HOME RANGE OF THE RACCOON (*PROCYON LOTOR*), AND THE DEGREE OF INTERACTION WITH DOMESTIC PETS AT AQUARENA CENTER, SAN MARCOS, HAYS COUNTY, TEXAS.

Thesis

Presented to the Graduate School Council of
Southwest Texas State University
in Partial Fulfillment of
the Requirements

For the Degree

Master of Science

By

Jayson M. Hudson, B.S.

San Marcos, Texas
August, 1999

ACKNOWLEDGMENTS

I would like to first thank my parents, Mike and Lynda Hudson and my sister Jennifer Hudson, for giving me the love and support that allowed me to take this opportunity.

I would also like to thank Dr. Randy Simpson for being a supportive advisor and allowing me to learn and grow from his knowledge and experience. I would also like to thank Dr. Rick Manning for letting borrow all of those Zappa CDs and for letting me come to him for advice on what seemed like a daily occurrence, and Dr. Francis Rose for his support and guidance.

I would also like to thank Bryan G. Elliott for his invaluable help in the field and the many graduate and undergraduate students who pitched in from time to time.

TABLE OF CONTENTS

LIST OF TABLES

PAGE

LIST OF FIGURES

PAGE

ABSTRACT

HOME RANGE OF THE RACCOON (*Procyon lotor*) AND THE DEGREE OF INTERACTION WITH DOMESTIC PETS AT AQUARENA CENTER, SAN MARCOS, HAYS COUNTY, TEXAS.

by

JAYSON M. HUDSON (B.S.)
Southwest Texas State University
AUGUST 1999

SUPERVISING PROFESSOR: DR. THOMAS R. SIMPSON

As raccoon (*Procyon lotor)* population densities increase in suburban and urban areas, the concern about an epizootic of rabies or the transmission of other diseases such as distemper, parvo and nematode parasites such *Toxacara* spp., and the raccoon ascarid, *Baylisascaris procyonis* that can infect pets are increased. The purpose of my study was to determine the home range of a sample of raccoons from Aquarena Center, San Marcos, Hays County, Texas, and to determine the degree of interaction between the raccoons and domestic pets. Home range was determined by radio-collaring a sample of seven raccoons and analyzing universal trans-mercator (UTM) coordinates using convex polygon method and plotting them on a DOQQ of North San Marcos with ArcView GIS v3.1. The degree of interaction was determined by personal observation, motion detecting camera and questionnaire survey of area residents. By using the home range and degree of interaction, the potential of a disease transmission was determined. Results indicated that the raccoons at Aquarena Center have high site fidelity, and a small home range. Interaction between raccoons and domestic pets was minimal, and under healthy population conditions, the potential for an epizootic was low.

INTRODUCTION

The raccoon is a native North America mammal, with a geographic range extending from Panama to Southern Canada, including all contiguous states of the United States with the exception alpine habitats in parts of the Rocky Mountains and Great Basin areas. It is an adaptable animal with few natural enemies. Raccoons exploit a wide range of food resources, successfully adapting to habitat changes caused by human activity. Historically these carnivores have been hunted for sport, fur, and less frequently for their meat. Many people value the raccoon as an attractive, likable entertainer of parks and residential areas, often providing food as an attractant. In areas of high raccoon density, their devastating effect on waterfowl populations, other types of wildlife and vegetable gardens have resulted in predator control measures by people who despise the destruction (MacClintock 1981).

Since the early part of this century the ecology and natural history of the raccoon in the wild has been documented in the northern and eastern United States. Other than the works by Hoffman and Gottschang (1977), MacClintock (1981), and Gehrt and Fritzell (1997), little information exists on the ecology of suburban raccoon populations, and the structure of raccoon social behavior.

MacClintock (1981) reported that raccoons on the prairie marshes of North Dakota had an mean home range of 1683 hectares. Gehrt and Fritzell (1997) reported that male raccoons at Welder Wildlife Refuge, San Patricio Co., Texas, had a median home range of 373.75 hectares whereas females raccoons in the same area had a median home range of 91.63 hectares. In contrast, suburban raccoons tracked in Glendale, Ohio, had an mean home range of 5.1 hectares while raccoons tracked in the Clifton area of

Cincinnati, Ohio, had an average home range of 4.65 hectares. Hoffman and Gottschang (1977) estimated a density of one raccoon per 1.46 hectares in the greater Cincinnati, Ohio Area.

A high density of raccoons utilizing urban resources in close proximity to humans and their domestic animals in suburban and urban areas provides the opportunity for the spread of viral diseases such as rabies and distemper. Less well known are zoonotic problems from infection by nematodes such as *Baylisascaris procyonis* and *Toxacara* spp., and the resulting larval migrans.

