TEMPORAL AND SPATIAL TRENDS OF THE AMPHIBIANS, REPTILES, AND MAMMALS OF THE RELICT OTTINE WETLANDS

THESIS

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By

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TEMPORAL AND SPATIAL TRENDS OF THE AMPHIBIANS, REPTILES, AND MAMMALS OF THE RELICT OTTINE WETLANDS

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ABSTRACT

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Ecological surveys are a snapshot in time, providing biological inventories and important documentation about ecological communities. If carefully documented these data may be used to estimate population sizes and demographics as well as community parameters such as abundance, species richness and diversity. The results of such surveys assist land managers and agency personnel to formulate conservation protocols and serve as important tools in assessing results from management efforts and temporal changes in community parameters. Herpetofauna and rodents are particularly important because they are easily monitored, locally abundant, and have been used as indicator taxa of ecosystem diversity and health. From January 2008 to June 2009, amphibians, reptiles, and mammals of Palmetto State Park and the Ottine Wetlands of south central Texas were surveyed to produce a current mammalian and herpetofaunal inventory and produce estimates of relative abundance, evenness and diversity. I compared my data to the results of a survey performed in the late 1950s by Gerald Raun, Ph.D. to determine if the composition of this community has changed through time or in relation to land use practices (agriculture vs. preserve/outdoor recreation). Standard survey methods were used equally among sites to sample amphibians, reptiles, and mammals. A total of 862 amphibians and reptiles representing 38 species (9 amphibians, 29 reptiles) were captured or observed. Time-constrained surveys (46.2%), nocturnal road surveys (30.9%), and drift fence arrays (10.1%) produced the highest amount of observations. Direct comparisons suggested noteworthy changes in the relative abundance within the snake assemblage between 1958 and 2008 despite little observed change in estimates of diversity and evenness. These data suggested that community composition of the herpetofauna has changed over the past 50 years resulting in a loss of amphibian richness (loss of five species) and changes to the composition and relative abundance of species within the reptile assemblage. Twenty-nine mammalian species were documented during the study. Differences in rodent evenness estimates approached significance with the private wetlands yielding higher values for species abundance and evenness.

Furthermore, a greater richness and abundance of species within all groups were observed at the wetlands contained within boundaries of Palmetto State Park, compared to adjacent privately owned Ottine wetlands. I propose that these changes resulted from changes in ground water availability through time (droughts and increased anthropogenic use) and the geophysical attributes of the wetlands. Assemblage compositions between sites are consistent with differences in land use practice.

CHAPTER I

INTRODUCTION

Studies that present ecological inventories over landscapes or habitats provide important documentation of natural resources by representing an ecological snapshot in time (Lips 1999, Wilson and McCranie 2003). These data may be used to estimate population sizes and demographics along with richness, abundance and diversity of fauna and flora (Cochran 1963, Scheaffer et al. 1996). With continued economic and environmental pressures on land use, these data are essential considerations in developing wildlife management plans and assessing management success (Sharitz et al. 1992, Siegel 1995, Rose and Cowan 2003). Also, ecological baseline surveys are essential in understanding the natural causality of ecological processes, anthropogenic influence, and effects of human mediated conservation practices (Arcese and Sinclair 1997). There is a paucity of scientifically repeatable and statistically comparable data available describing the historical composition of flora and fauna within the literature. The majority of accounts list presence/absence of species and describe qualitative assessments of abundance and natural history (both of which are useful in ecological trend analysis). This paucity of data combined with the rapidly changing structure of landscapes necessitates reliable, repeatable, and comparable surveys as baselines for the evaluation of temporal and spatial trends caused by ecological and anthropogenic influences.

Reptile, amphibian and rodent populations are easily monitored, can be locally abundant and have been used in previous studies as indicator taxa of ecosystem diversity and health (Heyer et al. 1994, Hanlin et al. 2000, Wilson and McCranie 2003, Sternberg and Judd 2006). Changes in habitats have contributed to the cosmopolitan decline of amphibian richness and diversity (Adams 1999, Retallick et al. 2004, Nystrom et al. 2007). Reptilian communities appear resilient in their response to mild habitat changes but experience changes in composition through extreme or continued ecological and/or anthropogenic pressures (Owen and Dixon 1989). Rodents are an important group representing a shared food resource for higher trophic levels (Sperry and Weatherhead 2008) and have been used to estimate ecological responses to drought and land-use practices (Spevak 1983, Sternberg and Judd 2006).

Floodplain wetlands represent one of the most threatened ecosystems in North America due to anthropogenic activities (Bayley 1991) and habitat destruction. However, wetland ecosystems have substantial floral and faunal diversity because of the frequency of habitat mosaics, greater topographic relief and increased primary productivity due to lengthened hydro-period and nutrient cycling (Baylay 1995). Findlay and Houlahan (1997) found a positive correlation between wetland surface area and species richness of birds, mammals, herpetofauna and plants.

The Ottine Wetlands encompass approximately 202 ha within the village of Ottine, Texas (Fig. 1). Although contiguous, the wetlands are devided between private ranching and public lands based on land use practices and ownership for the purpose of this study. The wetlands have historically supported a complex diversity of wildlife (Hildebrand 1935, Raun 1959) and were described by Carter Smith (2008), current director of Texas Parks and Wildlife, as one of Texas' "natural treasures". Recent surveys of the Ottine Wetland's flora (Fleenor and Taber 2009), invertebrates (Taber and Fleenor 2005) and the avian community (Rogers 1999) have been published. Fifty years have passed since the last published surveys of amphibian, reptilian and mammalian populations (Raun 1958). Between September 1957 and June 1958, Raun (1958, 1959) collected data on the species composition of these groups and fish at the relict Ottine Wetlands for both his Master's thesis and a subsequent journal publication. Although mostly qualitative in assessment, his Master's thesis provides sufficient detail for species presence and abundance to allow an insight into assemblage dynamics (Raun 1958). His more detailed results for snakes affords a more quantitative assessment of the group. This allowed a rare opportunity to compare vertebrate groups across five decades of change.

The primary objective of this study was to assess the current assemblage composition of mammals, reptiles and amphibians of the Ottine Wetlands, thus, creating a current species inventory of vertebrate inhabitants occupying and utilizing this ecosystem. These data were also used to establish trends in community composition through time by comparing species richness and heterogeneity to data reported by Hildebrand (1935) and Ruan (1958). Finally, comparisons between the portion of the Ottine wetlands located within boundaries of Palmetto State Park and the remaining portion of wetlands, located on surrounding private property, were made to determine how land use may reflect upon assemblage composition.

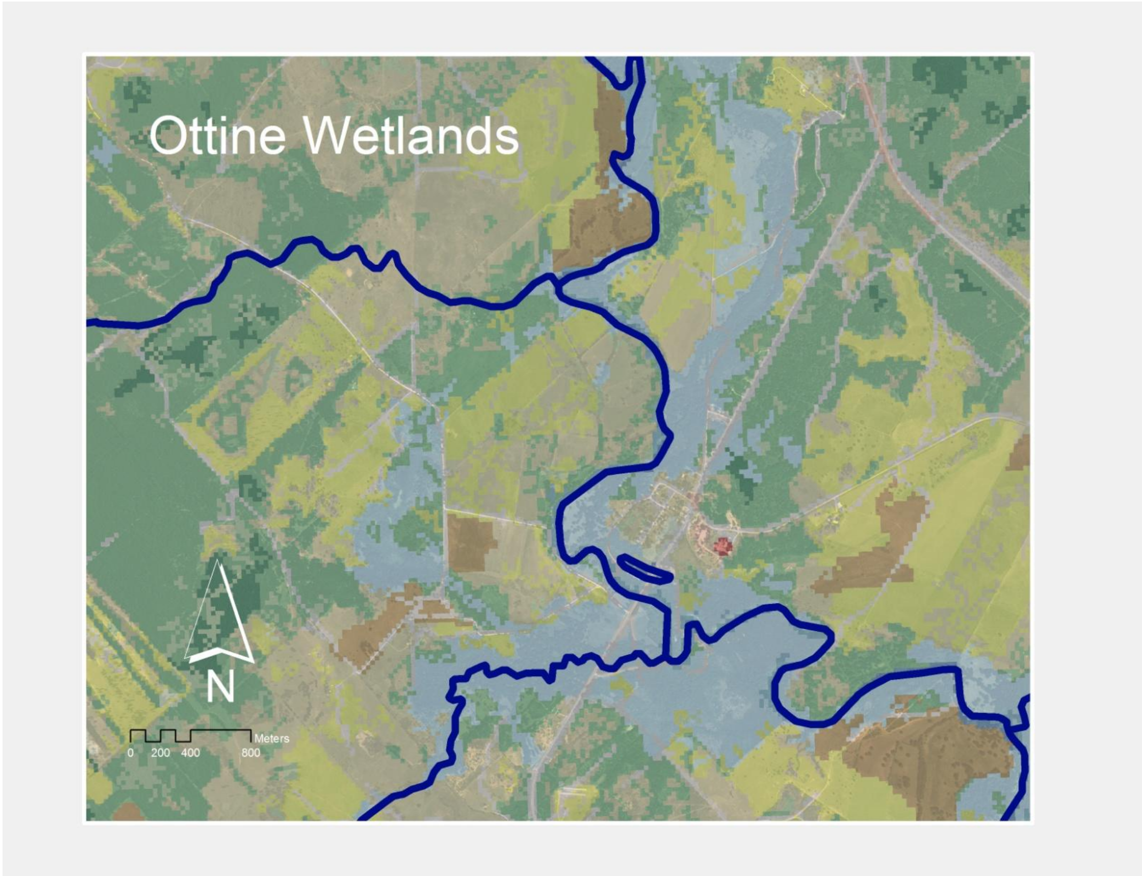

Figure 1. The Ottine Wetlands (highlighted in light blue) Gonzales County, Texas.

CHAPTER II

MATERIALS AND METHODS

Study Site

The Ottine Wetlands of north Gonzales County, Texas (N 29.59546, W -97.58916 WGS 84) are located within the Texan biotic province and proximal to the juxtaposition of the Texan, Balconian, and Tamaulipan provinces (Blair 1950). The Ottine wetlands represent a disjunct environmental outlier of the Austroriparian biotic province of Texas (Blair 1950). The habitats surrounding the wetlands are consistent with the Post Oak Savannah environmental region with influences from the nearby Blackland Prairies region (Diamond et al. 1987). These relict wetlands receive an average of 92.5 cm of precipitation per year and are a product of geologic and hydrologic conditions. In addition to water provided by seeps and springs, additional hydrological processes have allowed the existence of these wetlands by preventing ground penetration of flood and rain waters (Cumley 1931, Bullard 1935, King 1961, Taber and Fleenor 2005, Fleenor and Taber 2009). These environmental features provide habitat complexities which contribute to an increased potential for species richness and diversity. These wetlands are proximal to the 98th meridian and have been historically described as a complex and unique combination of eastern and western ranging flora and fauna (Bogush 1928, Hildebrand 1935, Raun 1958, Fleenor and Taber 2009). Two state threatened reptiles, canebrake rattlesnake (*Crotalus horridus*) and Cagle's map turtle (*Graptemys caglei*) inhabit the wetlands. These wetlands are currently divided between publically (Palmetto State Park) and privately owned properties. The lowland sites and surrounding uplands were delineated into three habitat types for the current study: Park Wetlands, Private Wetlands and Surrounding Uplands (Fig. 2).

Palmetto State Park (PSP) was created in 1933 and includes 109 ha of public property encompassing a series of diverse habitat types including: post oak (*Quercus stellata*)/blackjack oak (*Q. marylandica*) savannah uplands, riparian hardwood forests dominated by cedar elm (*Ulmus crassifolia*) and Texas sugarberry (*U. laevigata*), and dwarf palmetto (*Sabal minor*) swamps/marshes (Shearer 1956). The uplands site represented within the Palmetto State Park boundary is a narrow strip bounding a portion of the park road dominated by post oak, blackjack oak and yaupon holly (*Ilex vomitoria*). Ephemeral pools form after heavy rains in this portion of the park. The San Marcos River bisects the park, and the confluence of Rutledge Creek with the San Marcos River lies within its boundaries. A warm spring and an artesian well supply water to an oxbow lake (1.62 ha) and two small artificial ponds. The thickly canopied swamps are dominated by burr oak (*Q. macrocarpa*) and the remainder of the park bottomlands is dominated by cedar elm and Texas sugarberry.

During fiscal year 2008, approximately 42,000 visitors took advantage of the 6 km trail system and 40 camp sites at PSP (Jon Sunder, TPWD Analyst III, pers. comm. May 2009). The original park structures were constructed by the Civilian Conservation Corps (CCC) in the early 1930s. Subsequent construction of camp sites and trails was begun in the 1970s. Palmetto State Park is not used for cattle grazing nor hunting; and therefore, those areas not developed for outdoor recreation should be considered preserved lands.

