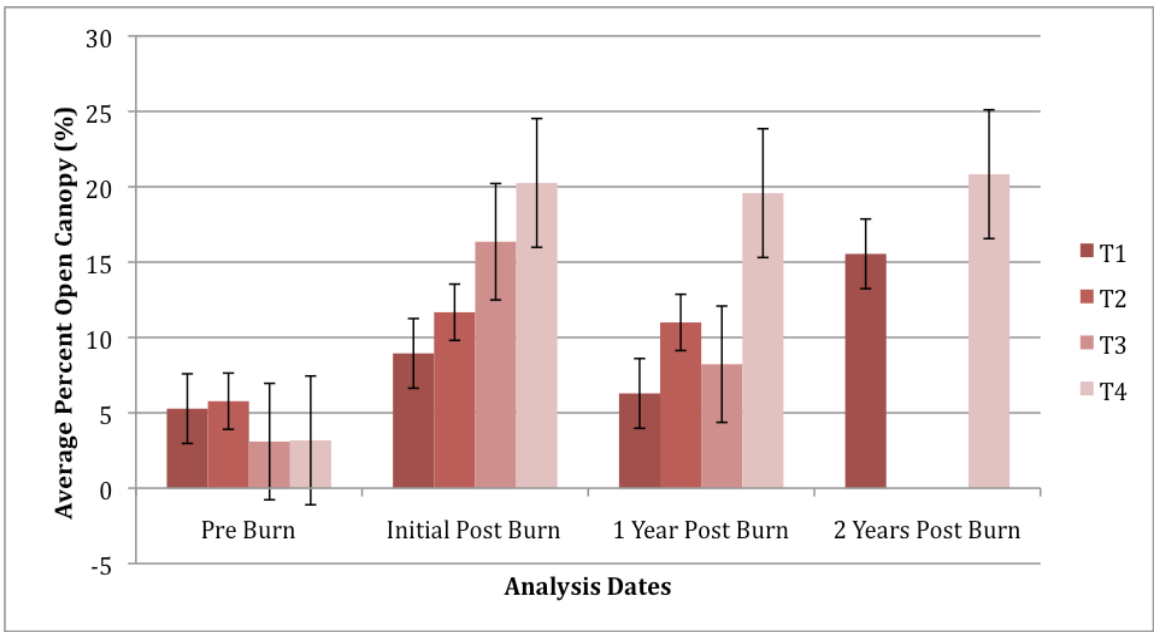

Figure 8: Average percent open canopy of burned transects pre-burn, initial post-burn, 1 and 2 years post-burn.

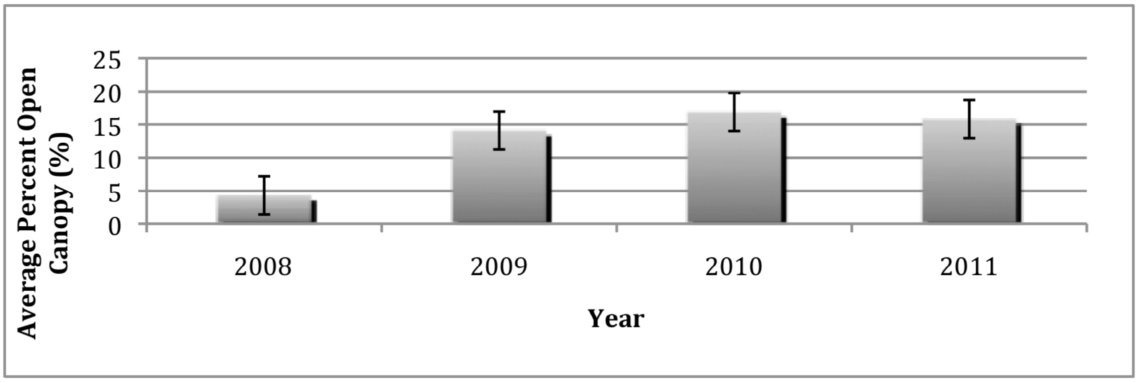

Figure 9: Average percent open canopy for all transects per year.

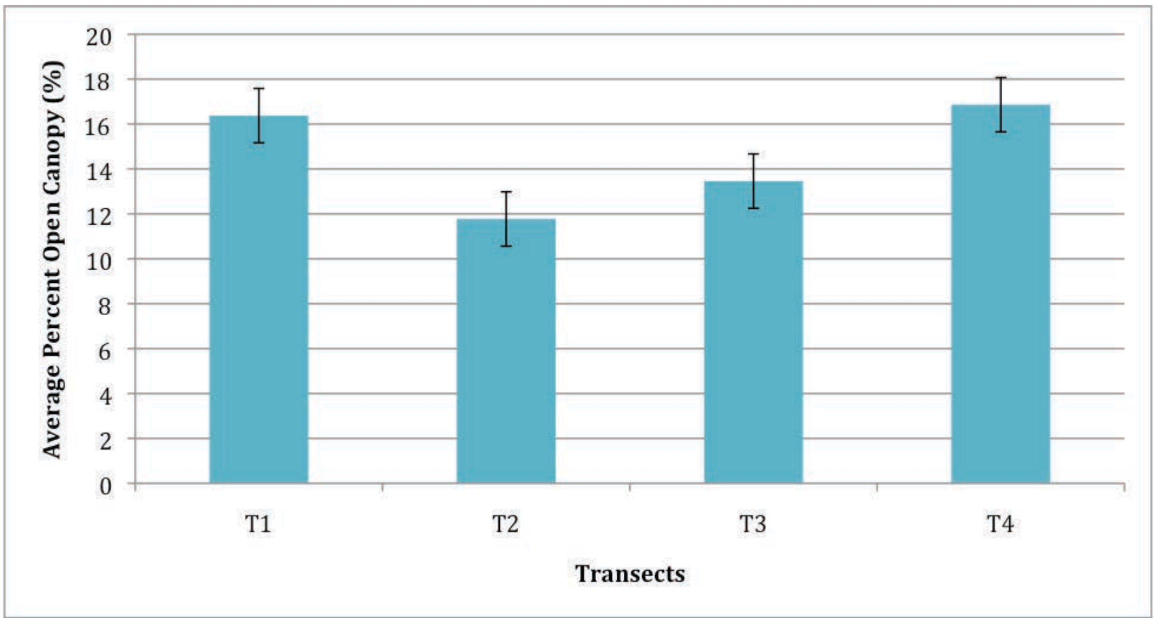

Figure 10: Average percent open canopy of each transect for all 1-2 year analyses.

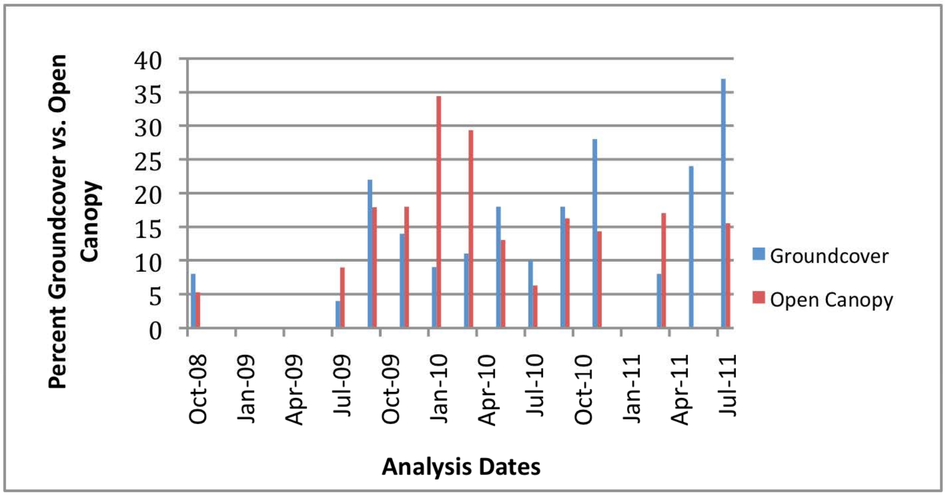

Figure 11: Transect 1 percent open canopy vs. percent groundcover. Months with no data are periods between pre- and post-burn data collection.

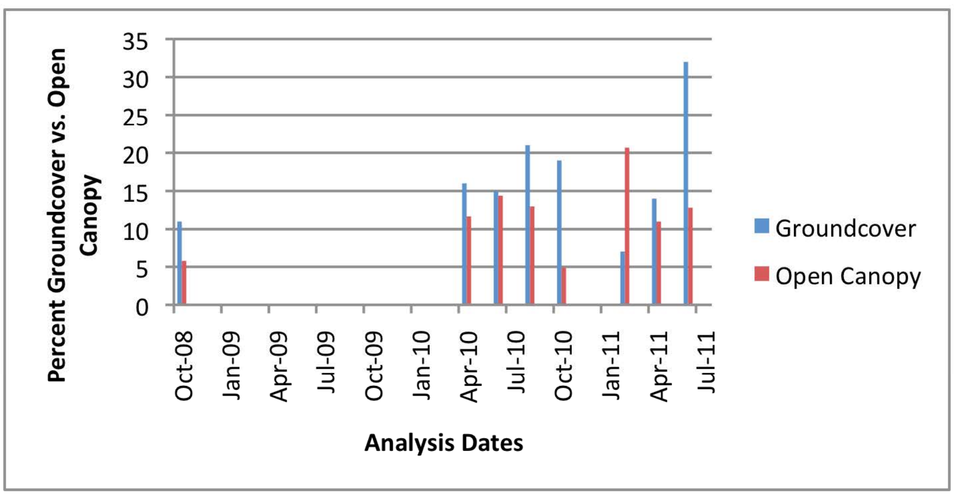

Figure 12: Transect 2 percent open canopy vs. percent groundcover.

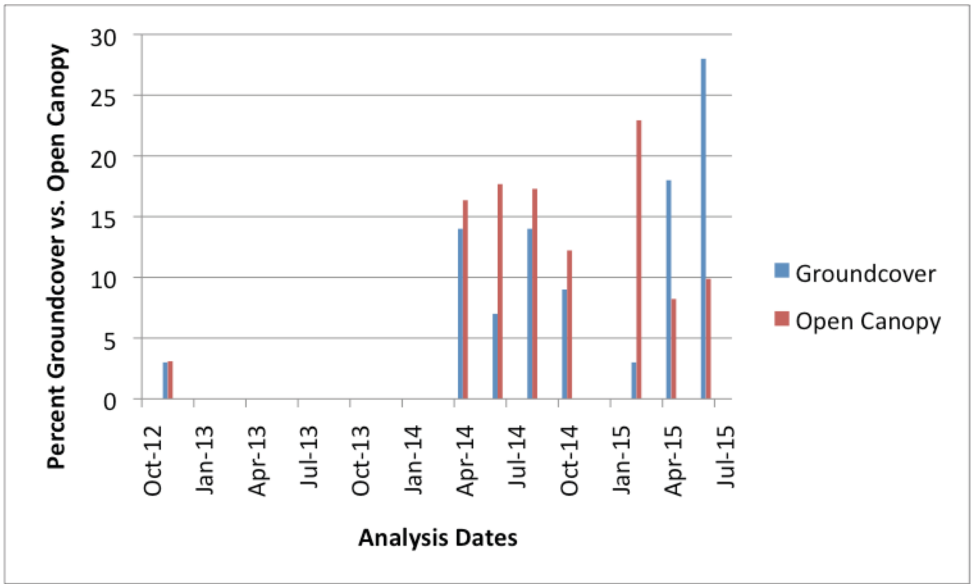

Figure 13: Transect 3 percent open canopy vs. percent groundcover.