Rabies in raccoons first was documented on the East Coast of the United States in 1947 in Brevard County, Florida, (Burridge *et al.* 1986) and has been continuously reported in Florida since 1953 (Carey 1980). By the early 1970's, rabies had spread into all of Florida, eastern Alabama, most of Georgia and South Carolina (Jenkins and Winkler 1987). In 1971, 85% of all raccoon rabies cases were reported from these southeastern states (McLean 1971). By the early 1980's, raccoon rabies had spread across northern Virginia, Maryland, Pennsylvania, Delaware and New Jersey. Highly urbanized areas such as metropolitan Washington D.C. and Baltimore also were affected by the disease (Jenkins and Winkler 1987).

A localized epizootic of raccoon rabies first was seen and studied in Florida. Three outbreaks were associated with human activities resulting from the major destruction of raccoon habitat leading to increased raccoon populations that were more dependent upon human handouts (Bigler *et al.*1973, Kappus *et al.* 1970). McLean (1975) further detailed an epizootic that followed a population increase of raccoons found near a single feeding station provisioned by a restaurateur. McLean (1975) further noted 10

factors thought to be shared by all raccoon rabies epizootics. The epizootics are associated with: (1) dense raccoon populations; (2) human habitation; (3) garbage-can feeding by raccoons; (4) access to refuse dumps; (5) disturbance or destruction of raccoon habitat; (6) coastal habitat; (7) a seasonal peak in the number of cases of rabies during winter and early spring (correlated with reproductive periods of the raccoon); (8) high levels of antibodies detected in raccoon populations during and after the epizootic; (9) a greater proportion of adult females having detectable rabies-serum neutralizing antibodies, and (10) the epizootics appear to be short lived. McLean (1975) hypothesized that rabies in raccoons may involve latent infections, reactivated by stress associated with increased contact and competition caused by overcrowding in artificially enhanced feeding-sites.

Few cases of raccoon rabies have been reported in Texas and most reported cases are considered to be spillover infections from Brazilian free-tailed bats, *Tadarida brasiliensis*. Bats have been implicated as a source of rabies in raccoons that utilize large bat caves in Texas. Modes of transmission included aerosol contact, consumption of rabid bats, and direct bites from bats (McLean 1975). Although rarely reported in the state, concern exists over the potential for a rabies epizootic outbreak in Texas raccoons.

An additional concern about raccoon rabies is the lack of the typical aggressive behavior associated with raccoons infected with rabies. The key factor in controlling the disease lies in identifying an outbreak early, before it becomes epizootic. In the 1960's southeast United States outbreak, 33% to 47% of rabid raccoons were considered to be aggressive, with 7% to 9% acting sick, uncoordinated or paralyzed (McLean 1975, Kappus *et al.* 1970). In the mid-Atlantic region outbreak of the 1980's, 11% to 24% of

rabid raccoons exhibited aggressive behavior, and 26% to 39% acted sick, uncoordinated or were paralyzed (Jenkins and Winkler 1987, Jenkins *et al.*1988).

McLean (1971) reported that raccoons captured in the wild developed antibodies without developing clinical signs of rabies. Veeraraghaven *et al.* (1970) suggested that the rabies virus antigens may be present, but not the infectious viruses. These two facts may account for the inconsistent reports of aggressive behavior, and help explain why a raccoon has the potential to spread the virus before rabies has been identified in a population. Domestic pets, such as dogs, are an important link because of their rate of contact with both raccoons and humans. Contact between dogs and rabid raccoons was reported in the southeast United States outbreak at 13% in 34% and in the mid-Atlantic region outbreak at a rate of 29% to 37%. In addition, the percentage of rabid raccoons found in yards during daylight hours ranged from 24% to 39% (McLean 1975, Kappus *et al.* 1970) in the southeast United States outbreak, while the range was 47% to 78% (Jenkins and Winkler 1987, Jenkins *et al.* 1988) for the mid-Atlantic region outbreak.

In addition to transmission of viral and bacterial infections from raccoons, there is a growing health concern about the threat of clinical nematode larval migrans resulting from contamination of raccoon fecal matter with parasite eggs. *Baylisascaris procyonis* recently was identified in Texas by Kerr *et al.* (1997), as part of a larger study in which helminth communities of raccoons were compared across different habitat types in Texas. Kerr *et al.* (1997) reported that 23 of 33 (70%) raccoons from Texas A&M University Kingsville, Texas, and surrounding areas, were infected with a total of 202 *Baylisascaris procyonis* nematodes. The mean number of adult helminths was 6.1 ± 1.3 per adult raccoon. Thus far, *B. procyonis* has not been identified in Hays County, Texas, but if

introduced, larvae may infect many secondary hosts such as birds, rodents, lagomorphs, other mammals, and ultimately humans (Davidson and Nettles, 1988).