Four hundred and five hectares of privately owned property, of which approximately 52 ha are wetlands, border the park to the south and west. These private lands can be described as a combination of riparian hardwood forests, improved pastures, palmetto swamps, and two artificially-fed water tanks. Approximately 25 percent of the Ottine Wetlands are located on this property and include the "peat bogs" that Raun surveyed (1958). This parcel is composed of both forested swamp land and riparian zones bordered by pasture land dominated by honey mesquite (*Prosopis glandulosa*). Additionally, a second upland site containing the former Ottine Fish Hatchery also surveyed by Raun is found on the property south of the park (1958). The Soefje wetlands and all surrounding rangelands are utilized by the owner for a cattle grazing operation supporting between 85-170 head depending upon environmental conditions.

Survey Methods

Although trapping methodology tends to bias particular species at the probable exclusion of others, my study attempts to maximize the detection of all taxonomic groups surveyed. I conducted this study over a 19 month period with intense sampling occurring during both spring and summer 2008 and the spring 2009. All surveys were performed by individuals familiar with local herptile and mammalian fauna. In an effort to avoid under sampling members of target taxa, I used a variety of survey techniques (Ryan et al. 2002, Ford and Hampton 2005, Ferguson et al. 2008). These techniques included: drift fence arrays with associated pit fall and funnel traps (Christiansen and Vanderwalle 2000), hoop net traps (Steen and Gibbs 2004), time constrained surveys (TCS) (Foster and Hampton 2003), nocturnal road surveys (NRS) (Seigel 1986), anuran chorus surveys (Ford and Hampton 2005), baited Sherman live traps and incidental sightings. I recorded GPS coordinates for all survey routes and permanent sampling sites (Fig. 3). Sampling began 28 January 2008 and concluded 25 August 2009. Additionally, environmental data including both high and low temperature, precipitation, and cloud cover were recorded with each survey.

Six Y-shaped drift fence arrays were constructed with 30.5-cm aluminum flashing and consisted of three 15-m arms radiating from a central pitfall trap (polyurethane 18.9 l bucket). A single rectangular one way funnel trap was placed flush on each side of an arm 5 m from the distal end (two funnel traps on each arm) and all arms terminated with a pitfall trap. All pitfall traps were covered with plywood leaving a 5 cm gap between the bucket lip and plywood cover to deter predation by carnivores. This cover was weighted and secured to deter predation of captured individuals by meso-carnivores. Arrays were closed at the conclusion of a trapping session and during daylight hours if temperatures were forecast to exceed 30° C between consecutive trapping nights. Two arrays were constructed at random points within each of three different predetermined land use areas: private wetlands, park wetlands, and uplands (Fig. 1). Arrays were checked each morning during trapping sessions and captured individuals were identified (Appendix 1), recorded and marked via scale clip or toe clip (Brown and Parker 1976).

I used hoop net traps to estimate the aquatic turtle assemblage. These traps were 1.0-m circular funnels baited with raw chicken. Traps were partially submerged in wetlands deeper than 0.75-m deep. Traps were checked every 24 h and each captured turtle was identified (Appendix 2), recorded and given a unique shell notch for individual identification (Cagle 1939).

Timed-constrained surveys (TCS) were performed to locate, identify and mark or count amphibians, reptiles and mammals. I carried binoculars (Eagle Optics, Platinum Rangers 10 X 42, Eagle Optics, Middleton, WI) while performing TSS to assist in identifying animals that otherwise prove difficult to identify from a distance (i.e., lizards). Searches began at a random point within a study site and concluded after 15, 30, or 60 min of searching. Searches were oriented in the direction of the nearest debris (cover) or wetland. I consider these searches of moderate intensity, meaning that debris piles encountered were inspected by being pulled apart or flipped for no more than 5 min and then replaced or reconstructed to preserve microhabitats after the conclusion of a survey. I performed a total of 1,800 min of TCS with equal amounts of time surveying each of the three sites (Appendix 3). Additionally, I used TCS to count chorusing anuran aggregates after the large rainfall event of 18 April 2009 in an attempt to better assess relative abundances of species within the assemblage.

I conducted nocturnal road surveys (NRS) along 2.9 km stretches of road (8.7 km total) located within each of the study sites during spring and summer shortly after dusk between the hours of 19:00 and 23:00 h. Nocturnal road surveys were conducted with a single spotter using a 3,000,000 candle power spot lamp (Q-beam, The Brinkman Corporation, Dallas, TX). Animals were counted only if they were seen proximal to the road and right of way. Data collected included: site, date, time, species encountered, number of individuals, and anuran species heard (Appendix 4). I conducted a total of 278.4 km of nocturnal road surveys.

Standard anuran chorus surveys (ACS) were used to categorically assess the anuran assemblage (Ford and Hampton 2005). Priority was given to this technique on nights during and following moderate to heavy (>1.25 cm) rainfall events in an effort to account for explosive breeders. Meteorological data recorded included temperature, mean wind speed, and relative humidity. Chorus size categories (1-3) were separated by number of individuals counted within each species specific chorus (category 1 representing a single individual, category 2 representing two to 10 individuals and category 3 representing >10 individuals). This method was performed concurrent with NRS on nights that NRS were performed. This method allowed for presence/absence data and categorical assessment of breeding population sizes at each site.

Sherman traps were used to capture small mammals during winter 2008 and summer 2009. I placed 50 or 100 traps along transects in upland and wetland sites each trapping night. I baited traps with a mixture of rolled oats and black-oil sunflower seeds at dusk and checked for captures within two h of sunrise. To prevent trapping mortality, I did not trap on nights when temperatures were forecast to fall below 15° C. All rodents caught were identified, recorded, marked and released at the site of capture (Appendix 5).

Incidental observations were recorded for those species that were extremely rare or unaccounted for using systematic sampling. These observations were not used in calculating statistics but were used for richness values and ecological inventory. Data recorded included: species seen, number of individuals, time of day, GPS co-ordinates and habitat description.

Species accumulation curves were created for each taxonomic group to determine whether survey effort (measured in days spent performing any method that may account for species of the focus taxa) versus new species accumulation appeared to reach an asymptote. This method allows an investigator to compare the detected species richness to the projected species richness of an environment as a function of sampling effort.

All appropriate precautions and protocols (as designated by Texas State University-San Marcos Institutional Animal Care and Use Committee- IACUC 0811_0224_12, research guidelines designated by the Society for the Study of Amphibians and Reptiles, and Texas Parks and Wildlife regulations) were followed in collecting animals. Specimens were collected under TPWD Scientific Permit #SPR-0993-638. I collected voucher specimens for new county records of mammals. These will be deposited into the Texas Tech University Museum and Texas State Vertebrate Teaching Collection. Additionally, tissue samples from specimens collected during the course of this study are stored within the Michael R. J. Forstner tissue catalog.

Statistical Analysis

I used data from the surveys of each taxonomic class surveyed at the Ottine Wetlands to determine the overall species richness and abundance (measured as total number of individuals caught from cumulative survey efforts) and to compare these data with data reported by Raun (1958). These data were also used to compare the richness, abundance, heterogeneity, and similarity of amphibians and reptiles between publically and privately owned wetland sites. Additionally, seasonal trapping results were used to determine if significant differences exist between wetland treatments (privately vs.

publically owned) using a paired *t*-test. Diversity, evenness, and similarity between communities were estimated using Simpson's Index of Diversity, Smith and Wilson's Index of Evenness, and Morista's Index of Similarity, respectively (Krebs 1999).

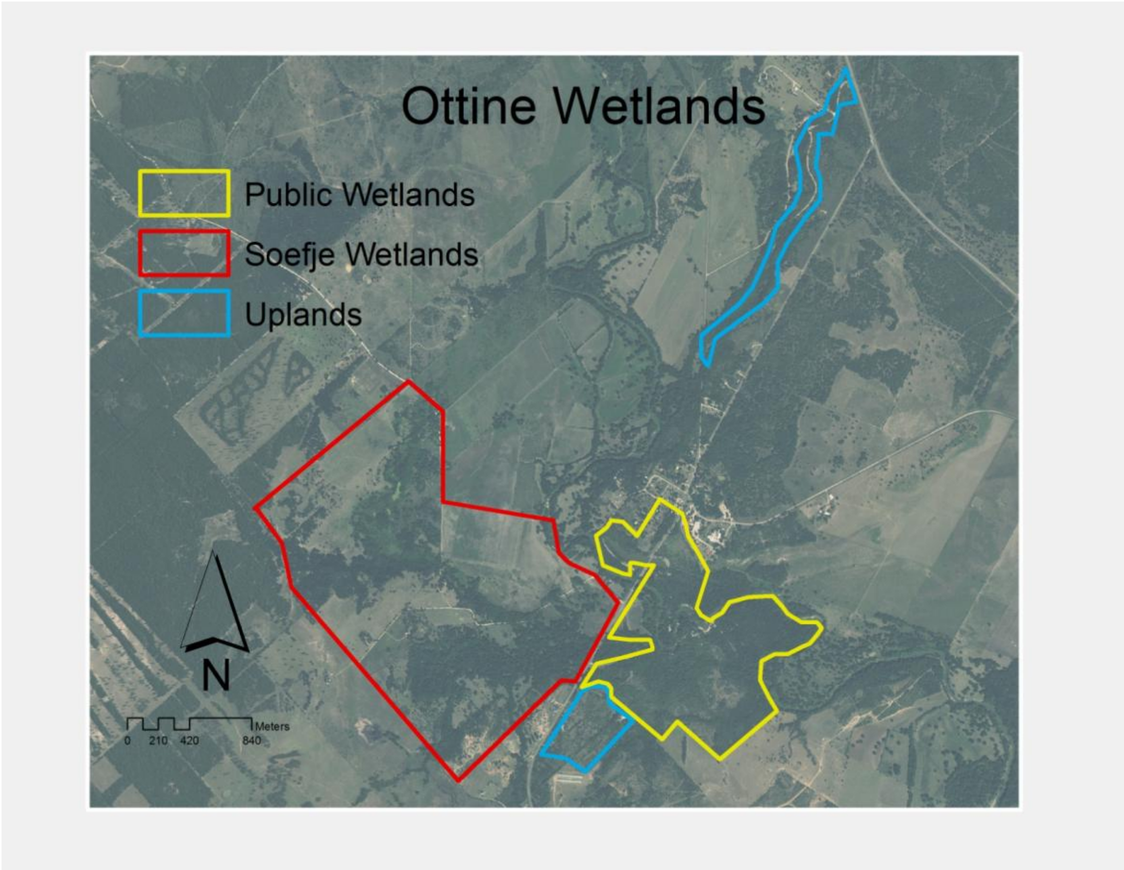

Figure 2. Uplands, public (Palmetto State Park) wetland, and private (Soefje) wetland sites of the Ottine Wetlands, Gonzales Co., Texas.

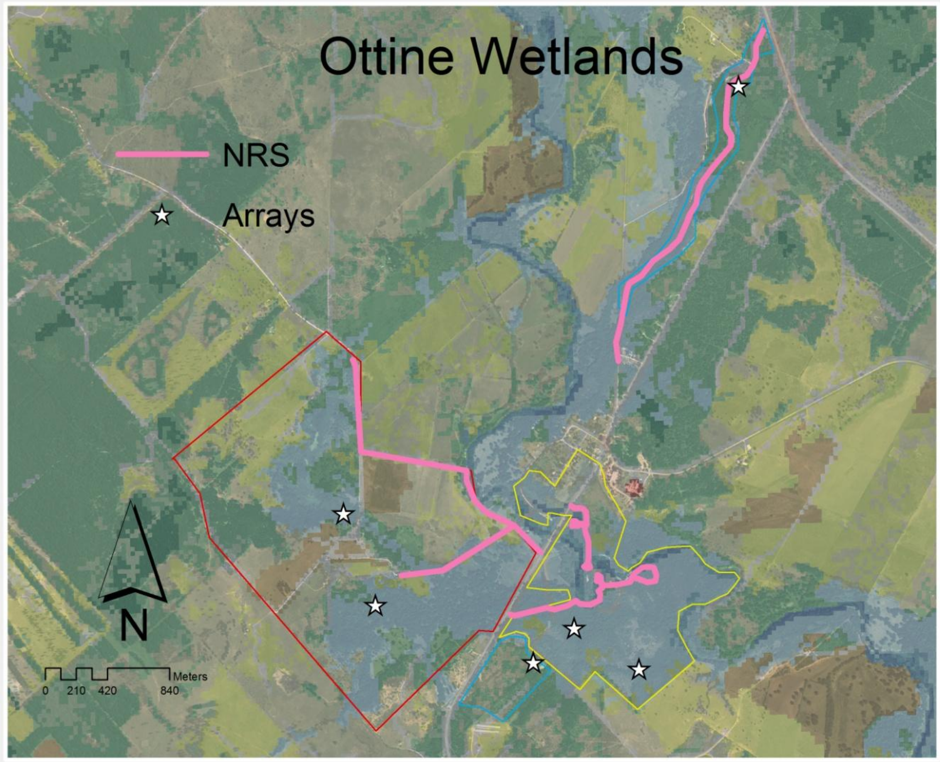

Figure 3. Survey method locations (NRS = Nocturnal Road Surveys) in relation to each study site within the Ottine Wetlands, Gonzales Co., Texas. Nocturnal Road Surveys were performed on existing roads.

