AN ABSTRACT OF THE THESIS OF

Wade B. Fothergill for the Master of Science Degree

in Biology presented on January 18, 1994

Title: Secondary Succession In Two Abandoned Landfills In East-central Kansas

Abstract Approved: Elmer J. Finck

Our society discards solid waste into landfills and covers them over with soil. Until recently the policy has been "out of sight, out of mind". Over the years large amounts of waste have forced the closing of many landfills with little thought about what will become of these landfills. My study compared two abandoned landfills of different ages to a native prairie. From July of 1990 through July of 1991, I compared the soil characteristics, vegetative cover, and small mammal populations on landfills in Lyon County to a native prairie site in Chase County in east-central Kansas. The soil bulk density of the prairie was significantly lower than that of the landfills and soil pH was significantly different among all sites. The percent of sand, silt, and clay at the landfills was significantly different than that of the prairie site. The richness of forbs decreased and the richness of grasses increased with succession. The grass biomass was significantly lower in the most recently abandoned landfill, and the biomass of forbs was significantly lower in the prairie site. The total biomass was significantly higher in the oldest landfill than the other sites. Small mammals were not evenly distributed among sites, and relative abundance of all small mammals was highest in the oldest landfill and lowest in the native prairie. The high relative abundance of a different small mammal species at each site may be explained by vegetative cover and prevalence of different forbs and grasses. The effects I studied suggested that old landfill succession to a native prairie does not differ greatly from that of any other disturbance on the prairie. However, a broader study including factors such as ground water and deep (2 to 4 m) soil cores may show landfill succession to be unique among prairie disturbances because of the depth of its effects.

SECONDARY SUCCESSION IN TWO ABANDONED LANDFILLS IN EAST-CENTRAL KANSAS

A Thesis

Submitted to

The Division of Biological Sciences

Emporia State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

by

Wade B. Fothergill

May 1994

Elmer J. Finck

Approved by Major Advisor

James M. Mayo

Approved by Committee Member

David E. Schroeder

Approved by Committee Member

Ann Scheve

Approved by Committee Member

Rodney J. Sobieski

Approved for Major Department

Faye N. Vowell

Approved for Graduate Council

ACKNOWLEDGEMENTS

I thank my major advisor, Dr. Elmer Finck, for allowing me to make mistakes and learn from them. Thanks to my committee members, Dr. Jim Mayo, Ann Scheve, and Dr. David Schroeder for their assistance during the writing of this thesis. I especially thank Bernard Sietman for his assistance during small mammal trapping, statistical analysis, the writing of this thesis, and his much needed motivation. I would like to thank Dr. Jim Mayo and Dr. Thomas Eddy for their help in plant identification. Thanks also goes to Dr. Larry Scott for his help with the statistical analysis and Ericka Nichols, Brad Simpson, and Shannon Rothchild for their help with small mammal trapping. I also thank Dr. Jim Mayo, the City of Reading, and J.D. Miller for allowing me to study succession on their land.

This thesis is dedicated to my mother because of her desire to have literate children.

TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

In the United States about 80% of all waste is transported to landfills, while 10% is incinerated and 10% is recycled (Council on Environmental Quality, 1989; Wingerter, 1989). Plastic, paper, yard wastes, as well as many chemicals and heavy metals are amassed in our municipal landfills at a rate of over 160 million tons of solid waste per year (Popkin, 1989). This yearly rate was reached in 1988 (Council on Environmental Quality, 1989), which is up from 87.5 million tons per year in 1960 (Forester, 1988; Council on Environmental Quality, 1989). In addition to the municipal waste, the industrial wastes generated come close to 7.6 billion tons per year (Council on Environmental Quality, 1989). In 1976 an estimated 30,000 landfills were in operation and that number has steadily dropped to under 6,000 in 1989 (Forester, 1988; Council on Environmental Quality, 1989). An estimated 33% of active landfills will be full by 1993 (Wingerter, 1989). Forty percent of the total waste generated is handled by 2.6 percent of the landfills (Council on Environmental Quality, 1989). Food and yard wastes are degradable on the surface, but buried in a landfill only about 25% degrades in the first 15 years with little to no additional change in original weight or volume for at least 40 years (Grossman and Shulman, 1990). A dump is just an area where trash and garbage is discarded in a heap (Forester, 1988). Whereas, a modern landfill is equipped with a synthetic liner at the base and has some form of leachate (mixture of water and dangerous chemicals caused from percolating rain water through a landfill) collection system and a methane collection system (Forester, 1988). Modern landfills have clay and sand layers on the bottom before the synthetic liner and clay, sand, and topsoil layers on the top. Layers of soil are also placed over each day's garbage to keep down the smell and number of rats.

The closing of a major proportion of municipal landfills warrants an investigation of the successional changes that occur on abandoned landfills and their effects on the soil, plant and animal communities present. However, very few studies have been reported in the literature. Thus, expected results from studies on succession in landfills must rely on comparison to other major disturbances. For example, where large scale disturbances are the norm, many species will become established and richness will decline through time and succession (Hobbs and Huenneke, 1992). The oldest landfills should more closely resemble late successional stages. The purpose of my study is to document differences and similarities in soils, vegetation, and small mammals among a recently covered landfill, an older landfill, and a native tallgrass prairie. I used the tallgrass prairie site as a reference site for the two landfills.

STUDY AREAS

Two landfills and a native, ungrazed, tallgrass prairie were selected as study sites. The first area will be referred to as the Emporia landfill even though the area is more of a dump, by definition, than a landfill.