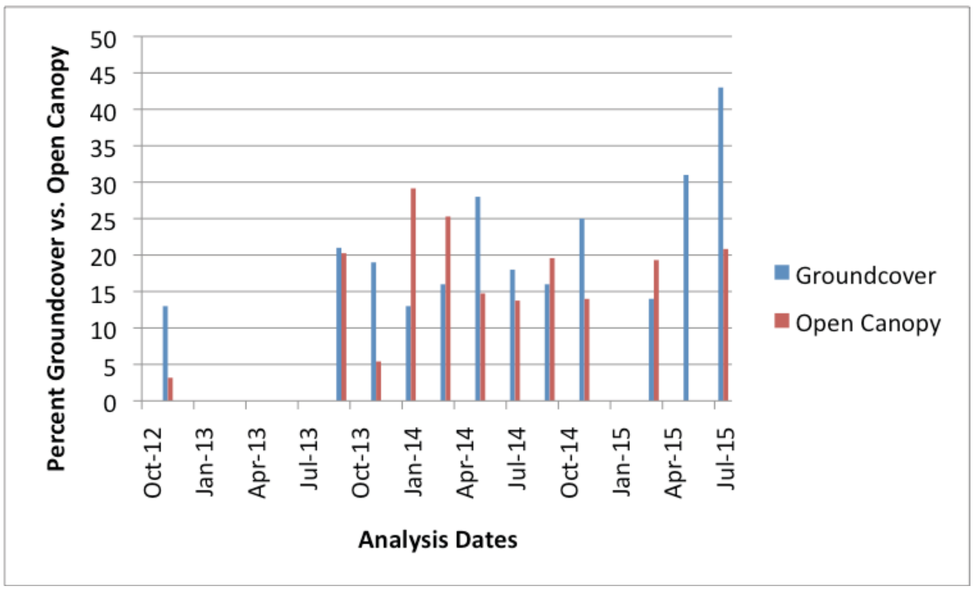

Figure 14: Transect 4 percent open canopy vs. percent groundcover

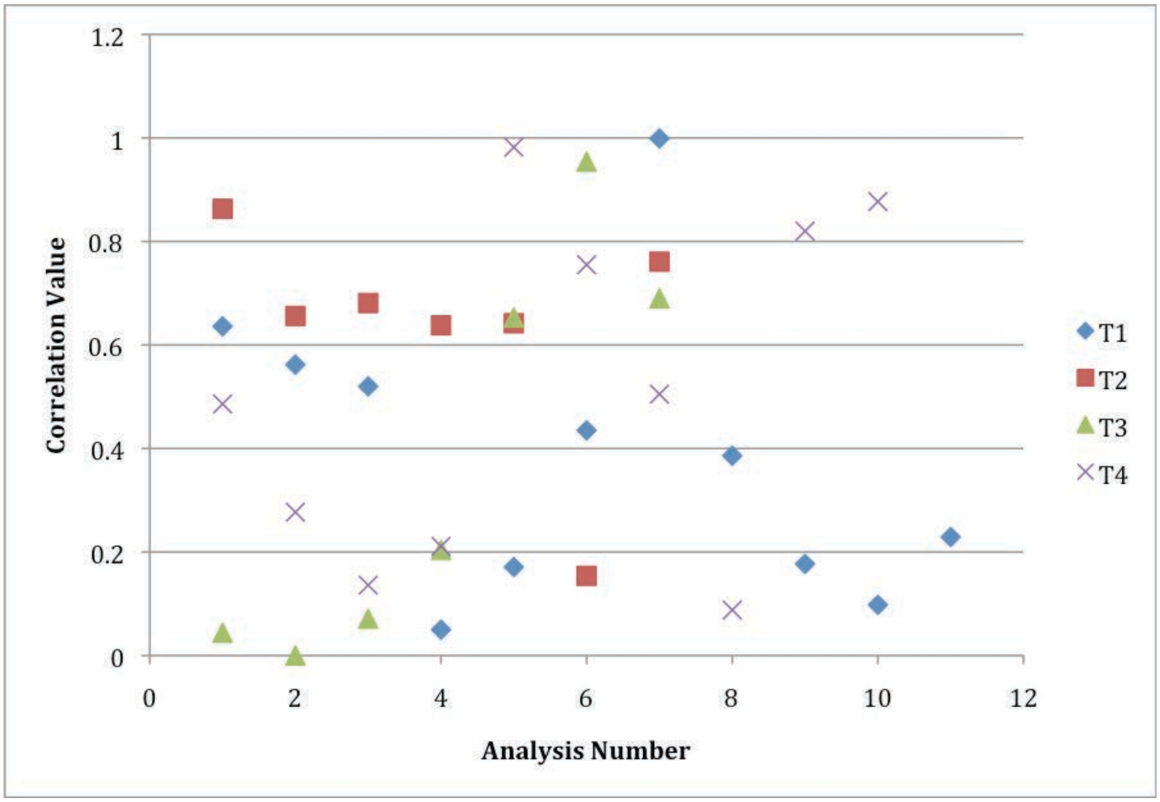

Figure 15: Correlation scatterplot for percent open canopy versus percent groundcover of the same data set.

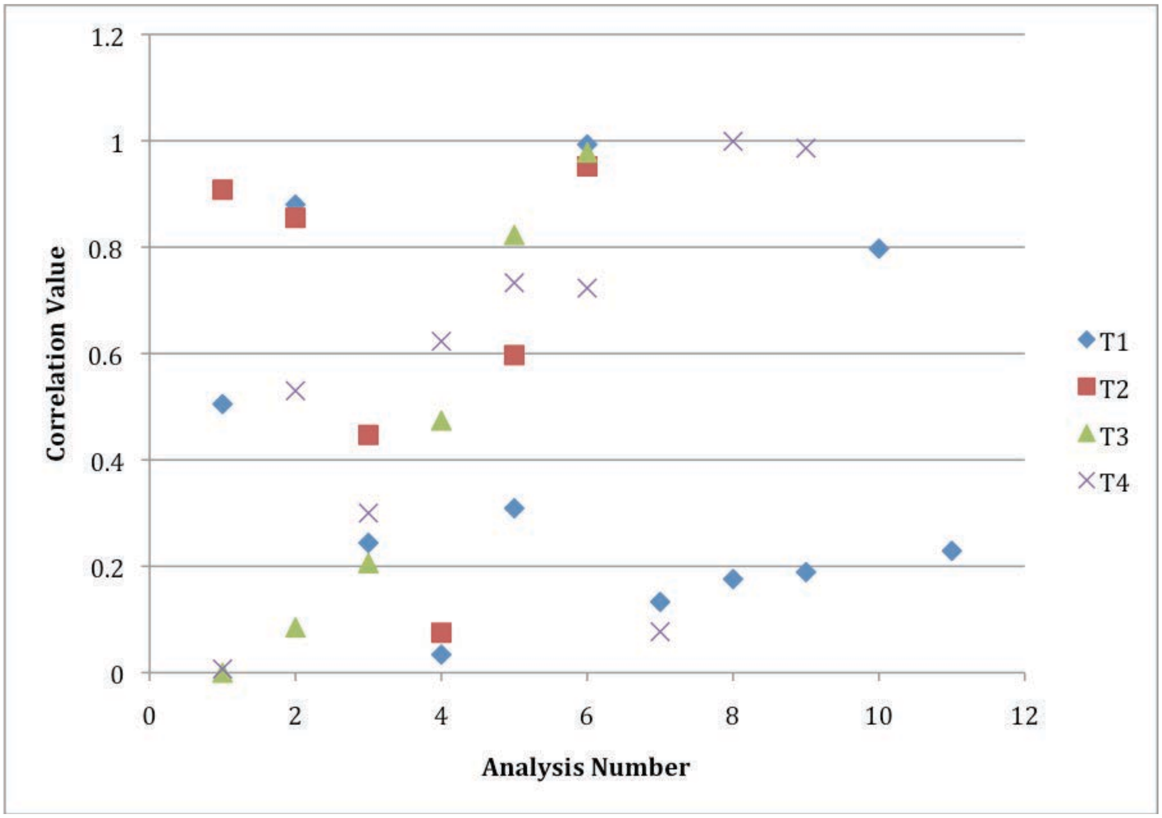

Figure 16: Correlation scatterplot for percent open canopy versus percent groundcover of the following data set.

Table 1: Vegetation found in all four transects for the entire study period

Family	Genus	Common Name
Anacardiaceae	Toxicodendron	Poison Ivy
Annonaceae	Asimina	Paw Paw
Apocynaceae	Ascepias	Milkweed
Aquifoliaceae	Ilex	Holly
Araliaceae	Hydrocotyle	Dollarweed
Arecaceae	Serenoa	Saw Palmetto
Asteraceae	Liatris Solidago Pterocaulon Cirisium Lygodesmia Arnoglossum Lactuca Taraxacum Pseudognaphaceae	Blazing Star Goldenrod Applebush Black Root Thistle Rose Rush Indian Plantain Woodland Lettuce Dandelion Rabbit’s Tobacco
Chrysobalanaceae	Licania	Gopher Apple

Clusiaceae	Hypericum	St. John's Wart
Commelinaceae	Commelina	Dayflower
Cyperaceae	Cyperus	Flatsedges
Dennstaedtiaceae	Pteridium	Bracken Fern
Ericaceae	Gaylussacia Vaccinium Lyonia	Dangleberry Dwarf Huckleberry Blueberry Staggerbrush
Euphorbiaceae	Stillingia Croton Cnidoscolus	Queen's Delight Rushfoil Tread-Softly
Fabaceae	Galactia Clitoria Trifolium Mimosa	Milkpea Butterfly Pea Clover Sensitive Plant
Fagaceae	Quercus	Turkey Oak Chapman's Oak Running Oak Sand Live Oak
Hypoxidaceae	Hypoxis	Stargrass
Juncaceae	Juncus	Rushes
Lamiaceae	Monarda	Horsemint
Myricaceae	Myrica	Wax Myrtle
Oleaceae	Jasminum	Jasmine
Pinaceae	Pinus	Longleaf Pine
Poaceae	Aristada Digitaria Andropogon Eragrostis Dicanthelium Paspalum Panicum	Wiregrass Crabgrass Bluestem Lovegrass Rosette Grass Dallis Grass Bahia Grass Switchgrass
Smilicaceae	Smilax	Green Briar
Verbenaceae	Phyla	Frog Fruit
Vitaceae	Vitis	Muscadine Grape
Xyridaceae	Xyris	Yellow Eye

Table 2: P values for percent groundcover of each transect. Red numbers indicate significant differences between pre-burn and corresponding post-burn data at a P < 0.05. Purple stars indicate significant differences when the Bonferroni correction value was applied.

Transect	Post 1	Post 2	Post 3	Post 4	Post 5	Post 6	Post 7	Post 8	Post 9	Post 10	Post 11	Post 12	Bonferroni Correction
T1	0.022	0.005	0.091	0.558	0.419	0.05	0.737	0.044	0.027	0.864	0.002*	0*	B < .004
T2	0.01	0*	0.001*	0.018	0.544	0.645	0*						B < .007
T3	0.099	0.172	0.017	0.047	0.77	0.009	0.009						B < .007
T4	0.01	0.196	0.888	0.407	0.005	0.079	0.438	0.059	0.794	0.029	0.005		B < .004

Table 3: P values and Bonferroni correction values for species number of each transect.

Transect	Post 1	Post 2	Post 3	Post 4	Post 5	Post 6	Post 7	Post 8	Post 9	Post 10	Post 11	Post 12	Bonferroni Correction
T1	0.269	0.743	0.693	0.053	0.423	0.309	0.035	0.042	0.006	0.001*	0.153	0.068	B<.004
T2	1	0.751	0.664	0.876	0.033	1	0.627						B<.007
T3	0.758	0.78	0.443	0.758	0.01	1	0.343						B<.007
T4	0.26	0.191	0.591	0.662	0.104	0.26	0.14	0.153	0.087	0.496	0.678		B<.004

Table 4: Bray-Curtis dissimilarity index.

	Pre-Burn	1 Year Post - Burn	2 Years Post - Burn
T1/T2	0.06	0.0588	0.0588
T1/T3	0.0588	0.2	0.2307
T1/T4	0.1111	0.0588	0
T2/T3	0.125	0.1428	0.2857
T2/T4	0.1764	0	0.0588
T3/T4	0.0526	0.1428	0.2307

Table 5: P values and Bonferroni correction values for percent open canopy of each transect.