CHAPTER III

RESULTS

Herpetofauna Richness, Heterogeneity and Evenness

For the purpose of parsimony during a period of continual debate between taxonomist, all reptile and amphibian nomenclature herein reported follow Dixon (2000). I captured or counted 862 individual amphibians and reptiles representing 38 species during this study (Table 1). Species accumulation curves appear to asymptote suggesting that projected species richness was similar to detected species richness within each taxonomic grouping (Fig. 4). The 38 species were composed of one salamander, eight anurans, six lizards, 16 snakes, and seven turtle species. Time-constrained surveys (398 individuals, 28 species) and NRS (266 individuals, 22 species) were the most productive survey methods in both richness and abundance (Table 2). However, NRS and drift fence arrays each accounted for a single species (eastern hognose snake, *Heterdon platirhinos* and yellow-bellied racer, *Coluber constrictor*, respectively) unverified by other methods.

The greatest herpetofaunal richness occurred in the park wetlands with 28 species followed by the upland sites with 27 and the private wetlands with 21 (Table 3). This same pattern was observed after tabulating herpetofauna raw abundance (513, 239 and

110, respectively). Values for richness, abundance, diversity and evenness for the herpetofauna are provided in Table 4. Morisita's Index (Table 5) indicated moderate similarities between the park wetlands, private wetlands and uplands. Morisita's Similarity Index ($C_\lambda = 0.75$) also measured a strong similarity between the snake community reported by Raun (1958) and myself.

Mammalian Richness, Heterogeneity and Evenness.

Mammalian nomenclature follows Schmidly (2004). Nocturnal road surveys were the most productive sampling method (230 observations) followed by Sherman traps (192 captures) and drift fence arrays (88 captures). Species accumulation curves were also created for both mammals cumulatively and small rodents. Both accumulation curves appear to asymptote suggesting that few new species would be expected with continued sampling effort (Fig. 5). I captured or observed 593 individuals, representing nine orders and 29 mammalian species (Table 6). The greatest number of species were represented by the orders Rodentia (9 species), Carnivora (5 species) and Artiodactyla (3 species). I captured or observed 249 individuals representing nine species from the families Muridae and Heteromyidae. I recaptured only one individual, a white-footed mouse (*Peromyscus leucopus*) in the park. With such low recapture rates, it was not possible to use these data to estimate population size.

Rodent species richness was highest in the park and private wetlands (7) followed by the uplands (5). The highest abundance occurred within the park wetlands and decreased within the uplands and private wetlands respectively (Table 7). One species was unique to each of the private wetlands and uplands sites (hispid pocket mouse, *Chaetodipus hispidus* and southern plains woodrat, *Neotoma micropus*, respectively). The white-footed mouse was the most abundant species caught within all sites. Values for diversity and evenness are provided in Table 8. Morisita's similarity coefficient (C_λ = 0.76) expressed a strong similarity between park and private wetlands. Land use practice was unable to explain variation in mean differences of abundance (F_t = 5, P = 0.126), evenness (F_t= 4.125, P = 0.1514), richness (F_t = 1, P = 0.5) or diversity (F_t = 3.076, *d.f.*= 1, P = 0.2).

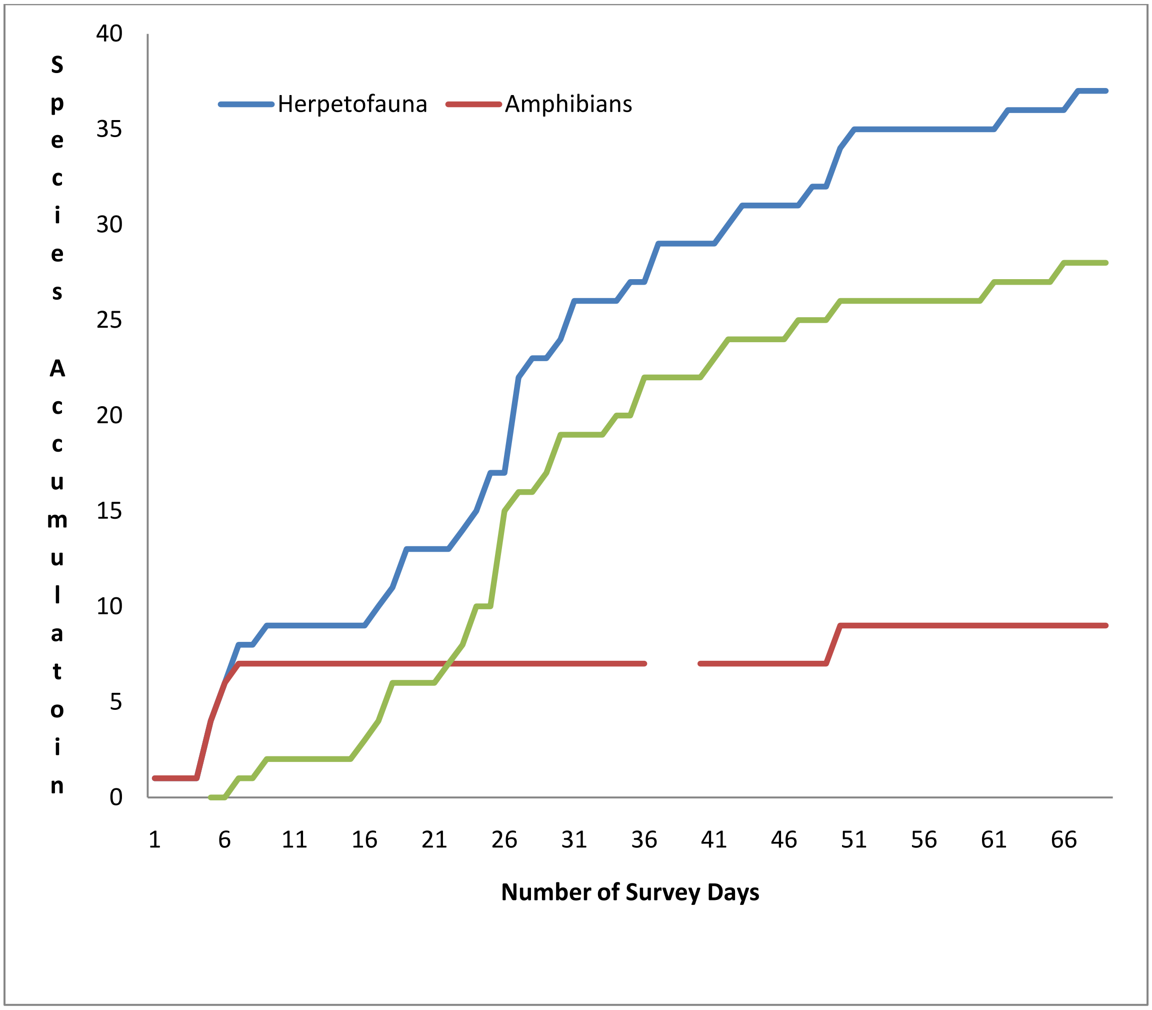

Figure 4. Species richness accumulation curves for herpetofauna, amphibians, and reptiles observed at the Ottine Wetlands. Observations were made between January 2008 and August 2009 and suggest that observed species richness appear to approach an asymptote of projected species richness.

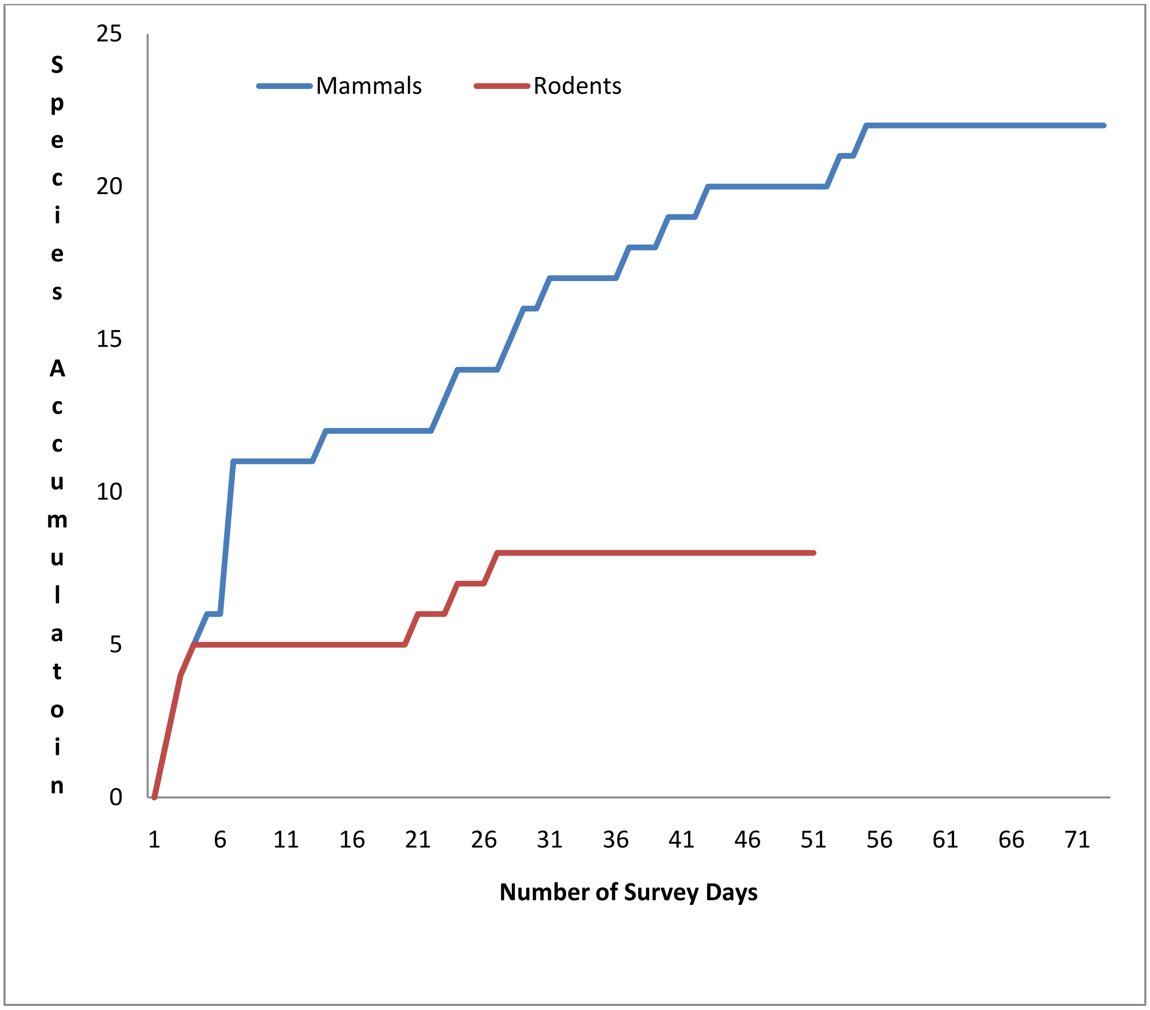

Figure 5. Species richness accumulation curves for mammals and small rodents observed at the Ottine Wetlands. Observations were made between January 2008 and August 2009 and suggest that observed species richness appear to approach the asymptote of projected species richness.

Table 1. Herpetofauna presence and abundance at the Ottine Wetlands, Gonzales Co., Texas as occurring in different studies through time. These data suggest changes in community structure and abundance as a product of detection and period of time surveys occurred.

	Abundance		
Taxa	Hildebrand, 1935	Raun, 1958	Swanson, 2009
Caudata			
Ambystoma texanum		C	R
Plethodon albagula	R		
Anurans			
Scaphiopus hurteri	C	C	C-52
Bufo speciosus	C		
Bufo compactilis	C	R-2	
Bufo debilis	C	R	
Bufo woodhousii		C	
Bufo valliceps	C	A	A-207
Acris crepitans	C	A	A-21
Pseudacris streckeri	C	C	
Pseudacris clarcki	C	C	
Hyla cinerea	C	C	A-91
Hyla versicolor/chrysoscelis	C	C	C-45
Eleutherodactylus augusti	R		
Syrrhophus marnocki	R		
Rana catesbeiana	C	C	C-50
Rana sphenocephala	C	A	A-67
Gastrophryne olivacea	C	C	C-53
Gastrophryne carolinensis	C		
Amphibians	17	14	9
Crocodylia			
Alligator mississippiensis	C		
Squamata- Lacertilia			
Hemidactylus turcicus			5
Anolis carolinensis	C	A	7
Holbrookia propinqua	C		
Sceloperus olivaceus	C	R	3
Sceloperus undulatus	C	A	1
Phrynosoma cornutum	C	(*[1])	
Ophisaurus attenuatus	C		
Cnemidophoris gularis	C	C	(*[2])
Cnemidophoris sexlineatus	C	R	(*[2])
Scincella lateralis	C	A	25

Table 1-Continued.