The objective of my study was to determine the home range of the raccoons, the degree of interaction with domestic pets, feral house cats, and humans at Aquarena Center and surrounding residential areas within San Marcos, Hays County, Texas, and to determine the possibility or potential pathway of an epizootic involving raccoons, domestic pets and ultimately humans.

METHODS AND MATERIALS

Study Site

Raccoons used for this study were live trapped, radio-collared, and ear tagged at Aquarena Center in San Marcos, Hays County, Texas. Aquarena Center is owned and operated by Southwest Texas State University. This education and research center includes Spring Lake, the headwaters for the San Marcos River, and surrounding habitat.

Spring Lake, a 7.9 ha impoundment, was created in 1849 by impounding the San Marcos River approximately 460m downstream from the headwaters. Dredging, flood control dams (located on Sink Creek), recreational facilities, and the introduction of exotic flora and fauna have also altered the native habitat. A combination of dependable water flow, high water quality, and relatively constant temperature produces a stable, highly productive ecosystem that supports many endemic species, in and around Spring Lake (Seaman 1997).

Aquarena Center is geographically located on the Balcones Escarpment Fault Zone bordered by the Edwards Plateau to the west and the Blackland Prairies to the east. Spring Lake consists of two parts, the main lake to the east and the slough to the west. The east side of the main lake formerly was a tourist resort originally built in the early 1950's. A conference center, a gift shop, and an educational facility, called Texana Village, border the east side of the main lake, occupying an area of 4.21 ha. Other structures include a hotel, built in 1929, and other educational displays built by the end of the 1960's (Figure 1).

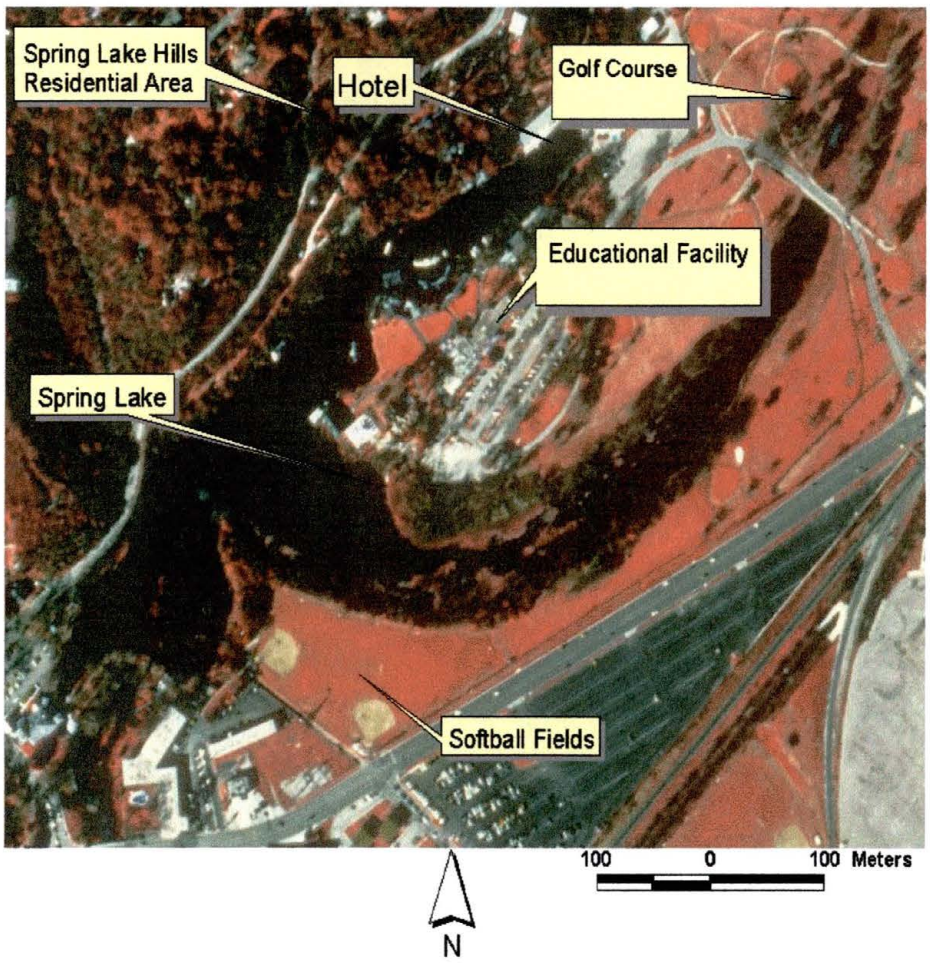

Figure 1. Color Infrared Satellite Image of Aquarena Center, Hays County, Texas.