Emporia was the oldest landfill site in my study and should be in a successional stage between a disturbed field and a native prairie. The Emporia landfill was a 16.2 ha plot that was closed and capped with soil and planted to fescue grass (*Festuca* spp.) in June of 1974. Since then some areas have been farmed, but much of the area was left with some exposed garbage. No trapping, soil collection, or plant collection was done in the farmed areas. This site was located in the Cottonwood River Basin in Lyon County, in east central Kansas in NW 1/4 of the NE 1/4 of Sec 3, Township 20 S., Range 11 E. This area was gently sloping to the south with the west side bordered by a row of cedar trees (*Juniperus virginiana*) and Kansas Highway 99. A gravel road ran along the north end, pasture land bordered the east side, and a creek ran along the south end. It was a weedy field with numerous open patches and a few shrubby trees and was surrounded by rangeland and rowcrop agriculture.

The second landfill area, Reading landfill, was closed and capped in 1986. Reading was the most recently abandoned landfill in my study and contain mainly weedy species of plants with very few grass species. Due to age, the total plant species richness should be high. The Reading landfill was also located in Lyon County, northwest of Reading, Kansas in SW 1/4 of the NW 1/4 in

Sec 34, Township 17 S., Range 13 E. It was a 4 ha plot that was planted with nitrogen fixing crown vetch (Coronilla varia) to help prevent erosion. This area had a limestone base and was bordered by an Oak-Hickory (Quercus spp.-Carya spp.) woodland to the northeast. On the southwestern edge of the landfill there was a grazed pasture, the northwest a bed of limestone, and the southeast a rocky limestone outcrop elevated above the rest of the surrounding landscape. The landfill itself was a gently sloping north facing hill.

The third study site was a 5 ha native tallgrass prairie, which has a 20 ha haymeadow and a 7.4 ha wheatfield to the immediate east and south, respectively. This area was used as a reference area and was located in the Middle Creek Basin of Chase County, in east central Kansas in N 1/2 of the NW 1/4, Sec 13, Township 19 S., Range 6 E. The surrounding landscape was composed of grazed rangeland, rowcrop agriculture (mainly wheat, soybeans, sorghum and corn). The topography was nearly level to sloping (1-5%). The area has never been plowed, but it may have been grazed by cattle before 1945. Since then it has been hayed periodically, most recently in 1988. The area was burned every 2 or 3 years, most recently in the spring of 1990. The area was dominated by big bluestem (Andropogon gerardii) and little bluestem (Andropogon scoparius) grasses.

METHODS AND MATERIALS

Soil Measurements

To determine soil bulk density, pH, and soil class (percent sand, silt, and clay), 15 soil samples from each study site were taken at approximately 30-m intervals in straight line transects. In August 1990, samples were taken below the surface level just under the litter layer with steel cylinders containing a volume of 100 cm^3. To determine the bulk density, the soil from the steel ring was dried in a microwave oven for approximately 3 minutes or until any signs of moisture were gone and the sample remained at a constant weight. The samples were then weighed to the nearest 0.01 g. The pH was determined with a Orion model SA 720 pH meter (Foth et al. 1982). A Bouyoucas Hydrometer was used to determine the percent sand, silt, and clay in the soil by standard procedures (Blake, 1965). A soil classification triangle was used to determine the soil class. All other inferences about the soil came from the soil surveys of Lyon and Chase counties (Neill, 1974; Neill, 1981).

Vegetative Measurements

Species richness, frequency, and biomass of plants were measured at each site by clipping plants to ground level. In September 1990, plants were collected using a 0.25 m^2 quadrat at 15 plots approximately 20 m apart in straight line transects. Separated by species and placed in paper sacks, the samples were air dried and weighed to the nearest 0.01 g with a Mettler PM 460 Delta range scale. Plant nomenclature follow Great Plains Flora Association (1986).

Small Mammal Trapping

Small mammals were trapped with large Sherman live traps (7.6 x 8.9 x 22.9 cm). Thirty nine stations with 2 traps per station were set at approximately 15 m intervals in two straight line transects. Traps were run for three consecutive nights per trapping period in each study site. Trapping was done in July and October of 1990 and May and July of 1991. The July trapping periods were referred to as summer 90 or 91, the May as spring 91, and the October as fall 90. Trap nights totaled 936 per site, for a total of 2808 trap nights. During each trapping period, trapping occurred within four days of the new moon to insure peak activity of small mammals (Wolfe and Summerlin, 1989). Bait consisted of oatmeal and peanut butter wrapped in perforated waxed paper. Small mammals were identified to species, sexed, and weighed to the nearest 0.1 g. Tail and hindfoot length were measured to the nearest mm and each animal was toe clipped according to standards established by the American Society of Mammalogists (Ad hoc, 1987) and released at location of capture. Species diversity, species richness, and density of individuals were determined.

Statistical Analyses

One-way analysis of variance and Duncan's Multiple Range Tests were used to determine if there were differences among habitats in soil pH, soil bulk density, percent sand, silt, and clay, grass biomass, forb biomass, total vegetative biomass, small mammal mass of <u>Sigmodon hispidus</u>, and <u>Peromyscus</u>

maniculatus (no other species were tested due to small sample size). G-tests were used to determine if small mammal sex ratios were evenly distributed among habitats. A log-likelihood ratio (Zar, 1984) was used to determine if small mammal abundance was evenly distributed among habitats.

RESULTS

Soil Measurements

Among the three sites, Reading landfill had the highest bulk density at 1.23, followed by Emporia at 1.18, while Chase County, was significantly lower ($F = 11.73$, df 2, $P < 0.0001$) at 0.93 (Table 1). The soil pH at all three sites was significantly different from each other ($F = 44.19$, 2 df, $P < 0.0001$) (Table 1). Reading was very slightly basic at 7.4. Emporia was near neutral at 7.0 and Chase County was acidic at 5.5 (Table 1).