Eumeces septentrionalis	C	R	
Squamata- Serpentes			
Leptotyphlops dulcis	C		
Diadophis regalis	C		
Heterodon platirhinos	C		1
Opheodrys aestivus	C	5	3
Masticophis flagellum		6	2
Masticophis taeniatus	C		
Coluber constrictor	C	3	1
Salvadora grahamiae	C	1	
Elaphe obsoleta	C	5	5
Elaphe guttata	C		2
Drymarchon corais	C		
Arizona elegans	C		
Pituophis cantenifer	C	3	
Lampropeltis getula	C		
Lampropeltis triangulum	R		
Rhinocheilus lecontei	C		
Sonora semiannulata	C		
Regina grahamii	C		
Nerodia rhombifer	C	21	16
Nerodia fasciata		8	26
Nerodia erythrogaster	C	7	4
Storeria dekayi	C	1	2
Tropidoclonion lineatum	C		
Thamnophis sirtalis	C		
Thamnophis proximus	R	7	3
Thamnophis marcianus	C	3	2
Tantilla gracilis	C	10	
Micrurus fulvius	C	2	2
Agkistrodon contortrix	C	3	19
Agkistrodon piscivorus	C	10	24
Crotalus atrox	C		
Crotalus horridus	R		1
Testudines			
Kinosternum subrubrum	C	(*[2])	4
Kinosternum flavescens	C	(*[2])	
Sternotherus odoratus	R	R (1)	11
Macrochlemys temminckii	R		
Chelydra serpentina	C	R	3
Terrapene carolina	R	R (1)	
Terrapene ornata	C	C (3)	

Table 1-Contined.

Graptemys caglei		R (3)	(*[3])
Trachemys scripta	C	A	71
Pseudemys texana	C	R	29
Gopherus berlandieri	C		
Trionyx spiniferus	C	R (3)	1
Reptilia	50	31	29

*[1] *P. cornutum* included although only found 10 km north of wetlands, *[2] represents individuals identified to genus but not species, *[3] *G. caglei* found within park boundary in San Marcos River but not the Ottine Wetlands.

Table 2. Herpetofaunal abundance for each method employed to survey reptiles and amphibians of the Ottine Wetlands illustrating the TCS and NRS as the most productive survey methods.

TAXA	TCS	NRS	Pitfall	Funnel	ACS	Hoop	Incidental	Total
Caudata								
Ambystoma texanum	1							1
Anurans								
Scaphiopus hurteri	52				*			52
Bufo valliceps	60	108	21	18	*			207
Acris crepitans	11	7		3	*			21
Hyla cinerea	70	21			*			91
Hyla versicolor	41	4			*			45
Rana catesbeiana	6	44			*		3	50
Rana sphenocephala	32	25	2	8	*			67
Gastrophryne olivacea	47		6		*		1	53
AMPHIBIA	320	209	29	29			4	587
Squamata- Lacertilia								
Hemidactylus turcicus	1	4						5
Anolis carolinensis	6			1				7
Sceloperus olivaceus		1	2					3
Sceloperus undulatus	1						1	1
Cnemidophoris spp.	2							2
Scincella lateralis	18		3	4				25
Squamata- Serpentes								
Heterodon platirhinos		1					1	1
Opheodrys aestivus		3						3
Masticophis flagellum	1			1			1	2
Coluber constrictor				1				1
Elaphe obsoleta	2	2		1				5
Elaphe guttata	1	1						2
Nerodia rhombifer	3	13					1	16
Nerodia fasciata	19	5		2				26
Nerodia erythrogaster		4					2	4
Storeria dekayi	1	1					1	2
Thamnophis proximus	3						2	3
Thamnophis marcianus	1	1						2
Micrurus fulvius		1		1				2
Agkistrodon contortrix	4	7		8				19
Agkistrodon piscivorus	9	10		5				24
Crotalus horridus	1						1	1
Testudines								

Table 2-Continued.

Kinosternum subrubrum						4		4
Sternotherus odoratus						11		11
Chelydra serpentina	1					2	1	3
Graptemys caglei							1	0
Trachemys scripta	3	1				67		71
Pseudemys texana	1	2				26		29
Trionyx spiniferus						1		1
REPTILIA	78	57	5	24	0	111	12	275

(TCS= timed constrained surveys, NRS= nocturnal road surveys, Pitfall and Funnels were each associated with drift fence arrays, ACS= anuran chorus survey, Hoop= hoop net traps) * denotes presence determined by ACS or by incidental observation

Table 3. Herpetofaunal richness and abundance of the public wetlands, private wetlands, and upland sites of Ottine, Gonzales Co., Texas.

SPECIES	Park	Private	Uplands
Caudata			
Ambystoma texanum		1	
Anurans			
Scaphiopus hurteri			52
Bufo valliceps	96	40	71
Acris crepitans	13	8	*
Hyla cinerea	82	*	9
Hyla versicolor/chrysoscelis	30	*	15
Rana catesbeiana	50		
Rana sphenocephala	39	20	8
Gastrophryne olivacea	4	2	47
AMPHIBIANS	314	71	202
Squamata- Lacertilia			
Hemidactylus turcicus	4		1
Anolis carolinensis	7		
Sceloperus olivaceus			3
Sceloperus undulatus	*		1
Cnemidophorus spp.			2
Scincella lateralis	14	11	
Squamata- Serpentes			
Heterodon platirhinos		1	*
Opheodrys aestivus		1	2
Masticophis flagellum	*		2
Coluber constrictor			1
Elaphe obsoleta	1	3	1
Elaphe guttata			2
Nerodia rhombifer	15	1	
Nerodia fasciata	15	5	6
Nerodia erythrogaster	4	*	
Storeria dekayi		2	
Thamnophis proximus	*		1
Thamnophis marcianus		1	*
Micrurus fulvius	*	1	1
Agkistrodon contortrix	2	4	13
Agkistrodon piscivorus	18	5	1
Crotalus horridus	1		
Testudines			

Table 3-Continued

Kinosternum subrubrum	4		
Sternotherus odoratus	11		
Chelydra serpentina	*	3	
Trachemys scripta	70	1	
Pseudemys texana	29		
Trionyx spiniferus	1		
REPTILES	196	39	37

*denotes presence determined by ACS or incidental observation

Table 4. Amphibian and reptilian richness, abundance, diversity, and evenness values among private wetland, public wetland, and upland sites within the Ottine Wetlands, Gonzales Co, Texas. These results illustrate a higher detected richness and abundance of herpetofauna associated with the park wetland in comparison to private wetlands.

		Park	Private	Uplands
Amphibian				
	Richness	7	7	8
	Abundance	314	71	202
	Diversity	0.789	0.598	0.751
	Evenness	0.48	0.308	0.583
Reptilian				
	Richness	21	14	17
	Abundance	199	39	37
	Diversity	0.829	0.881	0.85
	Evenness	0.347	0.641	0.667

Table 5. Morisita's Similarity Indices comparing the similarity of communities of herpetofauna among private wetland, public wetland, and upland sites among the Ottine Wetlands, Gonzales Co., Texas.

	Private	Uplands
Park	0.64	0.49
Private		0.67

Table 6. Mammalian abundance accounted for using each survey method at the Ottine Wetlands, Gonzales Co, Texas.

Species	TCS	NRS	Pitfall	Funnel	Sherman	Incidental	Total
Insectivora							
Cryptotis parva			25				25
Chiroptera							
Tadarida brasiliensis						1	
Pippistrel subflavus	1						1
Lagomorpha							
Sylvilagus floridanus	4	16					20
Sylvilagus aquaticus	2	10					12
Rodentia							
Castor canadensis						1	
Myocastor coypus						1	
Peromyscus leucopus	5		11	2	127		145
Peromyscus maniculatus	1	1	3	1	20		15
Reithrodontomys fulvescens			6	5	21		29
Mus musculus					2		2
Baiomys taylori			26		8		34
Sigmodon hispidus			3	5	1		9
Neotoma floridana	2				8		10
Neotoma micropus					3		3
Chaetodipus hispidus					2		2
Sciurus carolinensis		2					2
Sciurus niger	1	4					5
Geomys attwateri		1					1
Didelphimorphia							
Didelphis virginiana	7	10		1			18
Xenartha							
Dasypus novemcinctus	18	12					30
Carnivora							
Urocyon cinereoargenteus		1					1
Procyon lotor	6	44					50
Mephitis mephitis		1					1
Lynx rufus		1				1	1
Canis latrans		2					2
Artiodactyla							
Odocoileus virginianus	5	120					125
Pecari tajacu						1	
Sus scrofa		5				2	5

Table 6-Continued.

Total	52	230	74	14	192	6	548

(TCS= time-constrained surveys, NRS= nocturnal road survey, Pitfall and Funnels were each associated with drift fence arrays, Sherman live traps)

Table 7. Small rodent richness and abundance among sites. The species composition and abundance of nine species of rodent captured at private wetland, public wetland, and upland sites of the Ottine Wetlands, Gonzales Co., Texas.

Species	Park	Private	Uplands
Peromyscus leucopus	44	53	48
Peromyscus maniculatus	11	4	
Reithrodontomys fulvescens	27	2	
Mus musculus	1	1	
Baiomys taylori	18	1	15
Sigmodon hispidus	3	1	5
Neotoma floridana	1		9
Neotoma mexicanus			3
Chaetodipus hispidus		2	
Rodents	105	64	80

Table 8. Small rodent community measurements and indices among private wetland, public wetland and upland sites. Assemblage demographics suggest that greater richness, abundance, diversity, and evenness occur within the park wetlands when compared to the private portion of the Ottine Wetlands.

	Park		Private		Uplands	
	Winter	Summer	Winter	Summer	Winter	Summer
Richness	6	3	4	3	4	5
Abundance	47	15	41	11	57	14
Diversity	0.709	0.59	0.228	0.345	0.539	0.725
Evenness	0.401	0.553	0.278	0.478	0.563	0.687

CHAPTER IV

DISCUSSION

Temporal Trends

Amphibians

Since Hildebrand (1935) originally listed 17 species of amphibian to occur in the area of Ottine, two additional species (Woodhouse's toad, *Bufo woodhousii* and smallmouth salamander, *Ambystoma texanum*) have been reported (Raun 1958). Three of the species on Hildebrand's list; western slimy salamander (*Plethodon albagula*), barking frog (*Eleutherodactylus augusti*) and cliff chirping frog (*Syrrhophus marnockii*), have never been verified from Gonzales County or any of the bordering counties and were likely included erroneously (Dixon 2000). Raun (1958) reported 14 species of amphibian and included a categorical estimate of abundance for each. Notable to his survey are Texas toad (*B. specious,* originally recorded as *B. compactilis*, Bogart 1968) and green toad (*B. debilis*) as "rare" species represented, by no more than two individuals, and the absence of eastern narrowmouth toad (*Gastrophryne carolinensis*) (Raun 1958). Raun categorized all other amphibian species as common or abundant. The composition of amphibians detected during 2008 and 2009 (Table 1) reflects the absence of five previously reported anuran species and the inclusion of a single smallmouth salamander.

I did not find Texas toad , green toad or Woodhouse's toad and suspect that the current abundance of these species is less than that which Raun detected in 1958. Furthermore, the absence of Woodhouse's toad and the lone smallmouth salamander observed during the course of my survey correspond to noteworthy declines in the detection of these species in comparison to Raun (1958). Additionally, I was unable to detect spotted chorus frog (*Pseudacris clarki*) and Strecker's chorus frog (*P. streckeri*) although formerly categorized as common (Raun 1958). I observed Hurter's spadefoot toad (*Scaphiopus hurteri*) in high numbers and calling on a single night in April 2009. This observation accounts for the only occurrence of detection throughout my 20 month study period and mirrors the brief emergence of the species as reported by Raun (1958). I detected all other anuran species in categorical abundances similar to those listed by Raun and suggest that similar population sizes occurred during the course of both studies (1958).

Reptiles

Species richness of the aquatic turtle assemblage has remained constant (Table 1). I was unable to detect Cagle's map turtle (*Graptemys caglei*) at the park lake as recorded by Raun (1958), but I did observe a single individual on the stretch of the San Marcos River within the park boundaries. Raun (1958) reported observing individuals of the genus *Kinosternon* but was unable to identify to species. I captured four eastern mud turtles (*Kinosternon subrubrum*) from the park lake and park fishing pond. The Texas river cooter (*Pseudemys texana*) population has experienced a temporal increase in detection within the park lake and, along with Red-eared slider (*Trachemys scripta*), constitute the dominant species within the aquatic turtle assemblage. I was unable to detect ornate box turtle (*Terrapene ornata*) or three-toed box turtle (*T. carolina*) at any of the study sites. The last known record of *Terrapene* (*T. ornata*; Texas Natural History Collection #46160) collected from the area was in the area of Belmont (~15 km west of Ottine). These data coupled with no observations by land owners or park managers for > 30 years, suggest that a possible decline in *Terrapene* population size has occurred around the area of Ottine over the past 50 years.