The slough is a backwater of Spring Lake, fed by the Sink Creek watershed, which originates east of the headwater springs and runs through a golf course. It becomes progressively more stagnant and murky upstream from the main lake. The southeast side of the slough and main lake junction is bordered by two softball fields, a university owned apartment complex, and a university owned cottage. This entire area provides food, natural habitat and man-made shelter for a relatively large raccoon population.

In addition to the high volume of human traffic through Aquarena Center and the well-established population of raccoons, there are populations of other species of mammals susceptible to the rabies virus. These include opossums (*Didelphis virginiana*), common gray foxes, (*Urocyon cinereoargenteus*), feral cats (*Felis catus*) and white-tailed deer (*Odocoileus virginianus*).

Home Range

Eight raccoons were captured using Tomahawk Live Traps (Tomahawk Live Trap Co.). Traps were baited and placed in locations near possible den sites, travel routes, and feeding areas. After capture, raccoons were immobilized using 1cc of Ketamine hydrochloride (Bigler and Hoff 1974). Raccoons were ear-tagged, radio-collared, weighed to the nearest 0.1 kg, measured, aged by analyzing tooth wear (Grau *et al.* 1970), and released at the site of capture. Individuals captured, but not collared were ear-tagged and released to be included in a mark-recapture study to estimate population size using a Peterson Index (Krebs 1989).

Location and movement of each raccoon was monitored between February 1998 to July 1998 using hand-held receiving equipment (AVM Instrument Co. Ltd.) and

standard radio-tracking procedures. In addition, daytime recordings were taken to help identify possible den sites. Locations of raccoons and said den sites were recorded in UTM coordinates using a Garmin 12 GPU system and plotted on a DOQQ map of North San Marcos using ArcView GIS v3.1 (ESRI Inc.). Home range was estimated using the convex polygon method (Krebs 1989). Surface areas of Spring Lake included in the home range of individual raccoons was subtracted from the overall projected home range (land and water) using Arcview GIS v3.1 (Appendix 1).

Degree of Interaction

The degree of interaction with domesticated animals was estimated by personal observation, motion detection camera (Trail Master Co.), and analysis of 100 questionnaires completed by area residents.

To quantify the degree of interaction, I constructed four categories to measure interaction. Category 1 indicated the least amount of interaction and was defined as both raccoons and domestic animals being within 1000 meters of each other without being alerted to each other's presence. Category 2 indicated a mutual awareness between a raccoon and a domestic pet or feral cat had occurred. Category 3 indicated two individuals were close enough to share food from the same location. Category 4 indicated physical contact between a raccoon and a domestic animal.

One hundred questionnaire packets were distributed in Spring Lake Hills neighborhood, San Marcos, Texas, located to the east of Aquarena Center. The packet included a cover letter, briefly explaining the purpose of the study, and a questionnaire regarding raccoon activity. It was collected one week after distribution (Appendix 2).

RESULTS

Home Range

During the study, data were collected on 7 raccoons and used to compute home ranges of individuals. Capture date, age, sex, weight, body measurements and home range sizes are given in Table 1. The total number of verified radio locations ranged from 6 to 20 per raccoon. Home range estimates varied from 0.069 ha to 7.73 ha, with a mean value of 2.14 ha for males and 3.39 ha for females. The combined mean home range was estimated at 2.60 ha. The greatest distance traveled by radio-collared raccoons from Aquarena Center was 644 m for a female, and 514 m by a male. There was insufficient data to compare the degree of overlap among home ranges using single-classification analysis-of-variance. Home ranges were not mutually exclusive (Figure 2 and 3), and both male and female raccoons shared large portions of their home ranges (Figure 4).

Dens were located mostly in the education and research facility between the main lake and the slough. Several females used the Endangered Species Exhibit year round. One female utilized the drain system located near the headwaters, and is known to have reared at least one litter in this location. Males used several dens, including the Dive Shop, General Store, and Endangered Species Exhibit. However, females actively excluded males from the Endangered Species Exhibit when litters were known to be in the den. Some secondary dens were noted outside of the educational and research facility, such as the closed educational theater and gristmill. The Peterson Index (Krebs 1989) was used to estimate the population size, using a single capture event.

Table 1. Summary for Radio-Collared Raccoons at Aquarena Center, Hays Co., Texas.