Neill (1974 and 1981) placed the original soils at all three sites in the silty clay loam class. The soil classes differed from the descriptions in Neill (1974 and 1981). Of 15 samples examined in Emporia, over 1/3 (5.5) were silty clay loam, however a mean of all samples yielded a clay loam soil. Emporia had significantly more clay than the other study sites ($F = 23.24$, df 2, $P < 0.0001$) (Table 1). The Reading landfill was a sandy clay loam soil (Table 1). Reading had a significantly higher percent of sand ($F = 13.62$, df 2, $P < 0.0001$) and had a significantly lower percent of silt than the other sites ($F = 7.04$, df 2, $P < 0.0023$). Reading had 9 of 15 samples in the sandy clay loam or sandy loam classes. No samples were in a silt or silt related classes. Chase County was found to be a loam soil. Chase County had the highest percent of silt and the lowest percent of clay, however neither was significantly different than the other sites (Table 1).

Table 1. Mean standard soil characteristics at each study site.

	Emporia	Reading	Chase Co.
Bulk density (g/cm^3)	1.18(±0.13)[a1]	1.23(±0.09)[a]	0.93(±0.27)[b]
pH	7.04(±0.37)[b]	7.40(±0.08)[a]	5.51(±1.66)[c]
Sand (%)	21.10(±13.11)[b]	48.93(±11.64)[a]	31.30(±17.14)[b]
Silt (%)	41.83(±12.74)[a]	28.43(±12.91)[b]	44.13(±15.59)[a]
Clay (%)	37.03(±36.22)[a]	22.63(± 5.25)[b]	17.93(± 5.62)[b]
Soil class	clay loam	sandy clay loam	loam

[1] - Numbers with the same letter are not significantly different.
() - Numbers in parentheses indicate standard deviation.

Vegetative Measurements

Fifty-three species of plants were collected from all sites during August and September of 1990. Of these, 39 were forbs and 14 were grasses (Tables 2 and 3). See Appendices 1-3 for a complete list of plants along with scientific names.

The total species richness was highest at Emporia with 25, followed by 22 and 21 at Reading and Chase County, respectively. Species richness of forbs was highest at Emporia with 22 species. Reading had 16 species of forbs and Chase County had nine species of forbs, as well as four species which could not be identified and were referred to as unknown. I was unable to determine whether these four species were the same or four separate species (Table 2). The species richness of grasses was highest at Chase County with eight, Reading had six, and Emporia had the least with three (Table 3).

Seven forb species were common to both landfills and only western ragweed (Ambrosia psilostachya) was common to all three sites. Three grass species were common to both landfills, and only yellow foxtail (Setaria glauca) was found in a landfill and Chase County. No single grass species was found in all study sites.

Total plant biomass was significantly higher in Emporia than Reading or Chase County ($F = 13.30$, df 2, $P < 0.0001$) (Table 4). Biomass of grass was higher in Chase County then Emporia but Reading was significantly lower ($F = 52.36$, 2 df, $P < 0.0001$) (Table 4). Biomass of forbs was highest at Emporia and Reading

Table 2. Richness of forbs at each study site.

Plant	Emporia	Reading	Chase co.
Velvet leaf	3[1]	-	-
Yarrow	-	-	6
Western ragweed	7	9	1
Giant ragweed	9	9	-
Lead plant	-	-	3
White aster	7	-	-
Narrow leaf milkweed	-	-	4
Unknown aster	-	2	-
Narrow leaf aster	-	-	2
White sage	1	-	-
Tall thistle	2	-	-
Horse weed	7	-	-
Flowering dogwood	-	-	1
Crown vetch	-	8	-
Common croton	-	1	-
Unknown erigerone	1	-	-
Daisy fleabane	2	-	-
Flowering spurge	-	-	3
Toothed spurge	-	2	-
Snow-on-the-mountain	1	-	-
Prostrate spurge	2	-	-
Gaura	2	1	-
Broomweed	-	6	-
Annual sunflower	1	-	-
Marsh elder	1	-	-
Summer cyprus	3	2	-
False boneset	-	1	-
Wild lettuce	2	-	-
Yellow sweet clover	1	-	-
Ground cherry	2	-	-
Common plantain	1	1	-
Slender leaf knotweed	1	1	-
Scurf pea	-	-	1
Smooth sumac	-	2	-
Carolina horse nettle	-	1	-
Prairie goldenrod	2	1	-
Ruellia	-	-	6
American gerimander	-	2	-
Ironweed	1	-	-
Unknown	-	-	4
Total species per site	22	16	13

[1] - Number of quadrats containing each species in 15 ($1/4m^2$) sample plots.

Table 3. Richness of grasses at each study site.

Plant	Emporia	Reading	Chase co.
Big bluestem	-	-	15[1]
Little bluestem	-	-	9
Three-awn	-	1	-
Side oats gramma	-	-	1
Downy brome	13	1	-
Scribner's dichanthelium	-	-	2
White sedge	-	-	1
Crab grass	1	1	-
Barnyard grass	-	1	-
Switch grass	-	-	1
Yellow foxtail	-	5	2
Green foxtail	2	1	-
Tall dropseed	-	-	2
Total species per site	3	6	8

[1] - Number of quadrats containing each species in 15 ($1/4m^2$) sample plots.

Table 4. Plant biomass (g/m^2) at each study site.

	Emporia	Reading	Chase co.
Grass	65.73(±28.57)[a1]	5.88(± 9.36)[b]	80.79(±21.12)[a]
Total (g)	985.93	8.09	1211.71
Forb	90.98(±68.47)[a]	67.66(±31.17)[a]	9.73(± 8.33)[b]
Total (g)	1365.04	1014.01	145.60
Total	156.73(±70.73)[a]	73.47(±76.11)[b]	90.49(±21.80)[b]
Total (g)	2350.97	1022.10	1357.31

[1] - Values are means ± standard deviation from 15 (1/4 m^2) plots.
[a] - Numbers with the some letter are not significantly different.

yet significantly lower at Chase County (F = 13.74, 2 df, P < 0.0001) (Table 4).