With few exceptions, the composition of the lizard assemblage has remained consistent since the time of Raun's survey. Based on museum records from the Texas Cooperative Wildlife Collection and University of Texas Natural History Collection, neither Texas horned lizard (*Phrynosoma cornutum*) nor slender glass lizard (*Ophisaurus attenuatus*), have been collected from Ottine in >50 years. Raun (1958) reports a horned lizard during the period of his study but the specimen came from the town of Luling, > 10 km north of the wetlands. I was unable to detect either of these species providing evidence that both species have possibly disappeared from the area of Ottine. Hildebrand (1935) categorized the prairie skink (*Eumeces septentrionalis*) as commonly occurring in the area of Ottine whereas Raun (1958) categorized the prairie skink as rare during the period of his study. I was unable to detect the prairie skink and the closest current record known for the species comes from a single individual collected from M. O. Neasloney Wildlife Management Area on 31 July 2009 approximately 9.6 kilometers west of the Ottine Wetlands (TNHC #77208). To the best of my knowledge, this specimen represents the only individual that has been collected in Gonzales County since Raun collected two from Palmetto State Park in 1958. These data suggest a declining trend in abundance through time but must be interpreted with caution due to the undefined nature of categorization and area of inclusion by Hildebrand (1935). I observed two whiptail lizards (*Cnemidophoris* spp.) at the park upland site during the summer of 2008 but was unable to catch and properly identify to species. This sighting resembles the situation reported by Raun whom identified spotted whiptail (*C. gularis*) and six-lined racerunner (C. *sexlineatus*). The common ground skink (*Scincella lateralis*) was listed by Raun (1958) as the most abundant lizard species of the wetlands and this assessment is currently supported by the high relative capture rate (representing 58% of lizards caught) observed during my survey.

Detected species richness (16) within the snake assemblage remained constant between my survey and Raun (1958) although species composition and relative abundance of these species differ. Raun (1958) reported 96 individuals within the snake assemblage dominated by the three species; diamond-backed watersnake (*Nerodia rhombifer*), flat-headed snake (*Tantilla gracilis*) and western cottonmouth *(Agkistrodon piscivorus*). I observed 113 individuals dominated by the species; broad-banded watersnake (*Nerodia fasciata*), western cottonmouth and broad-banded copperhead (*Agkistrodon contortrix*). Absent from my study but reported by Raun are the species; Texas patchnose snake (*Salvadora grahamiae*), bull snake (*Pituophis cantenifer*), and flat-headed snake (1958). I account for three species; eastern hog-nosed snake (*Heterodon platirhinos*), southwestern rat snake (*Elaphe guttata*), and canebrake rattlesnake (*Crotalus horridus*), absent from Raun's study. The absence of the flat-headed snake from my survey is interesting considering the species represented 10.5% of the individuals surveyed by Raun (1958). Also, broad-banded copperhead and western cottonmouth appear to have increased in abundance represented by higher detection rates

(3.2% and 10.5% respectively in 1958 vs. 16.8% and 21.2% presently; Raun 1958). The number of observations of the broad-banded watersnake has grown from a relative abundance of 8.4% to 23% (Raun 1958). The often rare or cryptic nature of these species may have as much influence upon detection probabilities and noted changes as true changes in relative abundance or occupancy (Gregory et al. 1987). It is important to note changes in species abundance and species composition of the snake assemblage because diversity and evenness indices suggest little difference between the two communities compared. Actual changes in assemblage composition and estimates of similarity however provide evidence that changes have occurred between the two communities sampled through time.

I accounted for 38 species of amphibian and reptile at or peripheral to the Ottine Wetlands representing 69.4% of the 64 species known to occur within Gonzales County (Dixon 2000). However, a number of species known to occur in Gonzales County are absent from my study. Two of these accounts represent species which have never been reported from the Ottine Wetlands and include lesser siren (*Siren intermedia*) and Texas earless lizard (*Cophosaurus texanus*). This survey suggests the current composition of herpetofauna at the Ottine wetlands is a subset of the known historical composition of the area. The omission of previously reported species such as; green toad, eastern narrowmouth toad (*Gastrophryne carolinensis*) and long-nosed snake (*Rhinocheilus lecontei*), likely represent scattered or rare nature of individuals of each species at the edge of their range of distribution.

Important to note is the bias associated with the explosive breeding nature of Hurter's spadefoot toad. This species emerged for only a single night during the course of the study and I performed an intense TCS of this and all other anuran species at choruses within each of the three study sites types (Appendix 3, 18 April 2009). I performed these TCS in an attempt to count each species in proportion to other anuran species chorusing at the time. Few frogs were counted at the private wetlands due to swift runoff of rain waters pouring through Soefje swamp and the seeming absence of anurans from the area. Additionally, a relatively high number of bullfrog (*Rana catesbeiana*) were counted throughout the study by the method of NRS and species total certainly reflect a number of recounted individuals. It is also pertinent to illustrate the importance of survey length as the presence of four species (smallmouth salamander, Hurter's spadefoot toad, eastern hog-nosed snake, and Guadalupe spiny soft-shelled turtle (*Trionyx spiniferus*)) would not have been verified without extending this study through a second spring and summer season.

The Ottine Wetlands appear to have decreased in species richness within the anuran community. I present that a noticeable decline in the detection of smallmouth salamander, flatheaded snake, ornate box turtle and eastern box turtle has occurred at the wetlands possibly providing evidence of decreases in the abundance of these species within the area of Ottine in comparison to the period or Raun's survey (1958). I observed shifts in species abundance within the snake assemblage in comparison to data collected by Raun (1958). The broad-banded copperhead is currently observed to be the most dominant terrestrial snake whereas the broad-banded watersnake is the dominant semi-aquatic snake. I did not discover any new herpetofaunal records for Gonzales county during this study but am the first to report the exotic Mediterranean house gecko (*Hemidactylus turcicus*), as a permanent resident of manmade structures throughout the wetlands. These changes may be explained, in part, by natural fluctuations in the ecology of the species mentioned coupled with the short duration of both Ruan's and my own survey but are just as likely an indication of changes of species detection and actual species presence during the two different periods of time that animals were sampled.

Mammals

I accounted for 29 species of mammal during the survey representing the majority of those reported by Raun (all excluding black-tailed jackrabbit, *Lepus californicus* and roof rat, *Rattus rattus*). I surveyed a greater richness of mammalian species in comparison to Raun (1958) which can be credited to; the inclusion of two bat species (eastern pipistrelle, *Pipistrellus subflavus* and Brazilian free-tailed bat, *Tadarida brasiliensis*), an increased sampling intensity focused on meso-carnivores and ungulates and the re-establishment of species historically occurring within the area of Ottine. The absence of the black-tailed jackrabbit is likely an artifact of sampling effort focused upon wetland sites and only a small area of appropriate habitat represented by the peripheral savannah. I observed two previously unreported exotic species among the wetlands including; nutria (*Myocastor coypus*) and feral hog (*Sus scrofa*). I also observed bobcat (*Lynx rufus*) and coyote (*Canis latrans*) both of which were likely present during the 1950's but not reported by Raun (1958). Collared peccary (*Peccari tejacu*) and feral hogs are both current occupants of the area although not mentioned by Raun (1958). The wetlands of Ottine represent a significant expansion of the currently accepted range of collared peccary despite being within the specie's previously known historical range (Schmidly 2004). I observed Nutria in Mule Creek, approximately four km east of the

Ottine wetlands and a single American beaver was observed in the San Marcos River running through PSP.

Although Raun offers a qualitative assessment of the rodent community, it is difficult to assess temporal trends within the rodent community due to my interpretation of too small a sampling success in number of individuals captured (1958). Regardless Raun (1958) mentions the white-footed mouse, pygmy mouse (*Baiomys taylori*) and house mouse as the three most abundant rodents in the area. I captured white-footed mouse, pygmy mouse and fulvous harvest mouse (*Reithrodontomys fulvescens*) as the three most abundant species representing 83.5% of all small rodents caught. The eastern woodrat (*Neotoma floridanus*) and hispid pocket mouse (*Chaetodipus hispidus*) were not caught by Raun but are mentioned as having been collected prior to his study (1958). I present that both species currently occupy the wetlands. The house mouse (*Mus musculus*) maintains a presence within the wetlands but in numbers that appear much less conspicuous than reported by Raun (1958) according to current species capture proportions. The exotic roof rat was neither caught nor observed during my study although mentioned by Raun (1958) as a "common pest found in all barns and sheds of the area". The reason is not known for the apparent decline in the detected presence and abundance of these two exotic rodents but is interesting considering both economic and ecological detriment associated with both species. Additionally, I caught southern plains woodrats (*N. micropus*) among prickly pear cactus patches (*Opuntia* spp.) on the right away of Park Road 11 within the uplands of PSP. These captures represent the first documented occurrence of southern plains woodrat within the park.

Spatial Trends- Upland Sites

Five unique species and the highest amphibian richness among sites characterized the reptilian and amphibian assemblages at upland sites. I located two choruses of Hurter's spadefoot toad after a large rainfall event and this accounts for the only situation in which the species was encountered. The diversity in hydrology of the uplands (deep permanent, shallow flowing and ephemeral pools) is the most likely cause for the high richness in the amphibian community. The Texas spiny lizard (*Sceloporus olivaceus*), whiptail lizards, yellow-bellied racer (*Coluber constrictor*) and southwestern rat snake were only found at the upland sites as expected for species associated with xeric savannah situations. No turtles were observed in the uplands during the study but a single female red-eared slider was caught near Red-red Overlook (approximately 1.2 km east of the San Marcos River) after the conclusion of the survey. The upland sites collectively produced the fewest number of reptiles of all three study sites (*n*=37) but the highest measured evenness among habitats for both amphibians and reptiles. Amphibian diversity was highest at the uplands with coastal plains toad (*Bufo valliceps*), Hurter's spadefoot toad and great plains narrowmouthed toad (*Gastrophryne olivacea*) dominating the uplands amphibian assemblage. Important to note is that the majority of amphibians sampled at this site (143 of 202) came from a single TCS performed after heavy rains on the night of 18 April 2009. The broad-banded watersnake was also abundantly sampled on the same night feeding among the large chorus of anurans. The broad-banded copperhead was the most commonly encountered reptile of the area.

Of the five species of rodent species occurring at the uplands site, the southern plains woodrat was unique: however, the white-footed mouse (60%) was the most abundant species. The evenness index of the uplands was highest among sites and the diversity index was comparatively moderate. It is important to understand the ecology of the surrounding uplands as a possible influence on the ecology of the wetlands, especially during periods of drought.

Wetland Sites

The public wetlands were composed of seven species of amphibians and 20 species of reptiles. The highest richness and abundance of each group occurred at this wetland site. The coastal plains toad and green treefrog (*Hyla cinerea*) were the dominate anuran species within the park wetlands. The western cottonmouth, diamondback watersnake and broad-banded watersnake were the dominate reptiles. The private wetlands were characterized by seven amphibians and 14 reptiles. The amphibian assemblage at the private wetland was dominated by the coastal plains toad and southern leopard frog (*Rana sphenocephala*) while the reptilian assemblage was dominated by the common ground skink.

Both wetland sites were characterized by a similar subset of rodent species (n=7) with only one difference in species composition among sites. The hispid pocket mouse was only caught within the northwest portion of the private wetlands site. Rodent populations appear to be more abundant within the public wetlands in regards to capture success with a greater mean diversity, although the wetland site as a treatment could not explain this difference. These results parallel differences observed in herpetological richness and abundance of sampled individuals among the wetland sites.

There is a documented decline in the worldwide distribution and abundance of amphibians (Pounds and Crump 1994). The reasons for these declines likely have a similar affect upon other taxonomic groups. Several meteorological events and anthropogenic activities have caused landscape and community changes. Extended periods of drought have caused abundance and richness declines due to shorter hydro-periods and lowered reproductive success along with increased possibility of adult desiccation. Drought is also documented to have a negative effect on rodent communities through the loss of principle food sources and snake communities suffer decreased fitness from the decrease in rodent prey items (Sperry and Weatherhead 2008). Livestock grazing in wetlands has been reported to modify the rate of evaporation (Bremer et al. 2001) and alter soil properties (Daniel et al. 2002). Increased stocking rates or maintained stocking rates during times of environmental stress presumably amplify these conditions and the effects they have upon wetland flora and fauna. Herbicides and insecticides commonly used in agricultural settings have the effect of concentrating chemicals in wetlands due to run off and periods of evaporation. These chemicals have had a well studied detrimental effect on the biodiversity of wetland fauna (Boone and Semlitsch 2002, Boone and James 2003, Relyea 2005). Relyea (2005) found a complete loss of two species of larval tadpoles and almost the complete decline of a third species resulting in a 70 percent loss of overall anuran richness at wetland sites situated among pastures sprayed with chemical insecticides and herbicides. A detrimental effect on herpetofauna in the presence of imported red fire ants (*Solenopsis invicta*) and feral hogs are also documented (Clark 1982, Friend and Cellier 1990, Wojcik et al. 2001). The Mediterranean house gecko is an exotic reptile that has quickly established a wide ranging distribution throughout Texas (Farallo et al. 2009). Although ecological impacts of these exotic species are not well understood, the expectation is that all exotic species compete with native wildlife for resources either directly or indirectly. Finally, it should be noted that several of the species that appear to have experienced declines through time may be the result of natural processes. Many of these species occur at the periphery of their known range of distribution at the Ottine Wetlands. As a relict ecosystem possibly disjunct geographically from similar wetlands, there may not be a significant source population that can replenish local extinction or disruption events.