Transect	Post 1	Post 2	Post 3	Post 4	Post 5	Post 6	Post 7	Post 8	Post 9	Post 10	Post 11	Bonferroni Correction
T1	0.011	0*	0.002*	0.001*	0.001*	0.021	0.838	0.006	0.002*	0.001*	0.002*	B<.004
T2	0.004*	0.002*	0.002*	0.407	0*	0.004*	0*					B<.007
T3	0.048	0.017	0.017	0.257	0*	0.109	0.072					B<.007
T4	0.004*	0.142	0*	0.001*	0.004*	0.012	0.001*	0*	0.001*	0.015		B<.005

Table 6: P values and Bonferroni correction values for percent open canopy versus percent groundcover at each analysis.

Transect	Post 1	Post 2	Post 3	Post 4	Post 5	Post 6	Post 7	Post 8	Post 9	Post 10	Post 11	Bonferroni Correction
T1	0.636	0.562	0.52	0.05	0.171	0.435	0.999	0.386	0.177	0.098	0.229	B<.004
T2	0.863	0.656	0.681	0.638	0.642	0.154	0.761					B<.007
T3	0.044	0.002*	0.071	0.204	0.653	0.954	0.69					B<.007
T4	0.486	0.277	0.136	0.211	0.982	0.755	0.505	0.088	0.82	0.877		B<.005

Table 7: P values and Bonferroni correction values for percent open canopy versus percent groundcover of subsequent data set.

Transect	Post 1	Post 2	Post 3	Post 4	Post 5	Post 6	Post 7	Post 8	Post 9	Post 10	Post 11	Bonferroni Correction
T1	0.505	0.88	0.244	0.034	0.309	0.993	0.133	0.176	0.189	0.797	0.229	B<.004
T2	0.908	0.855	0.447	0.075	0.597	0.952						B<.007
T3	0.001*	0.085	0.206	0.474	0.823	0.978						B<.007
T4	0.007	0.53	0.3	0.623	0.733	0.723	0.077	0.999	0.986			B<.005

Discussion

Tortoise habitats require fire to maintain herbaceous groundcover and an open canopy (Landers and Buckner, 1981). Historically, the highest gopher tortoise population densities have been in longleaf pine/turkey oak communities where these habitat characteristics were generated by periodic fires (Landers and Speake, 1980; Auffenberg and Franz, 1982; FWC Status Report, 2006). Particularly in the 20th century, natural fires have been suppressed in the interest of agriculture and other human development (Diemer, 1986) and many southeastern United States pine forests have dense canopies, thick shrub layers, and reduced herbaceous groundcover due to fire suppression (Yager et al. 2007). Fire suppression is one factor that has been associated with declines in gopher tortoise numbers and life expectancy (Auffenberg and Iverson, 1979; Auffenberg and Franz, 1982; Diemer, 1986; Breininger et al., 1994; Boglioli et al., 2000).

In this study, combined dormant- and growing-season burns in a previously fire suppressed forest resulted in increased herbaceous groundcover and open canopy when pre-burn data were compared with each post-burn analysis. Herbaceous groundcover and open canopy were significantly different from pre-burn conditions two years after the burn. Ground cover approached the suggested value of 40% two years after the burn. When each transect was analyzed over time, the data reflected extended growing seasons. Other studies done in southeastern pine forests indicated that repeated annual or biennial fires are necessary to promote herbaceous vegetation (Waldrop et al. 1992, Haywood et al. 2001, Glitzenstein et al. 2003, Yager et al. 2006). Landers (1980) found that mixed stands of longleaf pine, turkey oak and other scrub oaks that were burned every two to four years supported the densest tortoise colonies. Transects had lower average percent

groundcover pre-burn, but this increased over time after burning, probably due to less litter accumulation allowing sunlight to reach the ground. Species richness for all transects decreased over time after burning, with nitrogen-fixing plants sprouting first (i.e. bracken fern and warm-season grasses), and then replacement of these by fire-adapted plants (i.e. bluestem and wiregrass).

In a study by Mushinsky and Gibson (1991), sandhills that had not been burned in 16 years had open canopy ranging from 40-55%. Burned transects on my site were not burned between 1994 and 2009 and had open canopy ranging from 2-5% for all plots pre-burn. After prescribed burning began again in 2009, open canopy ranged from 4-34%. Open canopy was rarely correlated to increased groundcover for this site, however, open canopy for all transects never reached the suggested 50% or more (FWC, 2007). Although there were only three significant correlations in the analyses, the lowest r value was 0.787 (T4), which indicates that the correlations were highly significant. Litter was reduced immediately following the fires, but in the following year litter began accumulating, which could also account for the decline in production as litter is a light-limiting factor (Mushinsky and Gibson, 1991). Also, the last two years have been extremely dry which would also decrease plant growth.

While the burns did result in a slightly increased open canopy, this site was still not at the target level, of at least 50% suggested for viable tortoise populations (FWC, 2007) at the close of data collection in July 2011. To more fully address the closed canopy, UNF girdled about 200 small turkey oaks (dbh < 10cm) during the winter of 2010 (Chuck Hubbuch, personal communication). While this girdling will likely decrease future canopy cover, there was no effect during this study. In Mississippi, a study by

Yager et al. (2006) found that although prescribed burns did not result in increased open canopy, there were five times more burrows in burned than unburned areas. The burning did increase percent groundcover of herbaceous vegetation and at least prevented further deterioration of the habitat. Most of the vegetation on this site is also of high quality to gopher tortoises including bahia grass, gopher apple, and saw palmetto (Ashton and Ashton, 2008). Burning has been accepted as a management tool, but increased urbanization has limited its use (Ashton and Ashton, 2008). In natural and planted longleaf pine stands, frequent burning is the most important maintenance practice (Landers and Buckner, 1981; Breininger et al., 1994).

Appendix I

Tortoise #	Date Captured	Sex	Burrow #	Researcher	Transect	CL	CW	PL	TL	Thickness	Weight	Comments
1	5/26/11	F	72	Kris	UV	26	21.1	26.2	28.7	11.3	3.8	caught her yesterday but didn't have pack and she was very calm. Later yesterday saw her excavating B72. today caught her after BATTLING with tort from B70 and is VERY energetic today. She was winning the battle!
2	6/21/11	F	132	Anne		26.8	24	27.5	29.1	10.5	3.5	pooped 2x. Urinated, a lot of grey gritty matter and urine. Really didn't like being handled. Came out and went back into B132. observed her doing apron maintenance. Very worn plastron, flaky in some areas.
3	7/18/90	F	85	JB		21.6	16.6	22.4	23.3	9.3	1.9	recaptured as it approached B85. looks like T23 but 2 not drilled all the way so just 3. wasn't sure if MorF
4	4/3/90	YA - F	157	JB		17	12.9	17	18	7		AW:28.7mm AN:28.8mm PC:1.4mm went right into 157
5	7/29/11	M	288	Kris, Asher	DE	26.5	25	27.8	29.8	11.9	4.4	

6	8/20/10	M	216	Zack, Anne	BBCC	25.9	19.8	26.3	28.3	11.2	3.4	was entering a burrow with a large female in it. Deep damage on left dorsal scute middle. No ticks. Too old to estimate age.
7	4/12/93	F	1	JB		26.6	20.2	26.6	28.2	11	4	AW: 5.8 AN: 4.3 on apron of B1 at 500
8	4/27/09	F	69	JB, Hilary, Justin, Will, Sarah	XY	26.8	21.1	26.1		11.4	4	Sunning on apron of burrow. Some yellowing around scute margins and marginal scutes very orange and worn. Found sunning 4/28 and 4/29
9	8/1/11	M	365	Anne	AB	26.7	21.25	27.9	29.8	12	4.3	may have taken over a smaller torts burrow. Was grazing - crabgrass in mouth. A good size, shy. Small smear of blood on underside of marginal scute R anterior 2-3. could not remove tick. >21 growth rings worn smooth
10	9/26/93	M	296	JB	WX	24.01	18.31	21.42	25.32		2.4	
11	4/6/90	M	41	JB	LM	24	19.3	23.7	25.6	9.7	3	AW:59.9 AN:33mm PC:8.5mm GP:1.6cm
12	5/18/93	F	99	JB		26.1	20.1	25.7	27.2	10.6	3.4	found in road across from B244 9/25 entering B99 at 4:25
13	9/18/93	M	71	JB	TU	24.8	20.12	23.27	26.69		3	
14	4/10/90	F	98	JB	VW	20.5	15.8	20.7	21.5	8.7	1.7	AW:35.1 AN:26.4 PC:3.2 Recapture in bucket on 5/20 at B102 after trapping for 10 days.
15	4/10/90	M	87	JB	TU	23.3	17.4	22.3	23.7	10.3	2.6	AW:52.7mm AN:25.7mm PC:2.3mm GP:0.4cm

16	7/28/91	F	126	JB		27.7	20.8	27.3	28.9	11.6	6.2	DEAD-drowned in trap after it was set for 4 days
17	9/20/93	F	183	JB	YZ	19.02	14.4	17.71	19.85		1.2	
18	9/8/10	M	81	Ally	XY	23.4	18.4	24.6	26.5	11.3	2.4	started raining during measurements. Broken scutes on 10's side (7 scute). Very large gular scute. Walking in fire lane (eating).
19	4/19/93	M	182	JB		26.7	19.8	26.05	27.8	12.2	4	AW: 5 AN:4.8 caught again 4/21 and 5/5/ caught on apron of burrow 182 sitting in the sun facing N
20	5/10/02	M				27.3	21				4.3	
21	4/14/11	M	22	Anne	IJ	25.75	20.25	25.2	28	11	3.6	healthy, active, strong, eyes clear, 2 adult ticks in rear leg pockets, flakey plastron
22	9/5/11	F	133	Kris, Asher	HHII	26.8	19.1	27.5	29.2	10.6	3.6	tick taken, blood sample taken, hard to tell if it was a F because there seemed to be slight concavity. Very small adult. Looked like there could have been a tiny hole in scute 7 but kept as T22 - probably correct.
23	9/7/10	F	216	Anne, Natalia, Katie	BBCC	29.9	23	29.35	31.5	12.3	5	extremely lively and energetic. Defecated.
24	4/15/93	F	14	JB		26	20	25.8	27.4	10.9	3.5	AW:5 AN:3.8 this is female I ran over late last August is large elongated hole ~2in long on left central carapace, also humorals are entirely cracked from side to side so humorals and gulars are movable. Also the #40 marginal is broken at

												edge. Entering burrow at 3:40
25	5/18/92	F	14	JB		25.9	19.9	25.3	26.8	11.1	2.6	8/30 ran over with car near B14. organs sticking out of carapace and will probably die.
26	7/28/91	YA	197	JB		16.4	13.1	16.2	16.8	7	0.8	8/2 trapped in B146 after 9 days.
27	6/9/11	M	241	Kris	YZ	28.2	20.7	29.6	30.8	12.8	4.4	caught foraging in trail
28	4/14/93	F	240	JB		21.7	15.7	22.1	22.8	9.4	2	AW:3.89 AN:2.54m, 11 clear rings, pulled from B240
29	8/4/11	M	56	Kris	PQ	30.4	24.8	29.8	32.3	13	5.5	found him at B56 with another tortoise on the apron, they were facing each other. The other tort ran into the burrow and I grabbed him. When released went into B56. when I came back later both torts were back on the apron, the other one ran in, he bobbed his head and pushed his way back into B56 again.
30	9/9/93	M	27	JB	IJ	26.12	20.41	25.51	28.52		3.6	found on warn day. Fell in bucket between 9:30 and 11:40 am
31	4/26/93	M	284	JB		26.3	20.3	27.2	28.4	11.4	4.1	AW:6.55 AN:3.5 on apron of 284 at 3:00PM. Left hindleg still swollen
32	5/2/90	F	136	JB	IIJJ	17.3	12.7	17.3	18	7.1	0.8	AW: 34.7 AN:22 PC:0.7 this burrow started out inactive