Small Mammal Trapping

Seven species, 337 individuals of small mammals, were captured 480 times during the study. See complete list of captures in Appendices 4-6. Species and percent of total were the hispid cotton rat (Sigmodon hispidus) at 46%, the deer mouse (Peromyscus maniculatus) at 34%, the white footed mouse (Peromyscus leucopus) at 12%, the prairie vole (Microtus ochrogaster) at 5%, the western harvest mouse (Reithrodontomys megalotis) at 1%, the eastern woodrat (Neotoma floridana) at 1%, and Elliot's short tailed shrew (Blarina hylophaga) at 1%.

Small Mammal Communities - Composition and Structure

Emporia had the highest total relative abundance of small mammals with 19.9 individuals per 100 trap nights. Reading and Chase County followed with 10.6 and 5.4 individuals, respectively. The number of individuals of all species was not evenly distributed (G = 85.55, 2 df, P < 0.0001). Sigmodon hispidus and P. maniculatus were the only species found at all locations. Peromyscus leucopus was absent from Chase County and R. megalotis was absent from Emporia. Several species were found at only one site. Microtus ochrogaster was only found at Chase County, B. hylophaga was only found in Emporia, and N. floridana was only found at Reading.

A different small mammal species had the highest relative abundance at each study site. Of the four species found at

Emporia, S. hispidus predominated with 67% of the total, P. maniculatus made up 30%, and both species were trapped every trapping season. The other 2 species at Emporia were B. hylophaga and P. leucopus (Table 5). Reading had almost equal numbers of P. leucopus and P. maniculatus with a relative abundance of 38% and 36%, respectively. Both of these species were trapped during all four seasons. Sigmodon hispidus, N. floridana, and R. megalotis were also trapped at Reading (Table 5). Chase County's most predominant species was P. maniculatus with 45% of the total and was the only species trapped each trapping season. The other species at Chase County were M. ochrogaster, S. hispidus, and R. megalotis (Table 6).

Seasonal variation across all three sites showed the highest relative abundance occurring in the fall of 1990 (Table 5). The summers of 1990 and 1991 were almost equal with 11.3 and 10.8 individuals per 100 trap nights, respectively. The lowest relative abundance was in the spring of 1991 (Table 5). The seasonal differences in distribution of small mammals at Emporia agree with the total and are highly significant ($G = 73.526$, 2 df, $P < 0.001$). Like the seasonal total, Reading had its highest number of individuals in the fall of 1990, but the summer of 1990 was the lowest and overall seasonal distribution was significantly different ($G = 9.407$, 2 df, $P < 0.01$). Chase County's seasonal distribution was highly significant ($G = 15.117$, 2 df, $P < 0.001$) and unlike the distribution at the landfills with the summer of 1991 being highest and the fall of

1990 and summer of 1991 being the lowest.

The mass of each animal captured was taken. Since only S. hispidus and P. maniculatus were captured in all 3 study sites, they were the only 2 species analyzed (Table 6). Among the 3 sites the mass of S. hispidus was not significantly different ($F = 1.30$, 2 df, $P < 0.2751$) nor was that of P. maniculatus ($F = 2.49$, 2 df, $P < 0.0872$).

The sex ratio of each species at each site showed a larger number of males in each case. However the sex ratio was not significantly different from equal (Table 7).

Table 5. Total individuals of each species of small mammals at each study site and each season.

Species Location	Sum 90	Fall 90	Season Spr 91	Sum 91	Mean Total
Sigmodon hispidus					
Emporia	13.2[1]	28.2	3.4	8.5	13.4
Reading	3.4	5.1	nc	0.4	2.2
Chase co.	nc	1.7	0.4	1.7	1.0
					5.5
Peromyscus maniculatus					
Emporia	7.7	9.0	3.8	3.0	5.9
Reading	1.3	3.8	6.8	3.4	3.8
Chase co.	5.1	1.3	0.4	3.0	2.5
					4.1
Peromyscus leucopus					
Emporia	nc	0.9	nc	nc	0.2
Reading	2.6	6.4	1.3	6.0	4.1
Chase co.	nc	nc	nc	nc	nc
					1.4
Microtus ochrogaster					
Emporia	nc	nc	nc	nc	nc
Reading	nc	nc	nc	nc	nc
Chase co.	0.4	nc	2.1	5.1	1.9
					0.6
Blarina hylophaga					
Emporia	nc	1.7	nc	nc	0.4
Reading	nc	nc	nc	nc	nc
Chase co.	nc	nc	nc	nc	nc
					0.1
Reithrodontomys megalotis					
Emporia	nc	nc	nc	nc	nc
Reading	nc	nc	0.4	0.4	0.2
Chase co.	nc	nc	nc	0.4	0.1
					0.1
Neotoma floridana					
Emporia	nc	nc	nc	nc	nc
Reading	nc	0.4	nc	0.4	0.2
Chase co.	nc	nc	nc	nc	nc
					0.1
Study Site Totals					
Emporia	20.9	39.2	7.3	11.5	19.9
Reading	7.3	15.8	8.5	10.7	10.6
Chase co.	5.6	3.0	3.0	10.3	5.4
Mean Season Total	11.3	19.5	6.3	10.8	12.0

1 - Numbers of individuals per 100 trap nites.
nc - No captures.

Table 6. Mean mass of each species of small mammals at each study site.

Species	Emporia	Reading	Chase Co.	Total
S. hispidus	92.1(123)	100.5(21)	75.3(9)	91.6(153)
SD	42.6	37.5	10.4	41.5
P. maniculatus	16.7(54)	19.0(37)	19.5(23)	18.0(114)
SD	4.2	6.7	3.9	5.2
P. leucopus	32.0(2)	25.5(38)	nc	25.8(40)
SD	0.0	5.9		6.0
M. ochrogaster	nc	nc	37.8(17)	37.8(17)
SD			8.7	8.7
B. hylophaga	13.3(4)	nc	nc	13.3(4)
SD	2.2			2.2
R. megalotis	nc	9.5(2)	11.0(1)	10.0(3)
SD		0.7	0.0	1.0
N. floridana	nc	188.5(2)	nc	188.5(2)
SD		23.3		23.3

() - Indicates number of individuals the mean mass was derived from.
nc - No captures.