Raccoon number	Date of Capture	Age Class	Sex	Weight (kg)	Total Length (mm)	Tail Length (mm)	Hindfoot Length (mm)	Ear Length (mm)	Number of locations	Home-Range Size (ha)
1	1997*	3	F	4.5	925	230	113	55	9	0.70
2	3/4/98	2	M	5.6	860	260	125	60	11	2.20
3	3/5//98	2	F	5.2	[760]	[170]	105	50	20	7.73
4	3/6/98	3.5	M	6.4	860	210	125	60	6	2.76
5	3/6/98	2.5	F	5.7	803	201	100	50	11	2.12
6	3/17/98	1	M	1.5	810	195	115	67	10	1.49
7	3/20/98	3.5	F	6.4	929	220	127	60	6	0.69

Asterisk (*) indicates original date of capture unknown, and [ ] indicates a broken tail.

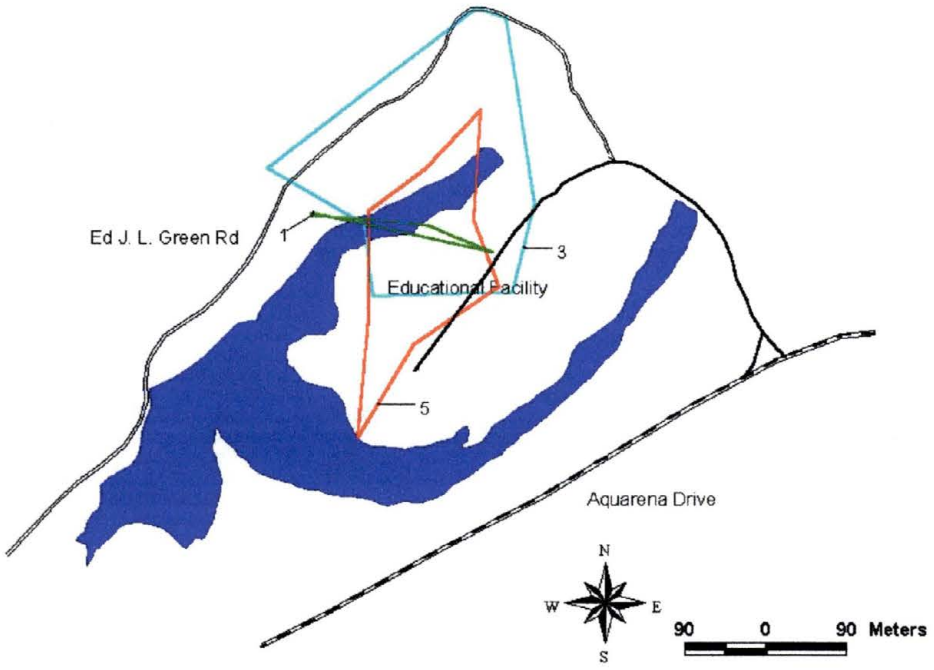

Figure 2. Home Ranges of Female Raccoons at Aquarena Center, Hays County, Texas. Numbers correlate with raccoon number in Table 1.

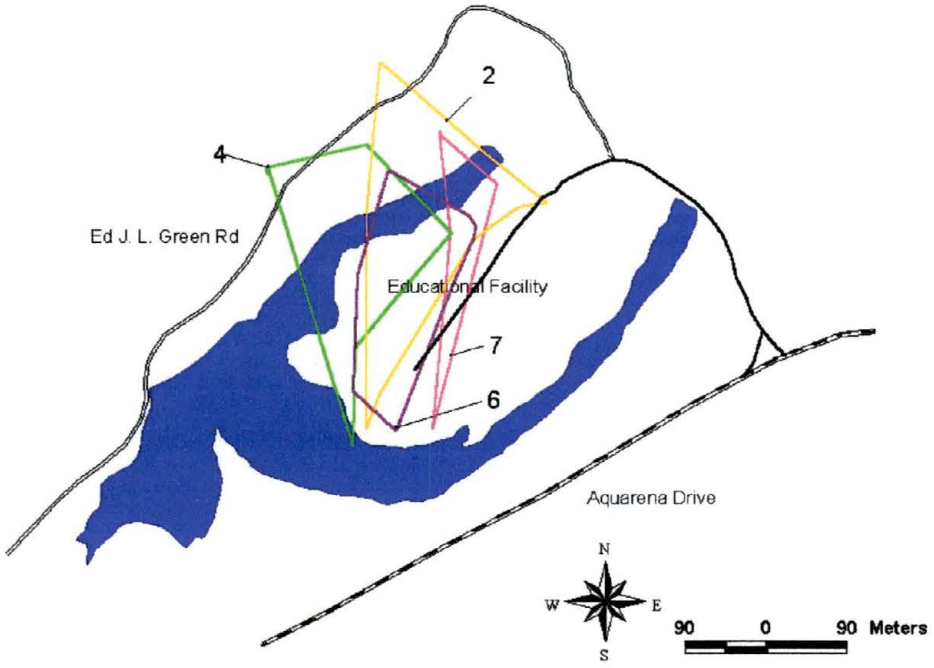

Figure 3. Home Ranges of Male Raccoons at Aquarena Center, Hays County, Texas. Numbers correlate with raccoon number in Table 1.