33	5/9/09	M	137			25.25	18.75	26.25	27.5	11.2	3.5	
34	6/8/10	M		Zack, Ally		24.5	19.1	25.3	26.4	10.8	3	tick off hind leg. Too old to tell age
35	9/14/11	M	57	Kris	QR	24.48	19.38	25.6	26.31	10.85	3.21	blood taken
36	7/24/11	YA	399	Kris, Ally, Amanda	FG	16.8	12.3	16.9	17.3	6.8	1	pooped, peed -very orange. Tried to take blood and stopped after 4 attempts. Checked back on 7/25 and tortoise was walking around - ok.
37	9/16/93	M	288	JB	ZAA	31.12	23.12	27.11	31.61		5.8	found in burrow, was in burrow deeper than the 2nd male
38	5/1/91	M	180	JB		23.5	17.5	22.8	24.5	9.7	2.2	
39	8/4/11	F	225	Kris	QR	27.2	19.6	25.4	27.6	10.4	3.9	caught eating ~10m from trail and followed to B225. This Tort was caught at a different burrow ~10 days ago.
40	5/10/90	M	178	JB	KKLL	5.16	4.55	5.06	5.36	2.82	too small	AW:9.5mm AN:8.5mm PC:none burrow diameter=54.3
41	6/22/11	M	6	Kris	BC	28.1	20.4	27	29.4	12.9	4.4	took blood, caught in trail by field stuff and followed to B6
42	4/11/11	M	1	Zack	AB	27	21.5	27.9	29.8	11.9	4.1	dehydrated but active and strong. Foamy nares and mouth. Cloaca appears normal but drippy from doo doo pee pee.
43	8/8/90	JUV	205	JB	WX	6.27	5.27	5.97	6.39	3.1	0.1	AW:8.7mm AN:9.6mm entered B205 after released
44	9/8/11	F	78	Anne	WX	28.95	22	28	30.6	11.2	4.3	a big girl. Was being courted by T186 while in the bucket. Caught the 2 days later in B170.
45	5/2/91	JUV	224	JB		10.6	8.4	10.2	10.7	4.6	0.4	7/22 returned to B224

46	4/12/93	F	111	JB		25.7	19	24.7	26.3	10.8	3.4	AW:5.3 AN:4 eating at 4:30 near B242. upon release crossed road and walked past 118 and went into 111
47	9/10/93	F	304	JB	MN	26.55	19.21	23.25	26.81		3.2	found running away towards burrow
48	4/12/93	M	7	JB		26.1	19.3	24.8	26.6	11.6	3.7	AW:6.2 AN:3.6
49	8/27/11	F	47	Kris	PQ	25.4	19.98	26.4	27.15	10.61	3.41	no ticks seen, blood taken, big gular scute for F but no concavity.
50	9/18/93	M	216	JB	IJ	26.63	20.71	24.86	28.31		3.4	deformed shell on R/L hind; no #
51	7/28/91	YA	202	JB		17.3	12.7	16.5	17.4	7.4	0.9	
52	4/25/93	F	203	JB		20.8	15	20.6	21.3	8.8	1.9	AW:40.3mm AN:20.3mm on apron of 203 at 11:50. 9 rings now hooks on H or G.
53	6/2/10	M	57	Kris, Katie, Natalia	PQ	24.3	19.4	25.2	26.1	10.9	3	plastron starting to wear smooth. Can count at least 15 rings. One carapace scute has a scraped off portion. Waited for 20 minutes and didn't move to any burrow but closest burrow to him was B57 about 25m away
54	6/13/90	F	49	JB	OP	16.5	12.7	13.3	16.5	7.2	1	AW:26.9 AN:20.7 I realeased here after getting from Rossi after having been chewed by a dog. Saw again 6/14 at mouth of burrow
55	8/16/90	M	149	JB		24.8	18.7	25.6	26.5	10.8	3	AW:64.8 AN:31.9 PC:8.9 GP:1.7
56	4/20/93	F	281	JB		14	10.45	13.4	14.2	5.7	0.4	AW:1.9 AN:1.8 tortoise found on burrow 281 facing into burrow.
57	8/21/90	M	86	JB								found 8/21 on west berm of SJB near lake on its back. Had

												been hit by car.
58	9/23/90	hatchling	81	JB		4.65	4.2	4.33	4.72	2.72		AW:8.9mm AN:9.2 this probably hatched ~8/23 as I noticed a disturbed area in the SW corner of the cage. See red binder
59	6/3/09	F	47	Anne		25	20	25.9	26.9	10.55	3	
60	6/13/09	hatchling Rossi		JB		5.01	3.99	4.99	5.2	2.78	0.3	AW:9.1mm AN:8.2mm of six that hatched within the past 2 days
61	8/28/90	hatchling Rossi		JB		4.75	3.73	4.68	4.95	2.68	2.84	AW:9 AN:8 of six that hatched
62	8/28/90	hatchling Rossi		JB		4.84	3.86	4.74	3.01	2.73	3.01	AW:8.4 AN:8.5 of six that hatched within the past 2 days
63	8/28/90	hatchling Rossi		JB		4.99	3.98	4.99	5.11	2.9	3.14	AW:9.5 AN:8 of six that hatched
64	8/28/90	hatchling Rossi		JB		4.81	3.92	4.69	5	2.58	2.96	AW:8.2 AN:6.9 of six that hatched

65	8/28/90	hatchling Rossi		JB		5.02	4.44	5.01	5.28	2.85	3.36	AW:9mm AN:8.5mm of 2 that hatched within 2 weeks of 8/28
66	6/17/92	JUV	267	JB		6.82	5.76	6.67	6.97	3.37	6.5	trapped with mammal trap. Still remnants of umbil. Scar
67	8/26/92	F	47	JB		26	18.8	24.9	26.1	10.8	2.1	AW: 4.8 AN:3.6 6/24 entered B26
68	9/3/90	hatchling	54	JB		5.23	4.49	4.94	5.27	2.88	3.28	AW:9.4mm AN:8.4mm hatched on 9/3
69	3/30/93	JUV	278	JB		7.44	6.14	7.06	7.56	3.46	0.81	AW:12.2 AN:10.6mm
70	8/9/90	M Rossi	16	JB		23.8	17	23.7	24.7	9.3	2.1	AW:47.7mm AN:28.1mm PC:5.1mm GP:1.4cm hit on Kingsley Road. Marked as 70 so as to not bother other parts of shell. Released at B16. having difficulty with L hind leg when walking
71	8/27/10	M	37	Anne	KL	25.6	19.4	26.7	27.3	10.6	2.65	redrilled as T254
72	9/3/90	hatchling	54	JB		5.01	4.36	4.73	5.1	2.89	3.18	AW:8.7mm AN:8.5mm hatched 9/3
73	4/13/11	F	10	Anne	EF	29.5	21.9	28.8	30.7	12.7	5.2	noisy, snorty lady. Only 12 apparent annuli but she's huge! Trapped at 10 but went to B6. she's a little slow and shy.
74	5/13/10	JUV	247	Anne, Zacl	TU	6.69	5.37	6.3	6.9	3.43	0.66	1 year old-very energetic. New capture
75	9/18/90	hatchling	54	JB		5	4.43	4.9	5.19	2.68	3.045	AW: 8.8mm AN:7.7mm hatched 9/18 others in this batch hatched 9/3

76	9/8/93	F	180	JB	north of entrance gate	25.85	19.6	23.19	26.61	10.95	3	
77	9/3/90	hatchling	54	JB		4.93	4.25	4.66	5.05	2.84	0.297	AW:10.1mm AN:8mm hatched 9/3
78	9/7/90	hatchling	27	JB		4.78	4.3	4.7	5.03	2.88	0.291	AW:9.6mm AN:8mm hatched 9/7
79	9/7/90	hatchling	27	JB		4.78	4.25	4.59	4.82	2.89	0.295	AW:8.9mm AN:8.6mm hatched 9/7
80	9/11/90	hatchling	192	JB		4.23	3.91	4.03	4.26	2.55	0.195	AW:9mm AN:5.9mm buried about 1-2 inches from the surface but surface askew. Hatched 9/11
81	9/13/90	M Rossi bondo	53	JB		27.8	21.5	28.2	29.6	11.6	4.4	AW:66.8mm AN:34.5mm PC:12mm hit by car and has bonded crack at 1/3 from front in middle of carapce 75cm long and smaller patch 1/3 from rear. Released in B53 which probably had been abandoned all summer. Entered burrow and started digging
82	4/22/91	hatchling	233	JB		4.45	3.75	4.34	4.55	2.39	0.217	AW:9.4mm AN:6.9mm holes still ok but hard to see because of sand. Looks like a growth ring on carapace but nothing evident on plastron. Scar still 9.1cm long but very wide. No open tissue at all.

83	10/9/90	2 year old from nest 54	247	JB		6.49	5.31	6.23	6.6	3.39	0.2	Todd caught near B247 eating.
84	9/20/90	M	118	JB		26.4	20.4	26.2	28.2	11.5	4	AW:57.5mm AN:34.6mm marked wrong on 10 side. At mouth of B118 but a second T further in. when released at B118 it left and went straight to B 227
85	9/27/90	JUV	225	JB		12.2	9.7	12	12.5	5.2	0.6	AW:19.3mm AN:14.6mm
86	6/4/91	JUV	229	JB		7.68	6.26	7.27	7.78	3.34	0.1	went to B229 where found last year. 6/24 found just S of B192 near fence-went into B229
87	6/20/91	JUV	211	JB		18.2	13.8	18.4	19.2	7.8	1.2	caught in same burrow w/89. 6/20 found 5 yards E of B236 and entered on release
88	4/10/91	JUV	231	JB		7	5.93	6.55	7.05	3.37	0.726	AW:9.8mm AN:10.5mm 6/18 heard him walking ~5 yards E of burrow. Redid holes since almost healed.
89	6/25/92	JUV	196	JB		15.5	11.8	14.9	15.8	6.7	0.9	
90	9/3/93	M	294	JB		27.9	21.3	27.9	30.1	11.6	4.2	AW:70.1 AN:41.3mm on road near B294 eating at 4:50
91	7/30/11	M	392	Kris	IJ	25.8	20.4	25.2	27.9	10.9	3.3	3 ticks near anus. 1 tick on neck. Flaky plastron and carapace. No annuli, rubbed smooth. Removed ticks. Weird dent on side.

92	7/30/11	F	22	Kris	IJ	25.5	19.9	25.3	26.8	10.5	3.1	missing anterior center marginal scute, looks like epoxy on carapace. Forgot to mark if M or F.
93	6/18/02	F				26.7	20.1				3.4	
94	6/13/91	hatchling	239	JB		6.76	5.44	6.28	6.76	3.27	0.592	
95	7/28/91	see Todd's notes	102	JB		20.9	15.1	20.1	21.4	7.4	1.6	
96	6/18/91	F	26	JB		24.2	18.3	23.5	25.1	9.9	2.4	AW:46.3 AN:34.9 may be T from B207. 7/16 trapped in B25 after 3 hours
97	8/22/91	JUV	245	JB		9.52	7.71	9.12	9.66	4.12	1.52	3 distinct rings
98	7/24/91	JUV	241	JB		9.55	7.67	8.98	9.57	4.01	1.43	9/19 mammal trapped in B246
99	7/19/11	F	31	Anne	LM	26.2	19.95	25.2	27.2	10.3	3.4	removed 1 tick. This is the tortoise that looks like it was epoxied at some point and missing center anterior marginal scute.
100	5/24/91	hatchling		JB		5.33	4.44	5.12	5.46	2.75		predates on only part of shell and transmitter left
101	8/26/91	hatchling	160	JB		4.45	3.95	4.09	4.31	2.62	2.07	hatchling from nest of 8
102	9/9/93	F	303	JB	A-fence	28.35	21.85	25.62	30.22		4.8	found going in burrow
103	9/5/91	hatchling	58	JB		4.99	4.27	4.8	5.04	2.61	0.27	6 hatchlings in cage. See blue binder notes