Table 7. Sexes of each species at each study site.

Species	Emporia M	Emporia F	Reading M	Reading F	Chase co. M	Chase co. F	Total M	Total F
S. hispidus	61	59	12	9	3	5	76	73
P. maniculatus	32	20	17	20	12	11	61	51
P. leucopus	1	1	20	17	nc	nc	21	18
M. ochrogaster	nc	nc	nc	nc	10	9	10	9
R. megalotis	nc	nc	1	1	1	nc	2	1
N. floridana	nc	nc	1	1	nc	nc	1	1
B. hylophaga	1	nc	nc	nc	nc	nc	1	nc
Total	95	80	51	48	26	25	172	153

nc - No captures.

DISCUSSION

Soil Measurements

The most probable reason that the bulk density was highest at Reading and slightly lower at Emporia is the use of machinery to cap each landfill. Root systems in established crops have been shown to reduce compaction (Lull, 1959). With twelve years of plant growth between 1974 (Emporia's closing date) and 1986 (Reading's closing date) the compaction level or bulk density at Emporia has decreased. This agrees with Prather (1990), who found a noticeable decrease in bulk density between two reseeded fields in Lyon County that were also twelve years apart. A significantly lower bulk density at Chase County may be a result of its long time standing crop, lack of trampling from cattle, rare compaction from machinery, a modified B horizon due to the loss of A horizon during filling of landfills, or all of the above. These densities may also be explained by the correlation of time since the last major disturbance.

The soil pH was acidic at Chase County and neutral to very slightly basic at both landfills. Perino and Risser (1972) found the pH to be acidic in the early successional or weedy stages and only slightly acidic in the tallgrass prairie stage. Inouye et al. (1987) found that soil pH and age were not significantly correlated. The difference in results may be because of soil type and geography. The pH may also have been altered by the removal of cations such as, calcium, magnesium, and potassium, that are removed during haying (pers. comm. J. M. Mayo).

Differences in soil class may result from geology as well as plant succession. Emporia had significantly more clay than the other sites due possibly to distance from the flood plain. The elevation at Emporia is high enough as not to receive silt from any flood regardless of magnitude.

The Reading site is on a limestone outcrop on a high plain area. Silt from floods can not reach the area and wind is prevalent. These factors may result in the significantly lower percent of silt and significantly higher percent of sand. The Chase County site was found to be a loam soil, possibly due to many years of soil building from native grasses.

Vegetative Measurements

Richness of forbs was highest at Emporia probably due to two factors. Reading was planted to crown vetch (*Coronilla varia*), which may have kept the influx of forbs low. The second reason may be a result of time with Emporia having twelve years to develop a large seed bank. Chase County had the fewest forb species and the most grass species as expected in a native prairie compared to the two disturbed areas (Perino and Risser, 1972). Reading had more grass species than Emporia, which may seem unlikely, however this may be a result of the planting of fescue (*Festuca* spp.) and the subsequent invasion of downy brome (*Bromus tectorum*) at the closing of the Emporia landfill. The biomass of grass at Emporia was made up mainly of downy brome, which was found in 13 of 15 plots and may be responsible for keeping the influx of grasses low.

A newly abandoned field would be expected to have a significantly lower grass biomass and a native prairie would be expected to have a lower forb biomass. These expectations were met in my study.

Small Mammal Trapping

The combination of the soil characteristics, plant species richness, and plant biomass most likely determine the species composition and relative abundance of small mammals. With three different study sites a diverse group of mammals was expected. Small mammals common to North American grasslands include Peromyscus maniculatus, Peromyscus leucopus, Microtus ochrogaster, Reithrodontomys megalotis, Blarina hylophaga, and Sigmodon hispidus (Finck et al., 1986). With the exception of finding N. floridana, seven western box turtles (Terrapene ornata), a king snake (Lampropeltis calligaster), several grasshoppers, and several cockroaches in the traps, the trapping fell within expected parameters.

Schroder and Hulse (1979) found that the operation of a landfill altered the structure of the rodent community only where the habitat was altered. Species normally found in coastal prairies were absent where landfill operation had destroyed the vegetation. Adjacent areas maintained a community structure typical of undisturbed habitats.

The highest total relative abundance of small mammals was found at Emporia followed by Reading and then Chase County. This total follows the same trend as, and is probably related to, forb biomass and richness. Sigmodon hispidus and P. maniculatus were the only species found in all locations. Sigmodon hispidus often inhabits areas with a predominance of forbs and well developed cover (Kaufman et al., 1990; Swihart and Slade, 1990), which may explain its high relative abundance at Emporia and low relative abundance at Chase County. Sigmodon hispidus also exhibits a more generalized habitat than P. maniculatus, P. leucopus, or R. megalotis (Kaufman et al., 1990; Swihart and Slade, 1990). Therefore, the high relative abundance of S. hispidus in Emporia may be because of its more opportunistic habits in heterogeneous environments or because of its dominance over other species due to body size (Sietman et al., 1994).

Peromyscus maniculatus prefer open grassy areas ranging from sparse, short vegetation to climax grassland (Bee et al., 1981). Bare ground cover positively relates to P. maniculatus captures (Snyder and Best, 1988) and barren strip mine areas lacking grasses were shown to be good habitat as well (Hansen and Warnock, 1978). Therefore, the predominance of P. maniculatus in Chase County and the relative abundance in the landfills is not unusual.