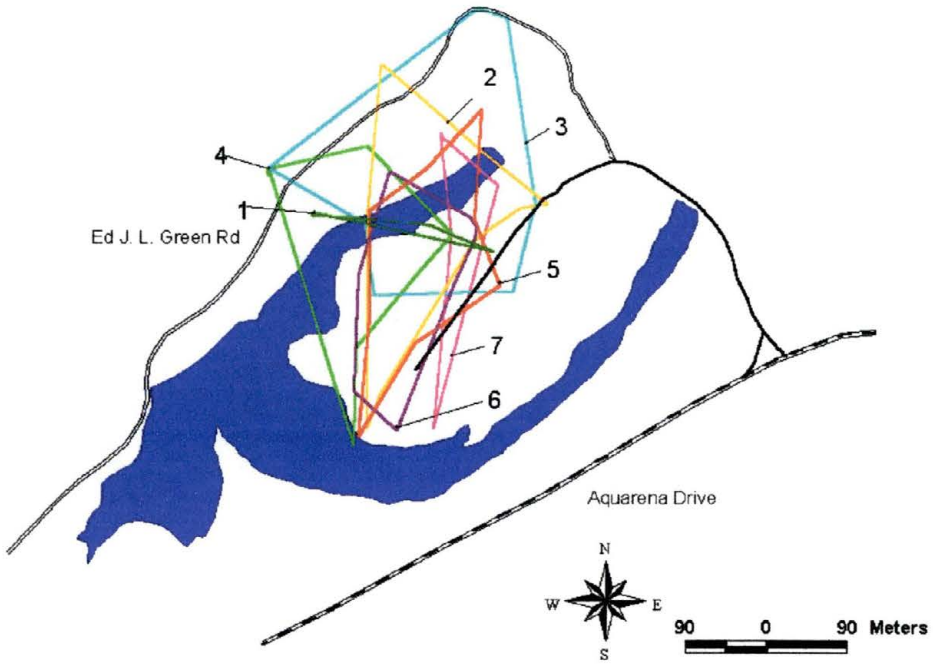

Figure 4. Map showing estimated home ranges of males and females at Aquarena Center, Hays County, Texas, showing large portions of shared home ranges between sexes. Numbers correlate with raccoon number in Table 1.

This estimate was 30 individuals, at Aquarena Center, in the spring of 1998, a density of 1 raccoon per 0.14 ha.

$$\hat{N} = CM/R$$

Where M is the number of raccoons tagged, C is the number of raccoons captured, and R is the number of tagged raccoons recaptured.

Degree of Interaction

During the personal observation and motion-detecting camera study, both Category 1 and Category 2 were recorded on a nightly basis. Category 3 behavior was observed only once, with a feral cat, near a bait station. Category four, physical contact between a raccoon and a domestic pet or feral cat, was not observed during my study.

Of the 100 questionnaire surveys sent out to Spring Lake Hill's residents, 30 were completed and returned. Of the 30 returned, 27 % reported Category 3, only one case of Category 4 was reported. Additionally, no injury to any domestic pet was reported.

CONCLUSION

Kaufman (1982) reported that the size of home ranges of most raccoons varied from 40 to 100 ha. The home ranges estimated in my study are smaller than home ranges previously reported. Kaufman (1982) also suggested that variation in home range estimates might be due to differences between sexes, age, population density, habitat quality, season of year, length of study, and methods of obtaining and analyzing data. Two of the seven estimated raccoon home ranges were less than 1 ha., and were concluded to be underestimated. When these two underestimated home ranges were removed from the mean home range estimation of this study, the combined home range becomes 3.36 ha., a value smaller than what Hoffman (1977) reported for suburban raccoons in the greater Cincinnati, Ohio area. This small home range estimate may be the result of the highly productive ecosystem that Seaman (1997) reported for Aquarena Center. All environmental needs are met in a relatively small space.

Habitat quality and length of study may have influenced the results of this study. After collars were placed on raccoons, the average longevity of the collars was only four months. To determine if the collared individuals had moved out of range of the receiver, a low level aerial survey was conducted with no success. I then concluded that the collars were failing. Several collars were retrieved and collar failure was confirmed. This may have resulted in the underestimation of home range of several individuals. The short duration of the radio collars also prevented a detailed study of seasonal effects to home range. The small data sample resulted in a less informative method of estimating the home range, and prevented core areas of activities from being identified (Samuel *et al.* 1985).

The study suggested that there was low degree of contact between raccoons and domestic pets and feral cats in the Aquarena Center area. This study also suggested there is a healthy raccoon population. During the course of my study, no indications of rabies or distemper were ever noted in the raccoons or any other potential carriers.