Management Implications

My results parallel similar inventory studies emphasizing the relationship between wetland sites and the concentration and diversity of herpetofauna (Ryberg et al. 2004, Ford and Hampton 2005, Ferguson et al. 2008). These results provide evidence that wetland habitats maintained in a near native state (as often found in state parks and natural areas) retain a higher diversity and abundance of herpetofauna and small rodent populations than wetland sites occurring in areas of disturbance and/or development. Frequent disturbance from shredding, grazing, herbicide application, and run-off combined with the presence of large ungulate populations within the wetlands appear to have a negative effect on the abundance and species richness of herpetofauna and the abundance of rodents. It is therefore recommended to limit as best as possible these influences upon wetland sites and conserve them in as near a natural state as possible when managing for ecological diversity.

APPENDIX 1

Appendix 1. Effort and results of drift fence array sampling (DFA). Array coordinates were DFA 1 (29.58532°, -97.58584°), DFA 2 (29.58370°, -97.58253°), DFA 3 (29. 58399°, -97.58954°), DFA 4 (29.58774°, -97.60177°), DFA 5 (29.59375°, -97.60239°), DFA 6 (29.61877°, -97.57516°). Each array number listed corresponds to that array (4 Pit fall traps (P) and 6 Funnel traps (F)) being open and functional for a period of 24 hr before being checked for captures. Climate conditions are equivalent to daily high (H), daily low (L), condition (C), and daily precipitation (P) in cm. The value (*n*) represents number of individuals caught.

DFA #	Array#	Date	Climate (H, L, C, P)	species	*n*	F, P
DFA1	1	12-Mar-08	23, 5, clear, 0.0	*Sigmodon hispidus*	1	P
				Criptotsis parva	1	P
				Peromyscus leucopus	1	P
	2			*P. leucopus*	1	P
				Peromyscus maniculatus	1	F
	3			N/A		
	4			N/A		
	5			N/A		
	6			N/A		
DFA2	1	13-Mar-08	26, 12, overcast, 0.0	*Baiomys taylori*	2	P
				P. maniculatus	1	P
				Reithrodontomys fulvescens	1	F
	2			*R. fulvescens*	1	P
				P. leucopus	1	P
	3			N/A		
	4			*P. leucopus*	1	P
	5			N/A		
	6			N/A		
DFA3	1	14-Mar-08	33, 20, overcast, 0.0	*S. hispidus*	1	P
				C. parva	1	P
				Gastrophryne olivacea	1	P
				P. leucopus	2	P
				R. fulvescens	1	P
				P. leucopus	1	P
	3			N/A		
	4			*Scincella lateralis*	1	F

Appendix 1-Continued.

	5			N/A		
	6			*G. olivacea*	1	P
DFA4	1	29-Mar-08	26, 12, overcast, 0.0	*P. maniculatus*	1	P
	2			*R. fulvescens*	1	P
				Acris crepitans	1	F
	3			*B. taylori*	1	P
				Bufo valliceps	1	F
	4			N/A		
	5			N/A		
	6			N/A		
DFA5	1	1-Apr-08	30, 17, overcast, 0.0	*C. parva*	1	P
				S. lateralis	1	P
	2			*P. leucopus*	1	P
				Agkistrodon piscivorus	2	F
	3			*C. parva*	2	P
				B. valliceps	2	F
	4			*C. parva*	1	P
	5			*C. parva*	2	P
	6			*C. parva*	4	P
				B. taylori	1	P
				S. hispidus	1	F
DFA6	1	2-Apr-08	25, 16, overcast, 0.0	*C. parva*	1	P
				B. taylori	1	P
	2			*B. taylori*	1	P
				R. fulvescens	1	F
	3			*P. leucopus*	1	F
	4			*C. parva*	1	P
	5			*C. parva*	1	P
	6			*C. parva*	1	P
				B. taylori	1	P
				Agkistrodon contortrix	1	F
DFA7	1	4-Apr-08	22, 15, overcast, 0.15	N/A		
	2			*R. fulvescens*	1	F
	3			N/A		
	4			*C. parva*	1	P
	5			N/A		
	6			*C. parva*	2	F
DFA8	1	9-Apr-08	25, 21, clear, 0.0	N/A		
	2			*G. olivacea*	1	P
				R. fulvescens	1	P
				A. crepitans	1	F

Appendix 1-Continued.

				B. valliceps	1	F
	3			N/A		
	4			N/A		
	5			*B. valliceps*	1	P
	6			*A. contortrix*	1	F
DFA9	1	12-Apr-08	23, 11, clear, 0.0	N/A		
	2			*C. parva*	1	P
	3			N/A		
	4			*P. leucopus*	1	P
	5			N/A		
	6			*B. taylori*	1	P
				S. hispidus	1	P
DFA10	1	20-Apr-08	27, 10, overcast, 0.0	*G. olivacea*	1	P
				S. lateralis	1	F
	2			*G. olivacea*	1	P
	3			*B. taylori*	1	P
	4			*R. fulvescens*	1	F
	5			*Micrurus fulivius*	1	F
	6			N/A		
DFA11	1	23-Apr-08	31, 21, overcast, 0.0	*B. valliceps*	1	P
				C. parva	1	P
				B. valliceps	1	F
	2			N/A		
	3			*B. valliceps*	1	P
				B. valliceps	1	F
	4			N/A		
	5			*B. valliceps*	2	P
				B. valliceps	3	F
	6			*B. taylori*	1	P
DFA12	1	24-Apr-08	30, 21, overcast, 0.0	*B. valliceps*	2	P
				Rana sphenocephala	1	P
				G. olivacea	1	P
				S. lateralis	1	F
	2			*G. olivacea*	1	P
	3			*C. parva*	1	P
				B. valliceps	1	P
				B. valliceps	1	F
	4			*C. parva*	1	P
				B. valliceps	1	F
				S. lateralis	1	F
	5			*B. valliceps*	2	P

Appendix 1-Continued.

	6			*B. taylori*	1	P
DFA13	1	3-May-08	25, 16, clear, 0.0	*B. valliceps*	3	P
				R. sphenocephala	1	P
				B. valliceps	1	F
				R. sphenocephala	1	F
	2			*G. olivacea*	2	P
	3			*P. leucopus*	1	P
	4			N/A		
	5			*R. sphenocephala*	1	F
	6			N/A		
DFA14	1	4-May-08	27, 13, overcast, 0.0	N/A		
	2			N/A		
	3			*C. parva*	1	P
	4			*B. valliceps*	1	P
	5			N/A		
	6			*B. taylori*	1	P
				Coluber constrictor	1	F
DFA15	1	11-May-08	27, 20, overcast, 0.0cm	*R. sphenocephala*	2	F
	2			*G. olivacea*	1	P
	3			*R. sphenocephala*	1	F
	4			*R. sphenocephala*	1	F
	5			*B. valliceps*	1	P
				B. valliceps	1	F
				A. contortrix	1	F
	6			*Elaphe obsoleta*	1	F
DFA16	1	24-May-08	36, 25, overcast, 0.0	N/A		
	2			N/A		
	3			*B. valliceps*	1	P
				G. olivacea	1	P
	4			*B. taylori*	1	P
				G. olivacea	1	P
				S. hispidus	1	F
	5			*B. valliceps*	1	P
				A. contortrix	1	F
	6			*A. contortrix*	1	F
DFA17	1	25-May-08	36, 25, overcast, 0.03	N/A		
	2			*A. piscivorus*	2	F
	3			N/A		
	4			N/A		
	5			*Nerodia fasciata*	1	F
	6			*Masticophis flagellum*	1	F

Appendix 1-Continued.

DFA18	1	26-May-08	35, 25, overcast, 0.0	*G. olivacea*	1	P
				A. piscivorus	2	F
	2			*B. valliceps*	1	F
	3			N/A		
	4			N/A		
	5			*B. valliceps*	1	P
				R. sphenocephala	1	F
	6			*B. valliceps*	1	P
DFA19	2	9-Sep-08	33, 22, overcast, 0.0	*B. taylori*	6	P
				R. fulvescens	1	F
	4			N/A		
	6			*S. hispidus*	1	F
DFA20	2	21-May-09	30, 12, clear, 0.0	N/A		
	4			N/A		
	5			N/A		
DFA21	2	22-May-09	30, 17, overcast, 0.0	N/A		
	4			N/A		
	6			N/A		
DFA22	2	23-May-09	28, 18, clear, 0.0	N/A		
	4			N/A		
	6			N/A		
DFA23	2	24-May-09	28, 18, cloudy, 0.63	*A. carolinensis*	1	F
	4			N/A		
	6			*Sceloporus olivaceus*	1	F
DFA24	2	25-May-09	32, 17, clear, 0.0	N/A		
	4			*B. valliceps*	1	P
				R. sphenocephala	1	F
	6			N/A		
DFA25	2	28-May-09	32, 20, clear, 0.0	N/A		
	4			N/A		
	6			N/A		
DFA26	2	29-May-09	33, 20, clear, 0.0	N/A		
	4			N/A		
	6			N/A		
DFA27	2	30-May-09	32, 20, clear, 0.0	N/A		
	4			N/A		
	6			*A. contortrix*	1	F
DFA28	2	31-May-09	32, 18, clear, 0.0	N/A		
	4			N/A		
	6			*A. contortrix*	2	F

*All nomenclature follows Dixon (2000) for herpetofauna and Schmidly (2004) for mammals.

Appendix 2

Hoop net effort, locations, and captures. Hoop # is associated with an a single hoop net trap located at a coordinate (N°, W°) for a period of 24 hr. Species captured and number (*n*) of individuals caught are provided.

Hoop #	Date	N°	W°	Site	Species	*n*
Hoop1	23-May-08	29.59299	-97.58686	Park	N/A	
Hoop2	23-May-08	29.59348	-97.58634	Park	*Trachemys scripta*	4
Hoop3	23-May-08	29.59383	-97.58661	Park	*T. scripta*	3
					Pseudemys texana	2
Hoop4	24-May-08	29.59299	-97.58686	Park	N/A	
Hoop5	24-May-08	29.59348	-97.58634	Park	*T. scripta*	2
Hoop6	24-May-08	29.59383	-97.58660	Park	N/A	
Hoop7	25-May-08	29.59299	-97.58686	Park	*T. scripta*	5
Hoop8	25-May-08	29.59348	-97.58634	Park	*Kinosternon subrubrum*	2
					T. scripta	3
					Sternotherus odoratus	6
Hoop9	25-May-08	29.59383	-97.58661	Park	*K. subrubrum*	1
					S. odoratus	3
Hoop10	26-May-08	29.59299	-97.58686	Park	N/A	
Hoop11	26-May-08	29.59348	-97.58634	Park	*T. scripta*	2
					P. texana	3
Hoop12	26-May-08	29.59383	-97.58661	Park	N/A	
Hoop13	17-May-09	29.59411	-97.60136	Private	N/A	
Hoop14	17-May-09	29.60263	-97.59575	Private	N/A	
Hoop15	17-May-09	29.59383	-97.58661	Park	*S. odoratus*	1
Hoop16	18-May-09	29.59411	-97.60136	Private	N/A	
Hoop17	18-May-09	29.60263	-97.59575	Private	N/A	
Hoop18	18-May-09	29.59383	-97.58661	Park	N/A	
Hoop19	19-May-09	29.59411	-97.60136	Private	*Chelydra serpentina*	2
Hoop20	19-May-09	29.60263	-97.59575	Private	N/A	
Hoop21	19-May-09	29.59383	-97.58661	Park	N/A	
Hoop22	20-May-09	29.59411	-97.60136	Private	N/A	
Hoop23	20-May-09	29.60263	-97.59575	Private	N/A	
Hoop24	20-May-09	29.59383	-97.58661	Park	*T. scripta*	12
Hoop25	21-May-09	29.59411	-97.60136	Private	N/A	

Appendix 2-Continued.

Hoop26	21-May-09	29.60263	-97.59575	Private	N/A	
Hoop27	21-May-09	29.59383	-97.58661	Park	N/A	
Hoop28	22-May-09	29.59411	-97.60136	Private	N/A	
Hoop29	22-May-09	29.59411	-97.60136	Private	N/A	
Hoop30	22-May-09	29.59411	-97.60136	Private	N/A	
Hoop31	23-May-09	29.59411	-97.60136	Private	N/A	
Hoop32	23-May-09	29.59411	-97.60136	Private	N/A	
Hoop33	23-May-09	29.59299	-97.58686	Park	*T. scripta*	11
Hoop34	24-May-09	29.59299	-97.58686	Park	N/A	
Hoop35	24-May-09	29.59348	-97.58634	Park	*S. odoratus*	2
Hoop36	24-May-09	29.59383	-97.58661	Park	N/A	
Hoop37	25-May-09	29.59299	-97.58686	Park	*K. subrubrum*	1
					P. texana	2
Hoop38	25-May-09	29.59348	-97.58634	Park	*T. scripta*	8
Hoop39	25-May-09	29.59383	-97.58661	Park	*T. scripta*	4
					P. texana	2
Hoop40	26-May-09	29.59299	-97.58686	Park	*T. scripta*	3
Hoop41	26-May-09	29.59348	-97.58634	Park	N/A	
Hoop42	26-May-09	29.59390	-97.58872	Park	*T. scripta*	5
Hoop43	27-May-09	29.59299	-97.58686	Park	N/A	
Hoop44	27-May-09	29.59348	-97.58634	Park	*P. texana*	1
Hoop45	27-May-09	29.59390	-97.58872	Park	N/A	

*All nomenclature follows Dixon (2000)

Appendix 3

Effort and results of timed-constrained surveys (TCS). Each TCS corresponds to a date and coordinate (N°, W°) of origin. Time (T) was measured as the period of time, in minutes, that I (alone) actively searched for animals. Time does not include travel to or from sites. Climate is recorded as daily high (H), daily low (L), condition (C), and daily precipitation (P) in cm. All species observed were recorded along with the number (*n*) of individuals.