The association of P. leucopus with woody and dense brushy vegetation is well documented (Kaufman and Fleharty, 1974; Kaufman et al., 1983; Clark et al., 1987; Snyder and Best, 1988). Thus, the proximity of the woody vegetation at Reading provides the best habitat for P. leucopus. The absence of woody vegetation or a complex vertical structure at Chase County probably relates to the absence of P. leucopus.

Microtus ochrogaster has been associated with areas having dense vegetation and well developed litter layers (Snyder and Best, 1988). This along with their preference for burrowing habitats may explain its absence from the high bulk density, low grass density landfills.

With the highest relative abundance occurring in the fall of 1990 and the lowest relative abundance occurring in the spring those results concur with Hansen and Warnock (1978) and Snyder and Best (1988), who showed a tendency for autumnal peak in _Peromyscus_ densities that can be related to increased food supply and Langley and Shure (1988), who showed _S_. _hispidus_ populations to suffer population crashes correlated with winter weather extremes, especially at northern end of its range.

CONCLUSION

Habitat degradation created by landfilling has a dramatic effect on every aspect of the ecosystem. My study compares soil characteristics, vegetative structure, and small mammal populations in landfills to a native prairie. The soil bulk density was significantly lower at Chase County possibly due to plant root development at Chase County and compaction from heavy machinery used at landfills during filling. The soil pH was significantly more acidic at Chase County, which may be a result of removal of cations during haying. The loam soil at Chase County may be the result of soil building agents in a native prairie. The significant difference in the percent of sand, silt, and clay at the landfills compared to Chase County is probably due to the landfilling practices.

The vegetative richness of forbs was highest at Emporia and is possibly due to seed bank or the fact that Reading was planted to crown vetch when closed not allowing forb species to move in as quickly as they might have on bare soil. The richness of grasses was significantly higher at Chase County compared to the landfills and the forb richness was significantly lower. Vegetative biomass of grass was significantly lowest at Reading and forb biomass was significantly lowest at Chase County.

The small mammal populations also varied between landfills and the native prairie with total relative abundance being higher at Emporia then Reading and Chase County, which follows the same trend of forb biomass and richness. Thus, my study shows how closely related several aspects of the ecosystem are. <u>Sigmodon</u>

hispidus had the highest relative abundance at Emporia, while Peromyscus maniculatus was highest at Chase County, and P. leucopus was highest at Reading, which may show the preference of specific habitat types for individual species. The patterns shown in my study show a unique succession in landfills. A short-term study like mine does not take into consideration all aspects. Other factors, such as water and predators, should be studied for longer time periods to help us understand human impact upon ecosystems from our excess waste.

LITERATURE CITED

AD HOC, Committee on acceptable field methods in mammalogy. 1987. Acceptable field methods in mammalogy: preliminary guidelines approved by the American Society of Mammalogists. J. Mammal. 68 (Supplement 4): 1-18.

BEE, J. W., G. E. GLASS, R. S. HOFFMANN, AND R. R. PATTERSON. 1981. Mammals in Kansas. Museum of Natural History. University of Kansas, Lawrence, KS. 300 pp.

BLAKE, G. R. 1965. Bulk density, p. 374-390. In: C. A. BLACK, D.D. EVANS, J. L. WHITE, L. E. ENSMINGER, AND F. E. CLARK (eds.). Methods of soil analysis. Part 1 -- Physical and mineralogical properties, including statistics of measuring and sampling. Am. Soc. Agron. Monogr. No. 9, Madison, Wisconsin.

CLARK, B. K., D. W. KAUFMAN, G. A. KAUFMAN, AND E. J. FINCK. 1987. Use of tallgrass prairie by Peromyscus leucopus. J. Mammal., 68:158-160.

COUNCIL ON ENVIRONMENTAL QUALITY. 1989. Environmental quality, annual report. Council on Environmental Quality. 425 pp.

FINCK, E. J., D. W. KAUFMAN, G. A. KAUFMAN, S. K. GURTZ, B. K. CLARK, L. J. McLELLAN, AND B. S. CLARK. 1986. Mammals of the Konza Prairie Research Natural Area, Kansas. Prairie Nat., 18:153-156.

FORESTER, W. S. 1988. Solid waste: there's a lot more coming. EPA J. 14:11-12.

FOTH, H. D., L. V. WITHEE, H. S. JACOBS, AND S. J. THIEN. 1982. Laboratory manual for introductory soil science, 6th edition. Wm. C. Brown Co, Dubuque, Iowa. 143 pp.

GREAT PLAINS FLORA ASSOCIATION. 1986. Flora of the great plains. University Press of Kansas, Lawrence, KS. 1392 pp.

GROSSMAN, D., AND S. SHULMAN. 1990. Down in the dumps. Discover 11:36-41.

HANSEN, L. P., AND J. E. WARNOCK. 1978. Response of two species of Peromyscus to vegetational succession on land strip-mined for coal. Am. Midl. Nat. 100:416-423.

HOBBS, R. J., AND L. F. HUENNEKE. 1992. Disturbance, diversity, and invasion: Implications for conservation. Conservation Biology 6:324-337.

INOUYE, R. S., N. J. HUNTLY, D. TILMAN, J. R. TESTER, M. STILLWELL, AND K.C. ZINNEL. 1987. Old-field succession on a Minnesota sand plain. Ecology, 68:12-26.

KAUFMAN, D. W., AND E. D. FLEHARTY. 1974. Habitat selection by nine species of rodents in north-central Kansas. Southwestern Naturalist 18:443-452.

-----, S. K. PETERSON, R. FRISTIK, AND G. A. KAUFMAN. 1983. Effect of microhabitat features on habitat use by Peromyscus leucopus. Am. Midl. Nat. 110:177-185.

-----, B. K. CLARK, AND G. A. KAUFMAN. 1990. Habitat breadth of nongame rodents in the mixed-grass prairie region of north central Kansas. Prairie Nat., 22:19-26.