104	9/5/91	hatchling	58	JB		4.96	4.34	4.8	5.17	2.7	0.28	see blue binder notes
105	9/5/91	hatchling	58	JB		4.83	4.26	4.65	5.03	2.62	0.27	released 9/11 without transmitter
106	9/5/91	hatchling	58	JB		4.88	4.15	4.67	5.03	2.71	0.25	
107	3/8/93	hatchling		JB		6.02	5.12	5.69	6.11	3.11		AW:11.2mm AN:9.5mm
108	9/5/91	hatchling	58	JB		4.81	4.3	4.68	4.86	2.61	0.26	
109	7/29/11	F	219	Kris, Asher	MN	27.5	21.4	27.5	29.1	11.4	4	large adult ticks, caught sitting next to the caged nest on B219
110	5/23/93	hatchling		JB		7.07	5.87	6.75	7.1	3.44		predated-dug up from burrow where he had been cohabitating with T112 for days. No carcass found.
111	5/12/10	F	272	Zack	ST	27.5	19.4	26.1	27.7	11.8	3.9	healthy and mad
112	9/11/09	YA	91	Todd, Anne, Zack	DDEE	17.1	12.8	17.45	18.2	6.85	0.85	skin flaking off head
113	6/4/94	hatchling		JB		7.26	5.64	6.57	7.23	3.46		dead-carcass and transmitter found
114	9/14/91	hatchling	81	JB		5.17	4.37	4.95	5.25	2.87	0.32	see blue binder notes

115	6/6/93	hatchling		JB		6.61	5.52	6.25	6.77	3.27		dead-carcass and transmitter found dug up
116	8/13/92	hatchling		JB		5.75	4.72	5.38	5.9	2.99		predated mocassin
117	6/6/93	hatchling		JB		6.23	5.4	5.89	6.35	3.23		AW:11mm AN:9.7mm
118	4/14/93	hatchling		JB		6.53	5.53	6.18	6.6	3.3		AW:13mm AN:9mm
119	5/7/09	M	56	Todd, Nicole, Jen, Luba, Sarah		24.5	18.25	24.61	25.95	11.4	2.7	yellow spots on carapace. Could count at least 12 growth rings
120	9/20/92	hatchling		JB		6.84	5.62	6.62	7.05	3.15	0.67	dead
121	4/28/93	M	270	JB		25.7	20.8	26.5	27.7	11.2	3.6	T121 caught in burrow 148 in shade.
122	8/31/93	JUV	271	JB		9.9	7.7	9.3	10.1	4.3	0.1	AW:17.6mm AN:15.6mm caught just as it rushed into B271 at 4:30.
123	6/11/92	JUV	244	JB		8.57	6.79	8.14	8.65	4.03	1.12	trapped after 1 day in mammal trap
124	6/19/92	hatchling	273	JB		4.76	4.2	4.41	4.62	2.54	0.25	not sure where hatched. Maybe B119. left hindfoot is missingbut healed well and first 4 digits of R forelimb were hanging by a piece of skin.

125	6/21/92	hatchling	274	JB		6.87	5.67	6.47	6.98	3.23	0.6	Todd caught
126	7/15/92	F	145	JB		17.4	13	16.7	17.7	7.4	1	
127	7/23/92	JUV	280	JB		6.76	5.83	6.64	6.97	3.33	0.65	2 rings. Nest burrow unknown.
128	8/18/92	hatchling	81	JB		4.93	4.37	4.89	5.21	2.78	0.33	AW:8.8 AN:7.4 hatched or was at surface todayin cage and was burrowing back in when picked up. 3 other eggs checked and show no signs of hatching
129	4/1/93	hatchling	81	JB		4.86	4.43	4.74	5.05	2.44		AW:10.9mm AN:8mm
130	5/24/92	hatchling	93	JB		5.79	5.25	5.73	5.96	2.81		lost-burrow dug up an no signal-check white binder for notes
131	9/18/92	hatchling	93	JB		5.59	4.95	5.55	5.82	3.12	0.45	
132	9/18/92	hatchling	93	JB		5.67	4.88	5.5	5.85	3.03	0.44	
133	5/23/93	hatchling		JB		5.98	4.94	5.65	6.07	3.07		dead-see white binder
134	9/18/92	hatchling	93	JB		5.4	4.73	5.28	5.57	2.85	0.41	
135	9/20/92	hatchling	110	JB		4.72	4.25	4.74	4.97	2.97	0.3	AW:10.8 AN:8

136	9/20/92	hatchling	110	JB		4.54	4.17	4.47	4.69	2.69	0.26	AW:9 AN:6.8
137	9/20/92	hatchling	110	JB		4.54	4.3	4.6	4.82	2.83	0.28	AW:8.8 AN:7.7
138	9/20/92	hatchling	110	JB		4.72	4.35	4.6	4.95	2.72	0.29	AW:10.2 AN:7.4
139	5/24/93	hatchling		JB		4.75	4.3	4.58	4.93	2.71		dead-carcass found puncture wounds in shell see white binder for notes
140	9/20/92	hatchling	110	JB		4.55	4.15	4.49	4.72	2.73	0.28	captured by Bob at edge of osprey hall parking lot where they're clearing for parking
141	5/24/93	hatchling		JB		4.95	4.44	4.79	5.19	2.6		dead-found 1/3 carcassnear burrow. See white binder for notes
142	5/25/93	hatchling		JB		4.25	3.87	4.21	4.41	2.41		missing presumed dead. Found parts of shell 5/25
143	9/28/92	hatchling	149	JB		4.59	4.09	4.65	4.88	2.56	0.24	
144	10/5/92	hatchling	nest 1	JB		4.8	4.1	4.73	4.9	2.61	0.28	AW: 9.4 AN:7.4
145	10/5/92	hatchling	nest 1	JB		4.73	4.28	4.69	4.89	2.59	0.28	AW:9.7 AN:6.2

146	6/16/93	JUV	290	JB		7.71	6.15	7.35	7.78	3.68	0.87	AW:13.9 AN:9.7 original scute and 2 rings so in 3rd summer. Trapped overnight in the middle of major predation and he wasn't found. On same night T118 was taken from a trap.
147	7/25/11	M	10	Anne	FG	26.85	19.7	28.1	28.9	10.9	3.5	adult ticks, 1 small puncture wound in R posterior scute. Very active. Caught at B13 and followed to B10
148	5/23/93	F	293	JB		26.4	19.5	26.2	28	11.1	3.2	AW:48.1 AN:39.4
149	6/25/93	F	look confused when released	JB		27.7	20.6	27.4	28.7	11.4	3.4	AW:48.3mm AN:36.4mm caught for 1st time ever by Don Waltz walking on road by B291
150	6/28/93	F		JB		22.3	16.1	21.9	23.1	9.1	1.8	AW:46.1mm AN:26.8 dan caught on road near B283. I think she's lost.
151	8/30/93	M	across from 302	JB		24.5	18.3	24.5	26	11.2		DOR on SJB at 5:20. hit by car.
152	8/2/93	F	303	JB		28.4	21.8	27.5	30	12.3	4.2	caught while digging burrow 303
153	9/3/93	hatchling		JB		4.85	4.23	4.66	4.92	2.64	0.25	given to me on this day by John McGlan… of Tree Hill- he had it for several days and someone brought it to him. Egg tooth present. Major femoral hooks. AW:10.6mm AN:5.3

154	9/7/93	hatchling	294	JB		5.18	4.36	4.9	5.29	2.79	0.35	AW: 10.7mm AN: 8.2mm hatched from 4 egg nest on 9/7-all eggs hatched. Egg tooth present.
155	9/7/93	hatchling	294	JB		5.05	4.22	4.77	5.17	2.85	0.33	AW:9.4mm AN: 7.6mm
156	7/1/11	JUV		Kris, Asher	BC	11.4	8.7	11.5	12	5	0.4	no pee or poop. Very well behaved
157	9/7/93	hatchling	294	JB		5.07	4.18	4.7	5.1	2.75	0.32	AW: 9.2mm AN: 8mm
158	6/22/93	JUV	272	JB		11.1	8.1	10.8	11.3	5.2	0.2	AW:19.1mm AN:12.5mm ~5 years old.
159	9/10/93	hatchling	fire lane nest	JB		4.7	4.02	4.64	4.84	2.66	0.26	AW: 8.5mm AN: 6.7mm hatched or came to surface and dug hole. Not collected until 9/11 only 2 of 6 hatched so far. Left side of carapace is depressed and appears a bit deformed. Egg tooth present, no femorals.
160	8/11/11	F	203	Kris	FG	24.6	18.7	24.75	25.72	10.6	2.8	19 growth rings, very feisty
161	8/28/93	hatchling	Rossi's	JB		4.99	4.23	4.89	5.18	2.73	0.31	AW: 9.6mm AN: 8.2mm hatched in captivity for Rossi. Laid June 7 after oxytorin inducement. One of 3. left side of carapace is depressed.
162	8/28/93	hatchling	Rossi's	JB		4.85	4.12	4.67	5	2.55	0.31	AW: 9.2mm AN:9.2mm see 161
163	8/28/93	hatchling	Rossi's	JB		5.12	4.32	5.06	5.32	2.6	0.33	AW: 9.8mm AN: 7.3mm marked 133

164	9/20/93	hatchling	10	JB		4.94	4.27	4.63	5.04	2.82	0.3	AW: 9.3mm AN: 7.4mm
165	9/20/93	hatchling	10	JB	fire lane	4.94	4.44	4.75	5.15	2.92	0.3	AW: 8.9mm AN: 5.8mm
166	9/20/93	hatchling	10	JB	fire lane	4.93	4.15	4.74	4.98	2.89	0.28	AW: 8.6mm AN: 7mm extra scute R of post. Of carapace.
167	9/20/93	hatchling	10	JB	fire lane	4.95	4.35	4.62	5.03	2.67	0.29	AW:8.2mm AN: 5.5mm
168	9/20/93	hatchling	10	JB	fire lane	4.89	4.25	4.63	4.94	2.83	0.29	AW: 8.8mm AN: 7.4mm
169	9/20/93	hatchling	10	JB	fire lane	4.65	4.37	4.39	4.65	2.75	0.26	AW: 9.2mm AN: 6.0mm
170	6/3/10	YA	241	Kris	XY	17.6	12.9	17.7	18.5	7	0.8	*didn't see that she was already marked as T170 so drilled scute 200 and 20. looks like 390 but is actually only 170!! SORRY!!*** very active. Sneezed twice and had bubbles/mucus coming out of her nose!
171	5/18/10	F	58	Kris, Ally	PQ	27.5	19.1	26.2	27.7	11.4	3.8	gular scute broken on left side. Plastron scratched and flaking. Very active. Can see at least 11 annuli. Tick on rear left leg
172	7/21/11	M	278	Kris	2211	23.7	17.6	24	25.3	9.7	2.6	
173	8/15/11	F	22	Kris	IJ	29.4	22	28.9	30.7	12.55	4.6	tick taken, blood sample taken

174	4/18/11	M	151	Zack	AB	26.55	19.25	27.6	28.25	10.5	3.3	fell in bucket head first so not happy, but well behaved
175	4/11/11	F	5	Zack	BC	30.95	22.7	30.35	32.6	14	5.6	very well behaved tort. After released went to B4 but there was a trap set so she went to B1 where T40 was and she went in.
176	4/30/09	YA	62			15.7	11.7	15.2	15.9	6.2	0.8	yellow on scutes still. About 5-6 years old. Do not have disecting needle to mark. Used Sharpie. Will check again to permanently mark.
177	7/26/11	M	402	Anne	AB	26.85	19.8	28	28.7	10.75	3.2	~19 growth rings visible
178	5/2/09	JUV	31	Will		14.75	11.9	14.8	15.7	6.6	0.8	~6 years old
179	8/31/11	YA	410	Kris	YZ	18.8	14.4	18.6	19.35	17.85	1.3	tick and blood sample taken
180	5/2/09	F	155			23.8	17.5	24.2	24.9	10	2.4	~16 years old
181	8/14/11	F	56	Kris, Daniel, John	PQ	27.8	19.05	26.25	27.8	11.55	4.1	flaky plastron at back-smooth at front. Gular scute part broken off on L side. Found walking near B56 (inactive) not hers. Brown excriment. Clear eyes, no apparent ticks. Observed her eating smilax on her way back to burrow.
182	4/2/10	JUV	241	Anne, Zack	YZ	17.39	12.65	17.55	18.15	6.99	0.8	8 annuli
183	5/3/09	JUV	23			12.49	9.78	12.6	13.1	5.5	0.5	
184	9/5/11	F	154	Kris, Asher	XY	30.24	22.72	29	31.42	13.4	5.3	very dark brown plastron, tick and blood sample taken
185	5/28/10	JUV	164	Anne, Zack, Jenn	DE	16.15	12.1	15.9	16.6	6.5	0.62	5 annuli