Date	T	Site	N°	W°	Climate (H, L, C, P)	Species	*n*
12-Mar-08	60	Upland	29.62002	-97.57560	23, 5, clear, 0.0	*Gastrophryne olivacea*	1
12-Mar-08	60	Park	29.58499	-97.58077		*Agkistrodon piscivorus*	1
						Rana sphenocephala	1
4-Apr-08	60	Upland	29.61373	-97.57698	22, 15, clear, 0.0	*Procyon lotor*	1
						Didelphis virginiana	2
4-Apr-08	60	Private	29.58847	-97.59731		*D. virginiana*	1
						P. lotor	2
						Sylvilagus floridana	3
						Odocoileus virginianus	1
4-Apr-08	60	Park	29.59471	-97.5848		*D. virginiana*	1
						P. lotor	2
						Sylvilagus aquaticus	1
						O. virginianus	1
22-Apr-08	60	Park	29.58683	-97.59002	31, 22, clear, 0.0	*Acris crepitans*	5
						A. piscivorus	2
						Hyla cinerea	3
						Scincella laterales	8
						Bufo valliceps	3
						R. sphenocephala	1
						Dasypus novemcinctus	4
23-Apr-08	60	Upland	29.61161	-97.57858	31, 21, clear, 0.0	N/A	
23-Apr-08	60	Private	29.59527	-97.59527		N/A	
23-Apr-08	60	Upland	29.62158	-97.5735		*Masticophis flagellum*	1
						Cnemidophoris	2
24-May-08	15	Upland	29.61702	-97.57436	36, 25, cloudy, 0.0	*Sceloporus. undulatus*	1
24-May-08	30	Private	29.59371	-97.60139		*G. olivacea*	1
						B. valliceps	1

Appendix 3-Continued.

						Elaphe obsoleta	1
24-May-08	45	park	29.58837	-97.58416		*B. valliceps*	2
						Sciurus niger	1
						R. sphenocephala	1
						Anolis carolinensis	2
						G. olivacea	1
						Rana catesbeiana	5
						Hemidactylus turcicus	1
						Nerodia fasciata	1
						Nerodia rhombifer	1
						D. novemcinctus	1
25-May-08	15	Upland	29.58147	-97.59262	36, 25, cloudy, 0.03	N/A	
25-May-08	15	Private	29.59540	-97.60613		*A. piscivorus*	1
						A. crepitans	1
						R. sphenocephala	1
25-May-08	15	Park	29.58675	-97.58520		*A. piscivorus*	1
26-May-08	15	Upland	29.58248	-97.59005	35, 25, cloudy, 0.0	N/A	
26-May-08	15	Private	29.58761	-97.60238		N/A	
26-May-08	15	Park	29.58432	-97.58165		*N. fasciata*	1
						S. laterales	1
5-Jul-08	30	Upland	29.62265	-97.57295	33, 20, overcast, 0.0	N/A	
5-Jul-08	30	Private	29.58407	-97.59781		*B. valliceps*	1
5-Jul-08	30	Park	29.59297	-97.58728		*N. rhombifer*	1
						Pseudemys texana	1
						Trachemys scripta	3
12-Nov-08	30	Upland	29.61620	-97.57503	26, 15, cloudy, 0.0	*Elaphe guttata*	1
						P. lotor	1
14-Nov-08	60	Private	29.59144	-97.59655	27, 15, cloudy, 0.0	*A. crepitans*	2
						B. valliceps	2
14-Nov-08	60	Park	29.58670	-97.58588		*Crotalus horridus*	1
						H. cinerea	8
						A. piscivorus	1
14-Nov-08	60	Park	29.59053	-97.58820		*H. cinerea*	6
						Thamnophis marcianus	1
						D. virginiana	1
						D. novemcinctus	1
20-Nov-08	30	Upland	29.58342	-97.59263	26, 5, overcast, 0.0	N/A	
20-Nov-08	30	Private	29.60146	-97.60218		N/A	
20-Nov-08	30	Park	29.58480	-97.57992		*N. fasciata*	1
						R. sphenocephala	1
21-Feb-09	60	Upland	29.61019	-97.57882	18, 6, overcast, 0.0	N/A	

Appendix 3-Continued.

21-Feb-09	60	Private	29.59231	-97.59992		*Storeria dekayi*	2
						D. virginiana	1
						R. sphenocephala	9
19-Mar-09	30	Private	29.58782	-97.59197	28, 16, clear, 0.0	*A. crepitans*	2
						S. laterales	2
28-Mar-09	60	Upland	29.61521	-97.57516	21, 3, clear, 0.0	*Neotoma micropus*	1
						Thamnophis proximus	1
28-Mar-09	60	Upland	29.62061	-97.57444		N/A	
18-Apr-09	30	Upland	29.61007	-97.57924	26, 17, cloudy, 1.09	*Scaphiopus hurteri*	52
						Hyla versicolor	15
						G. olivacea	44
						N. fasciata	5
						B. valliceps	23
						H. cinerea	9
18-Apr-09	30	Private	29.59375	-97.60324		*N. fasciata*	3
						Abystoma texanum	1
						B. valliceps	2
18-Apr-09	30	Upland	29.58429	-97.58818		*H. versicolor*	26
						H. cinerea	43
						B. valliceps	21
						T. proximus	2
						N. fasciata	5
						R. sphenocephala	17
						D. virginiana	1
						Agkistrodon contortrix	1
20-Apr-09	15	Private	29.59631	-97.60170	27, 11, clear, 0.0	*Chelydra serpentina*	1
						B. valliceps	2
						S. laterales	1
20-Apr-09	60	Park	29.58913	-97.58177		*A. piscivorus*	2
						N. fasciata	2
						A. crepitans	1
						R. sphenocephala	2
						H. cinerea	1
						A. carolinensis	5
						S. laterales	1
						A. contortrix	1
						D. novemcinctus	1
						S. aquaticus	1
27-May-09	30	Private	29.58815	-97.59858	30, 21, clear, 0.0	*S. floridana*	1
						Peromyscus leucopus	3
						B. valliceps	2
						S. laterales	2

Appendix 3-Continued.

27-May-09	30	Park	29.58635	-97.58603		*E. obsoleta*	1
						A. piscivorus	1
						Neotoma floridana	1
6-Jun-09	15	Upland	29.61982	-97.57488	33, 16, clear, 0.0	N/A	
6-Jun-09	30	Private	29.59759	-97.60484		*A. contortrix*	2
						P. leucopus	2
						Peromyscus maniculatus	1
						S. laterales	2
						B. valliceps	3
						N. rhombifer	1
6-Jun-09	15	Park	29.58593	-97.58872		N/A	
7-Jun-09	30	Private	29.60333	-97.60467	33, 17, clear, 0.0	*B. valliceps*	2
						S. laterales	1
						N. fasciata	1
7-Jun-09	30	Park	29.59326	-97.58484		N/A	

*Nomenclature follows Dixon (2000) for all herpetofauna and Schmidly (2004) for all mammals.

Appendix 4

Effort and observations associated with nocturnal road surveys (NRS). Each NRS was conducted on 2.9 km of road through each of the study sites. The upland route was conducted on Park Road 11 (29.62282°, -97.57272° to 29.60376°, -97.58327°), the park wetland route was conducted on both North Park Road Loop (entrance 29.58757°, -97.59126°) and South Park Road Loop (entrance 29.59403°, -97.58674°) situated within Palmetto State Park, and the private wetland route occurred on County Road 205 (29.59129°, -97.589012° to 29.60474°, -97.60362°). Time was recorded at the beginning of each survey along with each species observed and number (*n*) of individuals seen. Chorusing anurans were also recorded and assigned a chorus category (1 = 1 individual, 2 = 2-10 individuals, 3 = >10 individuals). Climate data corresponds to daily high (H), daily low (L), condition (C), and daily precipitation (P) in cm.

Date	Time	Site	Climate (H, L, C, P)	species	*n*	chorus
8-Apr-08		Uplands	30, 21, overcast, 0.0	*Procyon lotor*	1	
				Acris crepitans		3
		Private		*P. lotor*	3	
				Hyla cinerea		3
				A. crepitans		3
				Rana sphenocephala		1
		Park		*A. crepitans*		3
				Bufo valliceps	1	2
				H. cinerea	1	3
				Hyla versicolor	1	1
				Didelphis virginiana	1	
11-Apr-08	22:45	Uplands	27, 16, clear, 0.0	*H. cinerea*		1
	22:36	Private		N/A		
	22:15	Park		*P. lotor*	1	
				A. crepitans		3
19-Apr-08	20:18	Uplands	28, 7, clear, 0.0	*Odocoileus virginianus*	3	
	21:13	Private		*O. virginianus*	18	
				P. lotor	2	
				A. crepitans		2
				H. cinerea		3
				R. sphenocephala		1
	20:53	Park		*B. valliceps*	1	
				H. cinerea		3

Appendix 4-Continued.

				A. crepitans		3
22-Apr-08	20:14	Uplands	31, 21, clear, 0.0	N/A		
	20:58	Private		*R. sphenocephala*	1	
				B. valliceps	1	2
				A. crepitans		3
				H. cinerea		3
	20:22	Park		*H. cinerea*	3	2
				B. valliceps	7	
				R. sphenocephala	1	
				D. virginiana	1	
				A. crepitans		3
2-May-08	21:38	Uplands	30, 23, clear, 0.0	*R. sphenocephala*		3
				A. crepitans		3
	21:13	Private		*B. valliceps*	2	1
				P. lotor	1	
				Gastrophryne olivacea		2
				A. crepitans		2
				H. cinerea		3
	20:50	Park		*R. sphenocephala*	3	
				H. cinerea	1	3
				A. crepitans		3
				Nerodia rhombifer	1	
3-May-08	20:50	Uplands	25, 16, clear, 0.0	*Sciurus niger* (DOR)	1	
	20:29	Private		*P. lotor*	2	
				O. virginianus	4	
				D. virginiana	1	
				B. valliceps	1	
				A. crepitans		3
	21:13	Park		*P. lotor*	1	
				Dasypus novemcinctus	1	
				A. crepitans		3
10-May-08	22:07	Uplands		*Nerodia fasciata*	1	
	21:10	Private		*R. sphenocephala*	1	
				B. valliceps	1	
				Storeria dekayi	1	
				H. cinerea		2
				A. crepitans		2
	21:29	Park		*Agkistrodon piscivorus*	1	
				Rana catesbeiana	2	
				B. valliceps	1	
				N. fasciata	1	
				A. crepitans		3

Appendix 4-Continued.

				H. cinerea		3
23-May-08	20:40	Uplands	36, 25, clear, 0.0	*D. novemcinctus*	1	
				A. piscivorus	2	
				R. sphenocephala	2	
				B. valliceps	1	
	21:34	Private		*B. valliceps*	3	
				H. cinerea		3
	21:08	Park		*N. rhombifer*	3	
				B. valliceps	4	
				R. catesbeiana	2	
				A. crepitans		2
				H. cinerea		2
24-May-09	8:37	Uplands	36, 25, clear, 0.0	N/A		
	8:17	Private		*Ophyodrys eastivus*	1	
	7:50	Park		*Sciurus carolinensis*	1	
				S. niger	1	
				B. valliceps	2	
25-May-09	20:30	Uplands	36, 25, clear, 0.03	*Agkistrodon contortrix*	3	
				O. eastivus	1	
	21:40	Private		*O. virginianus*	1	
				H. cinerea		2
				A. crepitans		1
	21:08	Park		*N. rhombifer*	2	
				R. catesbeiana	2	
				B. valliceps	1	
				P. lotor	1	
				D. novemcinctus	1	
				A. crepitans		2
				H. cinerea	1	
1-Jun-09	20:30	Uplands	36, 23, clear, 0.0	*Hemidactylus turcicus*	1	
	20:51	Private		*S. niger* (DOR)	1	
				A. piscivorus(DOR)	1	
				O. virginianus	2	
				Sylvilagus floridanus	3	
				Thamnophis marcianus	1	
				A. crepitans	1	
				R. sphenocephala		2
	21:29	Park		*D. virginiana*	1	
				B. valliceps	1	
				R. catesbeiana	3	
				N. rhombifer	1	
				P. lotor	1	

Appendix 4-Continued.