LANGELY, A. K., AND D. J. SHURE. 1988. The impact of climatic extremes on cotton rat (Sigmodon hispidus) populations. Am. Midl. Nat. 120:136-143.

LULL, H. W. 1959. Soil compaction on forest and range lands. Forest Service, U. S. Dept. of Agr., Washington D.C. 33 pp.

NEILL, J. T. 1981. Soil survey of Lyon Co, KS. U.S. Dept. Agric. Soil Cons. Ser. 96 pp.

-----. 1974. Soil survey of Chase Co, KS. U.S. Dept. Agric. Soil Cons. Ser. 65 pp.

PERINO, J. V., AND P. G. RISSER. 1972. Some aspects of structure and function in Oklahoma old-field succession. Bull. Torrey Bot. Club 99:233-239.

POPKIN, R. 1989. Source reduction: its meaning and its potential. EPA J 15:27-29.

PRATHER, R. M. 1990. Organic carbon, bulk density, and microbial biomass in reseeded Kansas farmland soils. Unpublished thesis. Emporia State University. 49 pp.

SCHRODER, G. W., AND M. HULSE. 1979. Survey of rodent populations associated with an urban landfill. Am. J. Public Health 69:713-715.

SIETMAN, B. E., W. B. FOTHERGILL, AND E. J. FINCK. 1994. Effects of haying and old-field succession on small mammals in tallgrass prairie. Am. Midl. Nat. 131:1-8.

SNYDER, E. J., AND L.B. BEST. 1988. Dynamics of habitat use by small mammals in prairie communities. Am. Midl. Nat. 119:128-136.

SWIHART, R. K., AND N. A. SLADE. 1990. Long-term dynamics of an early successional small mammal community. Am. Midl. Nat. 123:372-382.

WINGERTER, E. J. 1989. Are landfill incinerators part of the answer? Three viewpoints. EPA J. 15:22-26.

WOLFE, J. L., AND C. T. SUMMERLIN. 1989. The influence of lunar light on nocturnal activity of the oldfield mouse. Anim. Behav. 37:410-414.

ZAR, J. H. 1984. Biostatisitcal analysis, 2nd edition. Prentice-Hall, Inc., Englewood Cliffs, N.J. 718 pp.

APPENDICES

Appendix 1. Plant species and weight (gm) per plot, at Emporia landfill.

SPECIES	SAMPLE PLOT 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL
Velvet-leaf (*Abutilon theophrasti*)	x	x	x	x	10.72	27.26	7.02	x	x	x	x	x	x	x	x	45.00
Western ragweed (*Ambrosia psilostachya*)	2.00	x	x	11.83	x	1.07	8.95	9.25	17.79	11.42	x	x	x	x	x	62.31
Giant ragweed (*Ambrosia trifida*)	7.30	32.92	x	x	14.53	56.18	39.08	70.00	107.59	186.21	8.72	x	x	x	x	522.53
White aster (*Aster ericoides*)	15.68	.56	x	.69	x	9.97	2.78	x	x	2.12	x	1.81	x	x	x	33.61
Narrow leaf aster (*Aster spp.*)	x	x	x	x	x	x	x	x	x	4.45	x	x	x	x	x	4.45
Tall thistle (*Cirsium altissimum*)	x	x	1.44	x	x	x	26.18	x	x	x	x	x	x	x	x	27.62
Horse weed (*Conzya canadensis*)	2.31	13.37	x	3.01	x	9.85	.41	13.61	x	x	x	47.50	x	x	x	90.06
Unknown (*Erigerone spp.*)	x	x	x	x	x	x	8.95	x	x	x	x	x	x	x	x	8.95
Daisy fleabane (*Erigerone strigosus*)	x	x	x	1.35	10.38	x	x	x	x	x	x	x	x	x	x	11.73
Snow-on-the-mountain (*Euphorbia marginata*)	x	x	x	x	x	x	x	x	24.51	x	x	x	x	x	x	24.51
Prostrate spurge (*Euphorbia prostrata*)	x	x	x	7.37	x	x	x	x	3.97	x	x	x	x	x	x	11.34
Gaura (*Gaura parviflora*)	x	x	x	x	x	x	x	x	x	x	125.17	29.23	x	x	x	154.40
Annual sunflower (*Helianthus annuus*)	x	x	x	x	x	x	x	x	x	x	x	x	10.87	x	x	10.87
Marsh elder (*Iva annula*)	x	x	x	x	x	x	3.10	x	x	x	x	x	x	x	x	3.10
Summer cyprus (*Kochia scoparia*)	x	x	x	x	x	x	14.08	x	x	x	74.24	x	x	160.08	x	248.40
Wild lettuce (*Lactuca canadensis*)	x	x	x	.19	x	x	x	x	8.15	x	x	x	x	x	x	8.34
Yellow sweet clover (*Melilotus officinalis*)	x	x	7.16	x	x	x	x	x	x	x	x	x	x	x	x	7.16
Ground cherry (*Physallis heterophylla*)	x	x	x	x	x	x	x	x	.75	x	x	4.26	x	x	x	5.01
Common plantain (*Plantago major*)	x	x	x	x	x	x	x	x	x	x	x	3.08	x	x	x	3.08
Slender leaf knotweed (*Polygonum* spp.)	x	x	x	x	x	x	x	.78	x	x	x	x	x	x	x	.78

Appendix 2. Plant species and weight (gm) per plot, at Reading landfill.