186	9/8/11	M	412	Anne	WX	24.5	18	24.5	26.05	10.5	2.85	caught at B78 head bobbing at T44 trapped in bucket. Old shell ding looks like he was stepped on or something when younger. Odd behavior where he thrashed, wiggled and made digging motions perhaps trying to scare me away. Followed him for at least 20 minutes
187	5/7/09	F	106	Todd,Nicole,Luba,Jen, Sarah	HHII	25	18.6	24.2	25.7	10.4	2.8	roughly 21 years old. Was unmaked. Indent in shell as if bit when younger.
188	5/8/09	M	133			26.7	20.1	26.9	28.75	11.2	3.5	tick on right back leg, worn plastron
189	5/9/09	JUV	52			12.9	10.05	12.3	13.1	5.6	0.6	
190	5/10/11	JUV	152	Zack	DE	17.8	13.3	17.5	18.3	7.7	1	minor shell damage on back right. Nice fella
191	9/13/11	F	144	Anne	KKLL	25.5	20	25	26.45	10.6		very old. >30 growth rings. Shy. Kicked some sand at me when I released her.
192	6/1/09	JUV	23	Will, Hilary, Anne, Sarah	KL	5.3	4.88	5.13	5.51	3.11	0.4	
193	6/11/09	JUV	27			9.9	7.9	9.7	10.2	4.1	1	
194	6/21/09	JUV	166		LM	11.75	9.7	11.8	12.4	5.4	0.45	~4-5 years old
195	5/24/11	JUV	385	Zack, Anne	GH	11.2	8.7	11.2	11.8	5		shell scab on rear, assymetrical pattern on front, ~2 years
196	7/13/11	JUV	397	Ally	EF	11.5	9	11.6	12.2	5	0.2	

197	6/14/11	JUV	391	Anne	IJ	13.8	10.4	13.8	14.4	6	0.5	extremely lively, wriggly. Defacated once, urinated 2x.
198	9/7/09	JUV	213	Anne, Katie		13.2	10.5	12.75	13.4	5.4	0.38	
199	9/10/09	JUV	236	Will, Erica, Nicole	LM	5.09	4.34	4.92	5.33	2.95	0.37	suspect this one hatched out of burrow #31
200	6/7/11	F	353	Anne		29.9	22.8	29.25	31.7	12	4.8	gular scute chipped on R side. Unmistakable shell damage. Dorsal L anterior carapace, large pieces of shell missing (see drawing) and healed crack. T200 is iffy - clear drill mark on underside of scute but not all the way through. Check records. Might be mama of nest found at this burrow last year.
201	10/21/10	JUV	245	Zack	IJ	10.48	8.09	10.17	10.77	4.77	0.2	~3 annuli
202	9/10/11	JUV		Kris	HI	12.2	9	11.65	11.65	4.9	0.42	tried to take blood but got very little. Marked as 2002 but actually 202. ~5-6 annuli
203	9/23/10	JUV	255	Ally	HI	12.8	9.8	12.8	13	5.2	0.5	~5 annuli. Very calm. Tick on R hind leg. Couldn't remove. Clear eyes.
204	7/11/11	JUV	345	Anne	NO	17.65	13.3	16.9	17.95	7.2	1.1	nares clear but bubblt froth. Quiet and shy.
205	9/17/09	JUV	71	Todd, Erica	YZ	6.5	5.2	6	6.6	3.1	1	
206	5/27/10	JUV	92	Zack	XY	11.4	9.1	11.4	11.9	5.1	0.1	~5 rings
207	8/4/10	JUV	219	Anne	MN	16.6	12.55	15.9	16.85	6.8	0.7	shy. 7 annuli. No ticks. Urinated when weighed
208	8/28/11	JUV	318	Kris, Asher	RS	18.9	14	18.4	19.3	7.5	1.4	blood sample taken, very active

209	8/2/11	F	396	Anne	MN	27.25	21.7	27.45	28.8	11.4	3.95	a large healthy looking lady. Went to B 219 when released.
210	6/14/09	JUV	177	Kevin, Zack, Anne	DDEE	6.75	5.5	6.11	6.75	3.09	0.57	1 annuli
211	10/23/09	JUV	175	Anne, Zack	DDEE	7.89	6.3	7.4	7.9	3.47		~1-2 years old
212	9/27/11	JUV	350	Anne	BBCC	17.4	13.3	17	17.8	6.9	1	extremely lively and active. ~9 growth rings. BS taken
213	5/12/10	JUV	228	Kris, Anne, Ally, Dave	WX	8.54	6.58	7.93	8.48	3.91	0.1	~2-3 annuli
214	6/8/11	JUV	389	Ally	BC	15.2	11.5	15.2	15.8	6.4		very active, peed a lot. Very dark coloration, from wetland?
215	9/3/10	JUV	363	Anne, Natalia	UV	8.39	6.8	7.83	8.32	3.74	0.1-0.2	4 rings, very lively. Umbilical scar.
216	5/27/10	JUV	287	Kris, Anne	HI	5.68	4.74	5.42	5.95	2.95	0.43	found in middle of trail. No annuli yet! Bright yellow, calm.
217	4/25/93	F	27	JB		26.4	20.4	26	27.2		3.8	AW:5.3 AN:3.9 on road eating at 12:30.
218	9/14/93	F	203	JB	HI	25.17	19.68	23.3	26.51		3	found in a bucket trap with another tortoise. When released went to burrow 203
219	5/9/10	M	219	Kris, Asher, Anne	MN	24.3	18.3	24.58	25.92	10.7		found in mouth of burrow. Sand underneath was moist and has mucus on nose. No bite marks. DEAD

220	6/2/10	JUV	162	Kris, Katie, Natalia	DE	14.3	10.8	13.9	14.5	6.2	0.4	~6 rings
221	10/5/09	JUV	253	Anne, Katie	QR	6.41	5.27	5.85	6.53	3.38	0.1	~1 year old, marked with a sharpie because dissection needle was not in backpack. Could also be in Burrow 224
222	5/26/11	JUV	388	Kris, Ally, Kevin	HI	12.9	9.7	13.1	13.6	5.5	0.6	~5 annuli
223	10/8/09	M	127/126	Will, Steph	NNOO	24.42	18.22	24.85	26.5	10.93	2.8	removed 1 tick, grooves on front half of carapace
224	10/8/09	JUV	256	Will, Steph		11.3	8.7	10.5	11.3	4.73	0.23	~5 annuli
225	10/15/09	JUV	261	Will, Steph, Erica	YZ	6.47	5.6	6.9	6.5	3.3	0.5	~2 annuli
226	10/15/09	JUV	163	Will, Steph	NO	10.4	8.11	10.13	10.7	4.17	0.16	~5 annuli
227	10/15/09	JUV		Will, Steph, Erica	OP	6.5	5.2	6.2	6.6	3.4	0.7	1 annuli
228	6/1/10	JUV	262	Ally	XY	10.9	8.4	10.6	11.2	4.9	0.2	very active. Healthy looking. Clear eyes. ~ 4 rings
229	10/15/09	JUV	72	Will, Steph, Erica		13.4	10.5	13.2	13.8	5.8	1.9	~10 annuli
230	10/15/09	JUV	154	Will, Steph, Erica		13.8	10.1	13.1	14.2	5.7	0.2	~ 5 annuli

231	9/22/10	YA	72	Ally	UV	17.4	13.3	18.4	18.8	6.8	1.2	~9 annuli. Female? Very active and lots of squeaking noises. No visible ticks. Followed back to B72.
232	8/9/11	YA	406	Anne	TU	13.9	10.35	13.65	14.2	6		lively and active
233												
234	6/8/10	JUV		Zack, Ally	XY	8.5	6.6	8	8.5	3.9	0.2	~2 annuli. New capture! Urinated. Found walking in XY
235	6/8/10	JUV		Zack, Ally		16	11.6	16.1	16.6	6.4	0.6	urinated a lot. 6 rings
236	9/12/10	YA	171	Ally, Kevin	GH	16	11.6	16	16.4	6.4	0.6	~6 annuli. #36? No visible ticks. Caught eating in road.
237	6/7/10	JUV		Anne, David	XY	5.92	4.95	5.62	6.01	3.1	0.52	no annuli. Umbilical scar visible. Extremely active and lively
238	6/16/10	JUV	303	Anne, Ally, David	FG	10	8.1	9.8	10.4	4.5	0.2	urinated, 3-4 rings. Still see umbilical scar. No visible ticks
239	8/12/10	JUV	308	Anne	JK	14	10.5	13.6	14.6	6	0.45	grazing in path. Shy. Urinated 4x. Projectile poop. 9 annuli. Dry looking carapace, light sandy color. Flaking poss. Left side carapace scutes esp. towards rear. Followed to burrow ~30m.
240	7/23/11	JUV		Kris	JJKK	14.5	11.2	14.3	14.8	6.3	0.6	found eating along veg transect 4. JUMPED a few times when put down.
241	6/3/10	JUV	172	Zack	JK	7.6	6.6	7.3	7.6	3.9	0.12	healthy, 2 rings
242	9/14/10	JUV	369	Anne, Katie, Natalia	NO	5.82	5.75	6.5	6.6	3.3	0.68	foundon trail, very active, urinated.

243	10/26/10	JUV	315	Anne, Katie, Natalia	QR	9.35	7.48	9.1	9.51	3.97	.1 - .2	
244	9/29/11	M	413	Kris	PQ	25.9	19.2	26.9	27.5	10.6	3.2	Blood taken. Took a long time to get blood. Did not go back to B413 when released. This tortoise is older and has been drilled so I don't know why he's not in the data base. It looks like Scute #7 might have been an old drill hole. Maybe #254?
245	8/11/10	JUV	156	Anne	IJ	8.1	7.1	8.1	8.4	4.1	.1 - .2	2-3 annuli. Umbilical scar. No ticks. Lively. Clear moist eyes. No urination.
246	8/3/10	F	349	Zack		29.1		29.2	31.7	22.7	4.3	eating crabgrass. Very deep and large gashes on front right carapace. Can see bone. Gular scute also damaged. Did not mark her but can ID by her wounds. Has an unfinished hole at 200 spot from underneath.
247	9/10/10	JUV	368	Anne, Natalia, Kim	PQ	8.3	6.8	8.1	3.84	8.8	.1 - .2	very lively, urinated
248	8/5/10	JUV	palette	Kris, Zack, Anne	PQ	8	6.6	7.9	8.5	4	.1 - .2	projectile peed on Anne. Nose bubbling. ~3 annuli.
249	8/5/10	YA		Kris	UV	8.5	7.9	8.1	8.4	4.9	0.25	~2 annuli, redrilled holes
250	6/3/10	JUV	185	Zack	IJ	9.1	7.1	5.2	9.1	4	0.2	~3 rings. Healthy, very calm. No pee.
251	8/8/10	JUV	palette	Kris, Asher	KL	6.56	5.4	6.1	6.6	3.2	0.61	1 annuli. Umbilical scar. Peed when marked. Found on trail.