As a side study, 15 raccoons were necropsied to determine infection rates of parasitic nematodes. No nematode parasites were found in any of the individuals. This lack of nematode parasites was attributed to the lack of an appropriate intermediate host (possibly *Neotoma* sp).

It is important to note that "healthy population conditions" is the operative statement in this conclusion. The density of raccoons estimated for this area is 1 raccoon per 0.14 ha. With such a high density, and multiple individuals sharing den sites, an enzootic is highly probable. In the case of an epizootic, Aquarena Center meets four of the ten shared factors of McLean's (1975) study of raccoon epizootics; dense raccoon population, human habitation, garbage-can feeding by raccoons and disturbance or destruction of raccoon habitat.

The first is the dense raccoon population occupying the 4.21 ha educational and research area. The second factor is the close proximity of human habitation. Spring Lake Hills is 337m from Aquarena Center's educational and research area. Several of the raccoon's home ranges extended to the border of the residential area, were residents are known to feed whitetailed deer, but did not cross into the neighborhood. The raccoons in Spring Lake Hills are considered to be a separate population, but individuals from the Aquarena Center population could easily enter this area, and may do so in winter months.

The third factor is utilization of garbage cans, by raccoons, from the educational and research facility, and hotel as a food source. Raccoons were reported feeding in garbage cans and dumpsters nightly. The fourth factor is disturbance or destruction of raccoon habitat. The education facility is under a long-term renovation, and is constantly changing educational displays, art displays, and frequently produce plays that require the construction and removal of theater sets located close to several male den sites.

These four factors, combined with the uniformly unaggressive behavior associated with raccoon rabies, suggest that the risk of exposure for humans and domesticated animals could be high. However, in Florida, exposure of humans and dogs to rabies occurred only when victims approached fearless raccoons (McLean 1975). With education of the public to the potential exposure to rabies and a strong program of vaccination of domestic pets, the risk may be reduced. A reduction of the raccoon population, the removal of feral cats and dogs, the prevention of the raccoons utilizing human development and a raccoon vaccination program may further reduce the risk of both an enzootic and epizootic.

APPENDIX

Appendix 1. Determination of net home range sizes for areas of overlap on Spring Lake included in gross home range numbers.

Raccoon Number	Gross Home Range Size (hectare)	Area of Home Range Overlapping Spring Lake (hectares)	Net Home Range Size (Hectares)
1	0.01224	0.052	0.07
2	3.2767	0.5194	2.20
3	8.2741	0.5461	7.73
4	2.8557	0.6525	2.76
5	2.5517	0.4347	2.12
6	2.2513	0.2519	1.49
7	0.8267	0.1391	0.69

Appendix 2.Cover letter and survey of Spring Lake Hills residents.

SWT

8 June 1998

Department of Biology

Dear Residents,

As part of my Graduate studies in the Biology Department at SWT University I am monitoring raccoons in and around Spring Lake Hills residential area. I will be conducting research for approximately one year under the supervision of Dr. Randy Simpson, major advisor, Dr. Richard Manning and Dr. Francis Rose. Research consists of tracking 10 radio-collared raccoons in order to follow and record their movements and activities nightly.

I am beginning my research by distributing the enclosed survey to gather your information about any raccoons in your neighborhood. Any and all information from the survey will allow us to begin assessing the ecological role that these raccoons play, and the level of interaction between the raccoons the residents and their pets and homes.

The surveys may be filled out, placed in the original plastic bag and placed outside your home for collection on Monday, June 15th.

Thank You Very Much For Your Time.

Jayson M. Hudson
Dept. of Biology
SWT University

Southwest Texas State University
601 University Drive San Marcos, Texas 78666-4616
Telephone: 512-245-2178 Fax: 512-245-8713
SWT is a member of the Texas State University System

Survey of Raccoons in Spring Lake Hills

1. Have you ever seen a raccoon in your neighborhood? Yes No

2. If yes, how often
1-3times 4-6times 7-9times 10 or more

3. Have you ever had to "raccoon proof" your house? Yes No

4. If yes, did it work? Yes No

5. Have raccoons ever damaged your garden, lawn or landscape? Yes No

6. Do raccoons ever get in you garbage? Yes No

7. If yes, how often

Rarely Frequently Very frequently

8. Have raccoons ever gotten into your dog and/or cat's food? Yes No

9. Do you feed raccoons in your neighborhood? Yes No

10. Have you ever seen a raccoon with white ear tags? Yes No

11. Have you ever seen a raccoon during the daytime? Yes No

12. Has your dog and/or cat ever encountered a raccoon? Yes No

13. If Yes, How many times has your pet encountered a raccoon?

1-3 Times 4-6 Times 7-9 Times 10 Or more

14. Was there any injury to your pet? Yes No

Comments:_____

Street Address _____
(voluntary, but it would help us very much)

LITERATURE CITED

Bigler, W. J. and G. L. Hoff. 1974. Anesthesia of raccoons with ketamine hydrochloride. J. Wild. Mgmt., 38:364-366.