				Peromyscus maniculatus	1	
				A. crepitans		1
				H. cinerea		2
9-Jun-08	20:57	Uplands	36, 25, clear, 0.08	*Agkistrodon contortrix*	1	
				D. novemcinctus	1	
	22:30	Private		*S. floridanus*	1	
	22:08	Park		*R. catesbeiana*	4	
				N. fasciata	1	
				N. rhombifer	1	
				B. valliceps	1	
				P. lotor	2	
				Urocyon cinereoargenteus	1	
				A. crepitans		3
20-Jun-08	21:45	Uplands	33, 25, clear, 0.0	*D. novemcinctus*	1	
				P. lotor	1	
	22:06	Private		*D. virginiana*	3	
				D. novemcinctus	1	
				H. cinerea		1
				A. crepitans		1
	22:36	Park		*R. catesbeiana*	5	
				D. novemcinctus	1	
				Geomys attwateri	1	
				A. crepitans	2	3
				H. cinerea	3	2
21-Jun-08	21:03	Uplands	36, 20, clear, 0.0	*O. virginianus*	1	
	21:35	Private		*R. sphenocephala*	2	
				O. virginianus	1	
	21:15	Park		*R. catesbeiana*	5	
				A. crepitans		1
4-Jul-08	20:53	Uplands	32, 20, overcast, 0.0	*D. novemcinctus*	1	
				A. contortrix	2	
	22:31	Private		*O. virginianus*	1	
	21:33	Park		*B. valliceps*	2	
				O. virginianus	2	
				R. catesbeiana	3	
				Nerodia erythrogaster	1	
				N. fasciata	2	
				N. rhombifer	2	
				H. cinerea	2	1
				A. crepitans	2	2
				H. versicolor	1	
				Canis latrans	1	

Appendix 4-Continued.

5-Jul-08	21:22	Uplands	33, 20, clear, 0.0	*B. valliceps*	25	
				R. sphenocephala	4	
				Sylvilagus aquaticus	1	
	21:55			*B. valliceps*	1	
				R. sphenocephala	1	
				O. virginianus	1	
	21:48			*B. valliceps*	16	
				R. sphenocephala	4	
				H. cinerea	3	
				N. rhombifer	3	
				R. catesbeiana	6	
				A. crepitans		3
29-Aug-08	19:04	Uplands	33, 25, clear, 0.05	N/A		
	19:38	Private		*O. virginianus*	13	
				B. valliceps	1	
				Elaphe obsoleta	1	
	19:19	Park		*S. aquaticus*	1	
				Pseudemys texana	2	
				A. crepitans		1
9-Sep-08	20:26	Uplands	33, 22, clear, 0.0	*B. valliceps*	2	
				S. carolinensis (DOR)	1	
	21:23	Private		*P. lotor*	3	
	20:52	Park		*R. catesbeiana*	5	
				B. valliceps	2	
				S. floridanus	2	
				R. sphenocephala	1	
				O. virginianus	1	
				H. turcicus	1	
				A. crepitans		3
				H. cinerea		1
19-Mar-09	21:08	Uplands	28, 16,clear, 0.0	N/A		
	20:16	Private		*A. piscivorus*	2	
				P. lotor	3	
				O. virginianus	2	
				A. crepitans		2
				R. sphenocephala		1
				S. floridanus	1	
	20:48	Park		*O. virginianus*	2	
				P. lotor	3	
				D. novemcinctus	1	
				A. piscivorus	1	
				R. catesbeiana	1	

Appendix 4-Continued.

22-Mar-09	20:13	Uplands	28, 17, clear, 0.0	N/A		
	20:24	Private		*O. virginianus*	3	
				P. lotor	1	
	20:43	Park		*D. virginiana*	1	
				O. virginianus	3	
				P. lotor	1	
				A. crepitans		2
				H. versicolor		2
				R. catesbeiana		1
15-Apr-09	21:16	Uplands	28, 10, clear, 0.0	*P. lotor*	1	
	22:15	Private		*D. novemcinctus*	1	
				O. virginianus	36	
				Mephitis mephitis	2	
				P. lotor	3	
				S. floridanus	2	
	21:30	Park		*P. lotor*	2	
				O. virginianus	5	
				D. virginiana	2	
				D. novemcinctus	1	
				S. aquaticus	3	
11-May-09	21:34	Uplands	33, 22, clear, 0.0	*R. sphenocephala*	1	
				Lynx rufus	1	
	21:08	Private		*O. virginianus*	8	
				A. crepitans	2	
				P. lotor	3	
				C. latrans	1	
				H. cinerea		2
				B. valliceps	1	
	20:52	Park		*H. cinerea*	2	2
				A. crepitans		3
				S. floridanus	1	
				R. sphenocephala	2	
				P. lotor	1	
17-May-09	20:36	Uplands	25, 16, clear, 0.0	*H. versicolor*		2
				Micrurus fulvius	1	
				B. valliceps	1	
				O. eastivus (DOR)	1	
	21:15	Private		*A. crepitans*		2
				P. lotor	1	
				D. novemcinctus	1	
				H. versicolor		1
	20:54	Park		*A. crepitans*		2

Appendix 4-Continued.

				H. versicolor		1
19-May-09	21:36	Uplands	30, 19, clear, 0.0	N/A		
	21:16	Private		*M. mephitis*	1	
				P. lotor	1	
				A. crepitans		3
	20:56	Park		*H. versicolor*		1
				A. crepitans		3
				O. virginianus	3	
				H. turcicus	1	
				S. aquaticus	1	
27-May-09	21:23	Uplands	30, 21, clear, 0.0	*B. valliceps*	6	
	21:37	Private		*S. floridanus*	1	
				D. novemcinctus	1	
				A. crepitans	2	
				H. cinerea		3
	21:00	Park		*H. versicolor*	2	2
				H. cinerea	3	3
				S. aquaticus	1	
				B. valliceps	4	
				A. crepitans		3
				R. catesbeiana	1	
				N. erythrogaster	2	
				P. lotor	1	
				R. sphenocephala	1	
28-May-09	21:05	Uplands	32, 20, clear, 0.0	*B. valliceps*	3	
	20:40	Private		*S. floridanus*	3	
				H. cinerea		1
				A. crepitans		3
				A. piscivorus	1	
				O. virginianus	6	
	21:34	Park		*B. valliceps*	5	1
				H. cinerea	1	3
30-May-09	20:34	Uplands	32, 30, clear, 0.0	*H. cinerea*		1
	20:44	Private		*A. crepitans*		2
				E. obsoleta	1	
				M. mephitis	1	
				P. lotor	1	
				R. sphenocephala	1	
	21:05	Park		*B. valliceps*	2	
				S. aquaticus	1	
				A. crepitans		3
				A. piscivorus (DOR)	1	

Appendix 4-Continued.

				H. cinerea		2
				S. floridanus	1	
				N. rhombifer	2	
4-Jun-09	20:38	Uplands	32, 18, clear, 0.0	N/A		
	20:53	Private		*P. lotor*	1	
				O. virginianus	1	
	21:10	Park		*B. valliceps*		1
				H. cinerea		2
				A. crepitans		2
				N. erythrogaster	1	
				R. catesbeiana	2	
				N. rhombifer	1	
				P. lotor	1	
5-Jun-09	21:44	Uplands	33, 15, clear, 0.0	N/A		
	21:23	Private		*Heterodon platirhinos* (DOR)	1	
				A. piscivorus	1	
	21:00	Park		*B. valliceps* (DOR)	1	
				H. cinerea	1	
				R. catesbeiana	2	
				N. erythrogaster	1	
				H. turcicus	1	
				A. piscivorus	1	
				A. crepitans		2
6-Jun-09	20:58	Uplands	33, 16, clear, 0.0	*O. virginianus*	2	
				M. mephitis	1	
	20:38	Private		*O. virginianus*	3	
	21:11	Park		*A. crepitans*		1
				H. cinerea	1	1
				R. catesbeiana	3	1
				N. rhombifer	1	
22-Aug-09	21:40	Uplands	37, 21, clear, 0.0	*Elaphe guttata* (DOR)	1	
				A. contortrix	1	
				Sceloporus olivaceus (DOR)	1	
				O. virginianus	1	
	22:05	Private		N/A		
	22:40	Park		*B. valliceps*	7	3
				S. aquaticus	3	
				A. piscivorus	1	
				O. virginianus	2	
				P. lotor	1	

Appendix 4-Continued.

	G. olivacea	2
	A. crepitans	2
	H. cinerea	3
	R. sphenocephala	1

*All nomenclature follows Dixon (2000) for herpetofauna and Schmidly (2004) for mammals. The abbreviation DOR stands for found dead on road.

Appendix 5

Total Sherman trapping effort, location and captures. Sherman traps were baited and set before dusk and checked for capture at dawn the following morning. Each trap baited and set overnight corresponds to one trap night (TN). Each site (upland, park wetland, and private wetland) was divided into two sampling areas creating a total of six trapping sites: Upland-1 (29.61782°, -97.57520°), Upland-2 (29.58387°, -97.58909°), Park-1 (29.58702°, -97.58443°), Park-2 (29.59276°, -97.58438°), Private-1 (29.59978°, -97.60418°), Private-2 (29.58808°, -97.59536°). Species and the number (*n*) of individuals caught at each trapping site were recorded. Climate conditions correspond to daily high (H), daily low (L), condition (C), and daily precipitation (P) in cm.

Date	Season	Site	TN	Species	*n*	Climate (H, L, C, P)
9-Sep-08	Summer	Upland-1	50	N/A		33, 22, overcast, 0.0
		Park-1	50	*Peromyscus leucopus*	2	
				Peromyscus maniculatus	3	
		Park- 2	50	*Reithrodontomys flavescens*	1	
				P. maniculatus	2	
				P. leucopus	1	
13-Nov-08	Winter	Upland-1	25	N/A		25, 15, overcast, 0.0
		Park-1	25	*P. leucopus*	5	
		Park-2	50	*P. leucopus*	1	
		Private-1	100	*P. leucopus*	7	
				Chaetodipus hispidus	1	
15-Nov-08	Winter	Uplands-1	50	*P. leucopus*	2	27, 15, clear, 0.0
				R. fulvescens	1	
		Park-1	75	*P. leucopus*	5	
				R. fulvescens	3	
		Park-2	100	*Baiomys taylori*	1	
				R. fulvescens	4	
				P. leucopus	3	
		Private-1	50	*P. leucopus*	9	
20-Nov-08	Winter	Upland-2	50	*P. leucopus*	10	26, 16, clear, 0.0
				R. fulvescens	1	
				Neotoma floridanus	4	
		Park-1	100	*P. leucopus*	10	
		Park-2	50	*R. fulvescens*	1	

Appendix 5-Continued.

				Sigmodon hispidus	1	
				B. taylori	2	
				Mus musculus	1	
22-Nov-08	Winter	Upland-1	100	*P. leucopus*	6	12, 5, overcast, 0.0
		Park-1	50	*P. leucopus*	2	
				R. fulvescens	7	
				B. taylori	2	
		Park-2	50	*P. leucopus*	4	
				R. fulvescens	2	
				B. taylori	1	
18-Dec-08	Winter	Park-1	100	*P. leucopus*	18	20, 10, overcast, 0.0
				P. maniculatus	4	
				R. fulvescens	2	
		Park-2	100	*P. leucopus*	6	
				R. fulvescens	2	
31-Dec-08	Winter	Upland-2	100	*P. leucopus*	10	17, 10, clear, 0.0
				P. maniculatus	7	
				R. fulvescens	1	
				N. floridanus	2	
		Private-2	100	*P. leucopus*	3	
7-Feb-09	Winter	Upland-1	50	*P. leucopus*	1	25, 16, overcast, 0.0
				P. maniculatus	1	
		Upland-2	50	*P. leucopus*	8	
				P. maniculatus	2	
				N. floridanus	1	
		Private-2	50	*P. leucopus*	9	
				P. maniculatus	3	
28-Mar-09	Winter	Upland-2	50	*P. leucopus*	2	21, 13, clear, 0.0
		Private-2	100	*P. leucopus*	8	
				R. fulvescens	1	
20-May-09	Summer	Upland-1	50	*P. maniculatus*	1	21,16, clear, 0.0
		Private-1	50	*P. leucopus*	2	
28-May-09	Summer	Upland-2	50	*P. leucopus*	3	32, 20, clear, 0.0
29-May-09	Summer	Upland-1	50	*Neotoma micropus*	1	33, 20, clear, 0.0
		Upland-2	50	*P. leucopus*	3	
				N. floridanus	1	
		Private-1	50	N/A		
5-Jun-09	Summer	Park-1	50	*P. leucopus*	2	33, 15, clear, 0.0
6-Jun-09	Summer	Upland-1	50	*N. micropus*	1	33, 16, clear,0.0
		Park-1	50	*P. leucopus*	1	
7-Jun-09	Summer	Upland-1	50	*N. micropus*	1	33, 17, overcast, 0.0
				B. taylori	2	

Appendix 5-Continued.

	Park-1	50	*P. leucopus*	1	
	Private-2	50	*P. leucopus*	1	
23-Aug-09	Upland-2	100	*P. leucopus*	1	38, 25, clear, 0.0
	Park-2	100	N/A		
	Private-2	100	N/A		
24-Aug-09	Park-2	100	*P. leucopus*	1	38, 23, clear, 0.0
			P. maniculatus	1	
	Private-1	100	*P. leucopus*	3	
			C. hispidus	1	
			M. musculus	1	
	Private-2	100	*P. leucopus*	3	

*Nomenclature follows Schmidly (2004). The first 200 TN from each trapping site during each season was used for the purpose of statistical comparisons between communities within the study.

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VITA

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