												Went into palette.
252	9/13/11	YA	16	Anne	HI	20.6	15.8	20.2	21.2	8	1.6	11 growth rings, carapace slightly swaybacked
253	8/25/10	JUV		Ally, Deedo	JK	14.2	12.2	15.9	16.3	6.8	0.7	walking in woods. Calm. No visible ticks. Urinated a LOT.
254	8/27/10	M	37	Anne	KL	25.6	19.4	26.7	27.3	10.6	2.65	caught in bucket exiting B346 when released went to B73. damage to 2nd R anterior marginal scute. Damage to 2 and 3rd R marginal scutes. Lively. Urinated. 1 large tick removed. (ACTUALLY OLD 71)
255	6/8/11	JUV	305	Ally	IJ	8.78	7.86	8.21	8.96	4.06	1.05	found in trap with T274, ~3 annuli
256	10/8/10	JUV	376	Anne, Rose	KL	6.92	5.59	6.46	7.01	3.41	0.72	eating-urinated. Found his way home.
257	8/31/10	JUV	238	Katie, Natalia, Anne	JK	7.21	5.76	6.72	7.22	3.54	0.78	visible umbilical scar. 1 ring. Shy. Urinated. Found in front of adult B31
258	9/14/10	JUV	345	Anne, Katie, Natlia	NO	6.9	5.6	6.3	6.9	3.4	0.71	shy, active when drilled, 1-2 growth rings
259	9/21/10	JUV	375	Anne, Katie, Natalia	VW	6.9	5.7	6.6	7.03	3.24	0.74	2-3 growth rings. Clear eyes. Went into B374, came out and went into B375. B375 is a nearby older, somewhat larger burrow.
260	6/21/09	F	9	Anne		27.7	17	23.1	24			crack between scutes 40&20. previous mark on scute 4, possible other markings obscured by age. 260 is mismarked.

261	9/21/10	JUV	370	Anne, Katie, Natalia	OP	6.43	5.5	5.8	6.3	3.4	0.67	shy, dark in color, found in middle of path. Remarked with dissecting needle.
262.1	10/15/10	JUV	174	Anne	XY	7.3	5.8	6.7	7.3	3.2	0.72	trapped in bucket at B174. rather shy, lethargic, cool to touch. Entered B 174 when released. 1-2 growth rings. No visible ticks.
262.2	10/27/10	M	278	Ally, Zack	oo11	23.99	17.25	24.5	25.1	9.8	2.5	~11 annuli. Well behaved. No visible ticks. Missing scale on right front limb.
263												
264	5/25/11	YA	wetland area	Kris, Ally, Kevin, Zack	wetland	20.8	16	20.6	21.5	9	1.7	dark brown, beautiful shell. Some moss on shell
265	7/21/11	M	286	Kris	2211	24.7	18.2	24.8	25.9	10	2.8	
266	7/25/11	JUV	402	Ally	AB	6.02	4.82	5.52	6.02	3.4	0.5	marked with permanent marker because so little
267	8/23/11	YA	407	Anne	EF	11.7	9.3	11.7	12.2	5.2	0.4	was grazing near B152. quiet and shy. Well behaved as Zack would say.
268												
269	7/25/11	M	48	Anne		23.7	18.5	25.2	26.6	11.2		considerable age, growth rings worn away except on outer edges. Caught at B47 and followed to B48 which a different tort also did last week. B47 seems to be popular - maybe a hot chick lives there.
270	6/8/10	JUV		Zack, Ally	XY	5.8	5	5.8	5.8	3	0.4	maybe 1 year at most. Urinated. Went in B293 but is 2 times his size.

271	6/1/11	JUV	24	Ally	IJ	8.2	6.5	7.6	8.3	3.9	1.1	~ 3 annuli, scarring on shell, drill holes closed up, very calm.
272.1	6/29/11	JUV	237	Ally, Erica	JK	4.84	4.55	4.81	4.81	2.84	0.31	peed a lot
272.2	6/30/11	JUV	394	Kris	LM	5.7	4.6	5.3	5.6	3.1	0.44	peed a little. This is a DIFFERENT 272!!!!! It was not marked off the list and used again the next day.
273	9/1/11	F	325	Anne	UV	26.6	20.6	26.4	28.1	11.3	3.7	moved slowly and went to what is possibly a new burrow. There is no marker but there is a burrow on the map. 24 growth rings, very very shy. Did not emerge from shell at all.
274	6/8/11	JUV	305	Ally	IJ	8.03	6.5	7.5	8.4	3.9	0.1	~1 annuli, found in bucket with T255, umbilical scar present
277	8/14/11	YA	trail	Kris, Daniel, John	XY	6.5	5.4	6.3	6.5	3.2	0.6	
280	6/10/10	F	208	Kris, Anne	BBCC	25.5	18.6	25.6	26.6	10.8	2.8	at least 21 annuli. Urinated a LOT. Pronounced chin glands. Was eating a feather near the trail. Possibly mismarked (180?). Pooped on Anne. Very active. Uric acid crystals excreted…on Anne.
300	8/14/11	JUV	175	Kris, Daniel, John	XY	20.1	14.2	20.5	27.2	7.8	1.4	tick and blood sample taken. Drill holes are so confusing and looks like it could be 402 because 100, 200 are drilled as well as 70, 20 and 10.

400	5/3/10	JUV	271	Kris, Anne, Zack	TU	6.7	5.5	6.2	6.1	3	0.6	found in trail. ~ 2 years old. Labeled as 400 because we didn't have notebook to know where we left off. Active!
401	4/19/11	JUV	14	Zack, Ana	FG	20.3	16	20.25	21	9	1.8	

CL = carapace length (mm), CW = carapace width (mm), PL = plastron length (mm), TL = total length (mm), thickness (mm), weight (g)

Appendix II

Burrow #	Latitude	Longitude	Corridor	Activity	Age / size
1	30° 15.932	81° 31.081	A-B	IA	AD
2	30° 15.930	81° 31.075	AB	AB	AD
3	30° 15.928	81° 31.063	A-B	IA	AD
4	30° 15.917	81° 31.074	AB	A	AD
5	30° 15.910	81° 31.080	B-C	A	AD
6	30° 15.895	81° 31.077	BC	A	AD
7	30° 15.903	81° 31.047			
8	30° 15.872	81° 31.078	E-F	A	AD
9	30° 15.886	81° 31.078	D-E	IA	AD
10	30° 15.882	81° 31.075	EF	A	AD
11	30° 15.879	81° 31.019			
12	30° 15.857	81° 31.016	FG	IA	JUV
13	30° 15.863	81° 31.075	FG	A	AD
14	30° 15.844	81° 31.010	FG	A	AD
15	30° 15.856	81° 31.061	FG	IA	JUV
16	30° 15.835	81° 31.034	H-I	A	AD
17	30° 15.839	81° 31.009	GH	AB	JUV
18	30° 15.832	81° 30.993	GH	IA	AD
19	30° 15.829	81° 31.051	H-I	A	AD
20	30° 15.823	81° 31.036	H-I	A	AD
21	30° 15.806	81° 31.011			
22	30° 15.809	81° 31.017	I-J	A	AD
23	30° 15.815	81° 31.017	I-J	IA	juv
24	30° 15.818	81° 31.019	I-J	A	juv
25	30° 15.813	81° 31.018	I-J	AB	juv
26	30° 15.812	81° 31.026	I-J	IA	AD
27	30° 15.806	81° 31.019	J-K	AB	juv
28	30° 15.809	81° 31.016	J-K	AB	juv
29	30° 15.809	81° 31.007	I-J	AB	juv

Appendix II

30	30° 15.804	81° 31.003			AD
31	30° 15.797	81° 31.015	J-K	A	AD
32	30° 15.798	81° 31.027	J-K	A	AD
33	30° 15.794	81° 31.034	K-L	IA	AD
34	30° 15.796	81° 31.041	K-L	AB	AD
35	30° 15.783	81° 31.003	KL	A	AD
36	30° 15.767	81° 30.966	L-M	IA	JUV
37	30° 15.774	81° 30.980	L-M	A	AD
38	30° 15.773	81° 30.992	L-M	IA	AD
39	30° 15.773	81° 31.039	L-M	A	AD
40	30° 15.771	81° 31.054	M-N	A	juv
41	30° 15.751	81° 30.997	N-O	IA	AD
42	REMARKED AS #229				229 doesn't align with orig. coords
43	30° 15.749	81° 31.071	N-O	A	AD
44	30° 15.745	81° 31.022	N-O	A	AD
45	30° 15.741	81° 31.000	N-O		
46	30° 15.730	81° 30.961	O-P	IA/AB	AD
47	30° 15.729	81° 30.966	O-P	A	AD
48	30° 15.735	81° 30.953	O-P	A	AD
49	30° 15.729	81° 30.923	O-P	IA	AD
50	30° 15.727	81° 30.912	O-P	A	AD
51	30° 15.732	81° 31.003	O-P	A	AD
52	30° 15.719	81° 30.964	P-Q	0	0
53	30° 15.716	81° 30.942	P-Q	A	AD
54	30° 15.705	81° 30.918	P-Q	A	AD
55	30° 15.711	81° 30.968	P-Q	IA	AD
56	30° 15.712	81° 30.956	P-Q	A	AD
57	30° 15.702	81° 30.937	Q-R	A	AD
58	30° 15.686	81° 30.905	RS		
59	30° 15.689	81° 30.913	RS		

Appendix II

60	30° 15.686	81° 30.932	R-S	AB	AB
61	REMARKED AS #225		R-S	AB	IA
62	30° 15.684	81° 30.937	RS	AB	
63	30° 15.689	81° 30.937	R-S		
64	30° 15.694	81° 30.945	Q-R	IA	AD
65	30° 15.689	81° 30.949	R-S	A	AD
66	30° 15.675	81° 30.916	R-S	A	AD
67	30° 15.675	81° 30.935			
68	30° 15.666	81° 30.931	TU		
69	30° 15.670	81° 30.926	TU	A	AD
70	30° 15.658	81° 30.912	t-u	A	AD
71	30° 15.663	81° 30.915	TU	A	AD
72	30° 15.648	81° 30.906	U-V	A	AD
73	REMARKED AS #161				
74	30° 15.646	81° 30.901			
75	30° 15.629	81° 30.889	V-W	IA	AD
76	30° 15.631	81° 30.907	V-W	A	AD
77	30° 15.624	81° 30.951	W-X	-	dillo
78	30° 15.618	81° 30.897	W-X	A	AD
79	30° 15.614	81° 30.908	W-X	A	AD
80	30° 15.604	81° 30.937	X-Y		
81	30° 15.598	81° 30.914	X-Y	A	AD
82	30° 15.610	81° 30.879	X-Y		
83	30° 15.608	81° 30.873	X-Y	IA	AD
84	30° 15.615	81° 30.872			
85	30° 15.610	81° 30.865	W-X	A	AD
86	30° 15.617	81° 30.870			
87	30° 15.612	81° 30.845	W-X	A	AD
88	30° 15.612	81° 30.842	W-X	A	AD

Appendix II

89	30° 15.595	81° 30.824	X-Y	A/IA	juv
90	30° 15.600	81° 30.830	X-Y		
91	30° 15.602	81° 30.870	X-Y		112 observed here
92	30° 15.593	81° 30.873	Y-Z	A	juv
93	30° 15.595	81° 30.865	X-Y		
94	30° 15.587	81° 30.874	Z-AA	A	AD
95	30° 15.583	81° 30.884	Z-AA	A	AD
96	30° 15.595	81° 30.858	Y-Z		
97	30° 15.590	81° 30.850	Y-Z	A	juv
98	30° 15.584	81° 30.840	Y-Z	AB	AD
99	30° 15.589	81° 30.829	Y-Z	A	AD
100	30° 15.568	81° 30.872	Z-AA	AB	AD
101	30° 15.574	81° 30.854	Z-AA		
102	30° 15.564	81° 30.874	AABB		
103	REMARKED AS #155				
104	30° 15.571	81° 30.821	Z-AA	IA	juv
105	30° 15.546	81° 30.846	BBCC		
106	30° 15.554	81° 30.839	AA-BB	IA	AD
107	30° 15.547	81° 30.838			
108	30° 15.539	81° 30.850			
109	30° 15.539	81° 30.837	BBCC		
110	30° 15.541	81° 30.824	BBCC		
111	30° 15.539	81° 30.802	BBCC		JUV
112	30° 15.535	81° 30.803	BBCC		
113	30° 15.526	81° 30.796			
114	30° 15.519	81° 30.804	DD-EE	A	AD
115	30° 15.526	81° 30.815	BBCC		
116	30° 15.526	81° 30.812	CCDD		
117	30° 15.524	81° 30.816	CCDD		
118	30° 15.526	81° 30.833	DD-EE	A	AD