Bigler. W. J., R. G. McLean, and H. A. Trevino. 1973. Epizootiological aspects of raccoon rabies in Florida. Am. J. Epidemiol., 98:326- 335.

Burridge, M. J., L. A. Sawyer, and W. J. Bigler. 1986. Rabies in Florida. Department of Health and Rehabilitative Services, Tallahasse, FL., p.19.

Carey. A. B. 1980. Multispecies Rabies in the Eastern United States: *In* Population dynamics of rabies in wildlife (P.L. Bacon, ed). Academic Press, London, pp. 23-41.

Davidson, W. R. and V. F. Nettles. 1988. Field manual of wildlife diseases in southeastern United States. Southeastern Cooperative Wildlife Disease Study, Athens, Georgia, pp. 309-313.

Gehrt, S. D., and E. K. Fritzell. 1997. Sexual differences in home ranges of raccoons. J. of Mammology, 78: 921-931.

Grau, G. A., G. C. Sanderson and J. P. Rodgers. 1970. Age determination of raccoons. J. Wild. Mgmt., 34: 364-372.

Hoffman, C. O., and J. L. Gottschang. 1977. Numbers, distribution, and movements of a raccoon population in a suburban residential community. J. of Mammology, 58: 623-636.

Jenkins, S. R., B. D. Perry, and W. G. Winkler. 1988. The ecology and epidemiology of raccoon rabies. Rev. Infect. Dis., 10:620-628.

Jenkins, S. R. and W. G. Winkler. 1987. Descriptive epidemiology from and epizootic of raccoon rabies in the mid-Atlantic states, 1982-1983. Am. J. Epidemiology,126: 429-438.

Kaufman, J. H. 1982. Raccoons and allies: *In* Wild mammals of North America. (J.A. Chapmand and G.A. Feldhammer, eds.) Johns Hopkins Univ. Press, USA, pp. 567-585.

Kappus, K. D., W. J. Bigler, R. G. McLean and H. A. Trevino. 1970. The raccoon as an emerging rabies host. J. Wild. Dis., 6:507-516.

Krebs, C. J. 1989. Ecological methodology, Harper & Row Publ., New York, N.Y.p. 21.

Kerr, C. L., S. E. Henke, and D. B. Pence. 1997. *Baylisascariasis* in raccoons from Coastal Texas. J. of Wild.Dis., 33(3): 653-655.

MacClintock, D. 1981. A natural history of raccoons. Charles Schribner's Sons, USA, pp 34-63.

McLean, R. G. 1971. Rabies in raccoons in the Southeastern United States. J. Infect. Dis., 123:680-681.

McLean, R. G. 1975. Raccon rabies: *In* The natural history of rabies (G.M. Baer, ed.). Academic Press, London, pp53-77.

Samuels, M. D., D. J. Pierce and E. O. Garton. 1985. Identifying areas of concentrated use within the home range. J. of Anim. Eco., 54:711-719.

Seaman, R. 1997. Food Habits of the Texas river Cooter (*Pseudemys texana*) at Spring Lake, Hays County, Texas. M.S. Thesis. Southwest Texas State University, San Marcos, Texas.

Woodruff, B. A., J. L. Jones, and T. R. Eng. 1991. Human exposure to rabies from pet wild raccoons in South Carolina and West Virginia, 1987 through 1988. Public Health,Vol.81, No10:1328-1330.

Veeraraghaven, N., H.Gajanawa, R. Rangasam, P. T. Osnnunni, C. Sarawatti, R. Devarraj and K. M. Hallan. 1970. Studies on the salivary excretion of rabies virus by the dog from Surundai. Sci. Rep.: p 21-30.

VITA

Jayson M. Hudson was born in Altus, Oklahoma on August 16, 1973, the son of Lynda Wixom and John Michael Hudson. After completing his work at Vanden High School in Vacaville, California in 1991, he entered Southwest Texas State University in San Marcos, Texas. In 1992 he transferred to Texas A&M in Galveston were he received a Bachelor of Science in Marine Biology. In 1996, he entered the Graduate School of the University of Texas at San Antonio, Texas. In 1997 he transferred to the Graduate School of Southwest Texas State University, San Marcos, Texas where he studied in the wildlife program and instructed General Zoology and General Ecology Labs for two years.

Permanent Address: 8718 Collingwood
San Antonio, TX 78148

This thesis was typed by Jayson M. Hudson