Appendix II

119	30° 15.522	81° 30.838	DD-EE	A	AD
120	30° 15.524	81° 30.833	DD-EE	A	AD
121	30° 15.507	81° 30.824	DDEE	IA	AD
122	30° 15.509	81° 30.817	EEFF		
123	30° 15.480	81° 30.814	FF-GG	IA	AD
124	30° 15.478	81° 30.816	GG-HH	IA	AD
125	30° 15.470	81° 30.812			
126	30° 15.472	81° 30.809	GGHH		
127	30° 15.481	81° 30.805	FF-GG	A	AD
128	30° 15.472	81° 30.797	GGHH		AD
129	30° 15.473	81° 30.791	GG-HH	A	AD
130	30° 15.463	81° 30.787	HH-II	A	AD
131	30° 15.461	81° 30.787	HH-II		
132	30° 15.463	81° 30.800	HH-II	A	AD
133	30° 15.461	81° 30.809	HH-II	A	AD
134	30° 15.912	81° 31.031	B-C	AB	AD
135	30° 15.579	81° 30.868	Z-AA	A	AD
136	30° 15.556	81° 30.851	AA-BB	A	AD
137	30° 15.433	81° 30.802	JJ-KK	A	AD
138	30° 15.430	81° 30.780	JJ-KK	A	AD
139	30° 15.436	81° 30.772	JJ-KK	A	AD
140	30° 15.440	81° 30.768		IA	AD
141	30° 15.448	81° 30.761	HH-II	A	AD
142	30° 15.440	81° 30.756	IIJJ	A	AD
143	30° 15.416	81° 30.781	kkll	IA	AD
144	30° 15.413	81° 30.793	kkll	A	AD
145	30° 15.413	81° 30.782	kkll	IA	AD
146	30° 15.409	81° 30.780	kkll		
147	30° 15.400	81° 30.753	llmm	A	AD
148	30° 15.410	81° 30.795	llmm		
149	30° 15.400	81° 30.764	llmm	A	AD

Appendix II

150	30° 15.438	81° 30.767	IIJJ	A	AD
151	30° 15.922	81° 31.068	A-B	A	AD
152	30° 15.874	81° 31.051	E-F	IA	AD
153	30° 15.864	81° 31.046	E-F	IA	AD
154	30° 15.610	81° 30.870		A	AD
155	30° 15.561	81° 30.842			
156	30° 15.807	81° 31.020	I-J	A	juv
157	30° 15.718	81° 30.972	P-Q	A	AD
158	30° 15.734	81° 31.000	N-O	IA	JUV
159	30° 15.590	81° 30.868	Y-Z	IA/AB	juv
160	30° 15.676	81° 30.940	R-S	AB	
161	30° 15.645	81° 30.892	U-V	A	IA
162	30° 15.896	81° 31.058	DE	A	AD
163	30° 15.784	81° 31.011			juv< 3 years
164	30° 15.881	81° 31.045	D-E	IA	juv
165	30° 15.446	81° 30.750	HH-II	A	AD
166	30° 15.810	81° 31.019	J-K	AB	juv
167	30° 15.558	81° 30.830			
168	30° 15.629	81° 30.889			
169	30° 15.438	81° 30.765		A	AD
170	30° 15.637	81° 30.891	V-W	A	AD
171	30° 15.836	81° 31.021	HI	A	juv
172	30° 15.805	81° 31.020	J-K	AB	juv
173	30° 15.804	81° 31.029	J-K	AB	juv
174	30° 15.608	81° 30.873	X-Y	A	juv
175	30° 15.607	81° 30.872	X-Y	A	juv
176	30° 15.605	81° 30.871	X-Y		juv
177	30° 15.598	81° 30.865	X-Y	A	juv
178	30° 15.554	81° 30.839	AA-BB	A	AD
179	30° 15.554	81° 30.833			juv
180	30° 15.545	81° 30.841			juv

Appendix II

181	30° 15.812	81° 31.008	I-J	IA	AD
182	30° 15.801	81° 31.014	IJ		HATCHLING
183	30° 15.802	81° 31.012	I-J	AB	HATCHLING
184	30° 15.808	81° 31.014	I-J	AB	HATCHLING
185	30° 15.813	81° 31.009	I-J	AB	juv
186	30° 15.784	81° 30.468	K-L	IA	JUV
187	30° 15.846	81° 31.024			juv
188	30° 15.804	81° 31.018	J-K	AB	juv
189	30° 15.629	81° 30.896			juv
190	30° 15.635	81° 30.878	V-W	IA/AB	AD
191	30° 15.441	81° 30.760	IIJJ	AB	juv
192	30° 15.456	81° 30.757	HHII		JUV
193	30° 15.814	81° 31.019	I-J	AB	juv
194	30° 15.755	81° 31.004	N-O	A	AD
195	30° 15.620	81° 30.860	J-K	AB	HATCHLING
196	30° 15.924	81° 31.085		A	AD
197	30° 15.902	81° 31.049	CD	AB	JUV
198					
199					
200					
201	30° 15.896	81° 31.062			JUV
202	30° 15.907	81° 31.064	B-C	IA	AD
203	30° 15.863	81° 31.029	E-F	A	AD
204	30° 15.856	81° 31.061	HI	A	JUV
205	30° 15.843	81° 31.026	GH		JUV
206	30° 15.784	81° 30.968			AD
207	30° 15.785	81° 30.965	K-L	IA	AD
208			AA-BB	A	AD
209			JJ-KK	A	JUV
210	30° 15.661	81° 30.907	T-U	-	dillo
211	30° 15.591	81° 30.846			JUV

Appendix II

212	30° 15.592	81° 30.829	X-Y	A	AD
213	30° 15.581	81° 30.831	Y-Z	A	J
214	30° 15.579	81° 30.843	Z-AA	AB	AD
215	30° 15.557	81° 30.837			JUV
216	30° 15.539	81° 30.850	BBCC	IA	AD
217	30° 15.508	81° 30.764	HH-II	A	AD
218	30° 15.430	81° 30.770	JJKK	A	JUV
219	30° 15.573	81° 30.991	M-N	A	AD
220	30° 15.438	81° 30.771			JUV
221	30° 15.538	81° 30.810			JUV
222	30° 15.422	81° 30.768			AD
223	30° 15.419	81° 30.772			
224	30° 15.755	81° 31.004	N-O	AB	juv
225	30° 15.554	81° 30.857	R-S	A	AD
226	30° 15.695	81° 30.959			AD
227			R-S	A	AD
228	30° 15.618	81° 30.883	W-X	A	juv
229	30° 15.748	81° 30.972	N-O	A	AD
230	30° 15.822	81° 31.007	I-J	IA	juv
231	30° 15.822	81° 31.013			J
232	30° 15.800	81° 31.016			J
233	30° 15.570	81° 30.832	Z-AA	A	J
234	30° 15.646	81° 30.899	UV	A	J
235	30° 15.810	81° 31.028	I-J	n/a	J
236	30° 15.809	81° 31.027	I-J	AB	juv
237	30° 15.799	81° 31.018	J-K	A	juv
238	30° 15.798	81° 31.013			J
239	30° 15.587	81° 30.859	Y-Z	A	J
240	30° 15.588	81° 30.858			J
241	30° 15.593	81° 30.862	Y-Z	A	AD
242	30° 15.587	81° 30.860			J (baby)

Appendix II

243	30° 15.632	81° 30.910	V-W	A	Juv
244	30° 15.647	81° 30.939	U-V		J
245	30° 15.823	81° 31.025	I-J	IA	juv
246	30° 15.818	81° 31.824	HI	AB	JUV
247	30° 15.662	81° 30.915	TU	AB	J (baby)
248	30° 15.805	81° 31.017	I-J	AB	AD
249	30° 15.788	81° 30.997	K-L	IA	juv
250	30° 15.845	81° 30.998	FG	IA	J-YA
251	30° 15.754	81° 30.995			J
252	30° 15.809	81° 31.014	J-K	AB	juv
253	30° 15.753	81° 31.001	N-O	IA/AB	J
254	30° 15.941	81° 31.087	00-A	A	AD
255	30° 15.819	81° 31.026	I-J	A	juv
256	30° 15.427	81° 30.764	JJKK	A	J
257	30° 15.597	81° 30.866	Y-Z		J (baby)
258			Y-Z		
259			TU	AB	
260			T-U	AB	juv
261					
262			GH		
263			V-W	A	juv
264					
265			J-K	IA	juv
266			CCDD		
267				A	juv
268			W-X	A	AD
269			v-W	A	AD
270			E-F	AB	juv
271			Y-Z	A	JUV
272			S-T	A	AD
273			A-B	NA	HATCHLING

Appendix II

274			U-V	A	AD
275			E-F	AB	AD
276			T-U	A	AD
277			22-11	A	AD
278			22-11	A	AD
279			X-Y	A	JUV
280			X-Y		
281			X-Y	A	JUV
282			X-Y	AB	JUV
283			M-N	IA	juv
284			K-L	A	AD
285			X-Y	A	JUV
286			2211	A	AD
287			I-J	A	juv
288			D-E	A	AD
289			D-E	AB	juv
290			E-F	IA	juv
291			E-F	IA	AD
292			T-U	A	AD
293			X-Y	A	juv
294			FG	IA	JUV
295			FG	IA	A
296			GH	A	JUV
297			H-I	IA	juv
298			K-L	A	juv
299				A	JUV
300				A	JUV
301			Q-R	A	juv
302				A	JUV
303			FG	IA	JUV
304			I-J	IA	HATCHLING

Appendix II

305			I-J	A	juv
306			J-K	AB	juv
307			M-N	IA	juv
308			L-M	A	AD
309			M-N	IA	JUV
310			n/a	n/a	n/a
311			N-O	A	AD
312			O-P	A	AD
313			O-P	A	AD
314			O-P	A/IA	AD
315			Q-R	-	DILLO
316			Q-R	A	AD
317			Q-R	A	juv
318			Q-R	A	juv
319			R-S	A	AD
320			S=T	IA	JUV
321			T-U	A	juv
322			T-U	IA	JUV
323			U-V	A	AD
324			U-V	A	juv
325			U-V	A	juv
326			V-W	A	juv
327			V-W	A	juv
328			V-W	A	juv
329			V-W	A	AD
330			W-X	A	juv
331			W-X	AB	AD
332			X-Y	A	juv
333			X-Y		
334			X-Y		
335			Y-Z	A	juv

Appendix II

336			Y-Z	A	juv
337			Y-Z	A	AD
338			Z-AA	A	AD
339			Z-AA	A	AD
340			Z-AA	A	JUV
341			Z-AA	A	juv
342			AA-BB	A	juv
343				A	A
344					
345			NO	A	JUV
346			KL	A	AD
347			MN	A	AD
348			HHII	A	AD
349				A	AD
350			BBCC	A	AD
351				AB	AD
352			BBCC	A	AD
353			CCDD	A	AD
354			KKLL	A	JUV
355				A	JUV
356			IIJJ	A	JUV
357			IIJJ	A	JUV
358			FFGG	A	AD
359			GGHH	A	AD
360					
361				A	JUV
362			JK	0	HATCHLING
363				A	JUV
364				A	AD
365				A	AD
366			IJ	0	0

Appendix II

367			IJ	0	0
368					
369				A	JUV
370					
371				A	JUV
372			U-V	A	AD
373				A	JUV
374				A	JUV
375				A	JUV
376			JK	AB	Hatchling
377			GH	AB	
378			GH	A	JUV
379			IJ	A	JUV
380					
381			X-Y		
382			HHII		
383					
384					
385			GH	A	JUV
386			DE	A	JUV
387			GH	A	JUV
388			HI	A	JUV
389			BC	A	JUV
390			IJ	A	JUV
391			IJ	A	JUV
392			IJ	A	ADULT
393					
394			LM	A	Juv
395			LM	A	JUV
396			MN	A	AD
397			EF	A	JUV

Appendix II

398			FG	A	JUV
399			FG	A	JUV
400			GH	A	juv
401			OP	A	JUV
402			KL	A	JUV
403			AB	A	AD
404			FG	A	JUV
405			TU	A	JUV
406			TU	A	JUV
407			EF	A	juv
408			KKLL	A	juv
409			CCDD	A	AD
410			YZ	A	JUV
411			XY	A	Juv
412			VW	A	AD
413			PQ	A	AD
414			DE	A	AD

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