SPECIES	SAMPLE PLOT 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL
Western ragweed (<u>Ambrosia psilostachya</u>)	x	x	2.77	3.22	64.64	12.96	x	50.86	1.81	18.78	99.43	x	25.48	x	x	279.95
Giant ragweed (<u>Ambrosia trifida</u>)	x	51.44	23.05	26.33	36.87	15.43	x	x	x	25.62	4.77	x	x	92.21	41.40	317.12
Unknown Aster (<u>Aster</u> spp.)	x	x	x	x	x	x	x	x	x	11.72	x	x	1.24	x	x	12.96
Crown vetch (<u>Coronilla varia</u>)	55.26	61.97	20.33	10.91	x	x	x	x	x	x	x	25.03	9.14	2.15	34.85	219.64
Common croton (<u>Croton grandulosus</u>)	x	x	x	x	x	.25	x	x	x	x	x	x	x	x	x	.25
Toothed spurge (<u>Euphorbia dentata</u>)	x	x	x	x	x	x	x	x	x	x	.37	1.52	x	x	x	1.89
Gaura (<u>Gaura parviflora</u>)	x	x	x	x	x	x	16.65	x	x	x	x	x	x	x	x	16.65
Broomweed (<u>Gutierrezia dracunculoides</u>)	x	x	x	x	1.98	5.39	x	.26	3.17	x	5.58	x	x	x	14.26	30.64
Summer cypress (<u>Kochia scoparia</u>)	x	x	x	x	x	x	14.44	x	x	x	.85	x	x	x	x	15.29
False bone-set (<u>Kuhnia eupatorioides</u>)	x	x	x	x	x	x	3.19	x	x	x	x	x	x	x	x	3.19
Common plantain (<u>Plantigo major</u>)	x	x	x	x	x	x	9.26	x	x	x	x	x	x	x	x	9.26
Slender leaf knotweed (<u>Polygonum spp.</u>)	x	x	x	x	x	12.44	x	x	x	x	x	x	x	x	x	12.44
Smooth sumac (<u>Rhus glabra</u>)	x	x	x	20.44	x	x	x	x	x	x	x	x	17.88	x	x	38.32
Carolina horse nettle (<u>Solanum carolinense</u>)	1.32	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1.32
Prairie goldenrod (<u>Solidago missouriensis</u>)	x	x	x	x	x	x	45.16	x	x	x	x	x	x	x	x	45.16
American germander (<u>Teucrium canadense</u>)	x	x	x	x	x	x	x	5.16	x	x	x	5.55	x	x	x	10.71
TOTAL FORBS	56.6	113.4	46.2	60.9	103.5	46.5	88.7	56.3	5.0	56.1	111.0	32.1	53.7	94.4	90.5	1014.79
Three awn (<u>Aristida oligantha</u>)	x	x	x	x	x	x	x	3.35	x	x	x	x	x	x	x	3.35
Downy brome (<u>Bromus tectorum</u>)	x	x	x	x	x	x	4.85	x	x	x	x	x	x	x	x	4.85

Appendix 2. continued.

SPECIES	SAMPLE PLOT 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL
Crab grass (<u>Digitaria</u> spp.)	x	x	x	x	1.35	x	x	x	x	x	x	x	x	x	x	1.35
Barnyard grass (<u>Echinochloa</u> <u>crusgalli</u>)	x	x	x	x	x	x	x	x	x	x	2.10	x	x	x	x	2.10
Yellow foxtail (<u>Setaria</u> <u>glauca</u>)	x	x	x	x	x	5.42	x	x	12.79	22.42	29.09	4.86	x	x	x	74.58
Green foxtail (<u>Setaria</u> <u>viridis</u>)	x	x	x	x	x	x	x	1.86	x	x	x	x	x	x	x	1.86
TOTAL GRASSES	0.0	0.0	0.0	0.0	1.4	5.4	4.9	5.2	12.8	22.4	31.2	4.9	0.0	0.0	0.0	88.09
TOTAL	56.6	113.4	46.2	60.9	104.8	51.9	93.6	61.5	17.8	78.5	142.2	37.0	53.8	93.4	90.5	1102.88

Appendix 3. Plant species and weight (in grams) per plot, at Chase county.

SPECIES	SAMPLE PLOT 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL
Yarrow (Achillea millefolium)	x	1.04	x	x	x	x	x	x	x	1.63	1.01	4.82	1.69	.93	x	11.12
Western ragweed (Ambrosia psiloctachya)	x	x	x	2.55	x	x	x	x	x	x	x	x	x	x	x	2.55
Lead plant (Amorpha caneceis)	x	x	x	x	x	x	x	x	12.57	25.19	x	19.00	x	x	x	70.76
Narrow leaf milkweed (Asplepias stenophylla)	x	x	x	2.89	x	14.00	4.55	.86	x	x	x	x	x	x	x	8.30
Narrow leaf aster (Aster spp.)	x	x	x	.58	x	x	x	x	1.36	x	x	x	x	x	x	1.94
White sage (Artemisia ludoviciana)	x	x	10.14	x	x	x	x	x	x	x	x	x	x	x	x	10.14
Flowering dogwood (Cornus floridana)	x	x	x	x	x	x	x	x	.24	x	x	x	x	x	x	.24
Flowering spruge (Euphorbia corolata)	x	x	x	5.84	x	1.63	x	x	.44	x	x	x	x	x	x	7.91
Scurf pea (Psoralea tenuiflora)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	10.44	10.44
Ruellia (Ruellia numilis)	3.09	x	1.11	.94	7.38	x	x	x	x	x	x	x	x	5.28	.36	18.16
Unknown	x	x	x	x	x	x	x	x	x	.53	1.48	.95	x	x	1.08	4.04
TOTAL FORBS	3.1	1.0	11.3	12.8	7.4	15.6	4.6	.9	14.6	27.4	2.5	24.8	1.7	6.2	11.9	145.60
Big bluestem grass (Andropogon gerardi)	13.49	102.03	5.13	35.97	90.19	69.68	53.04	103.18	46.53	47.12	70.77	117.98	77.89	99.16	52.45	984.61
Little bluestem grass (Andropogon scoparius)	21.51	x	61.37	36.73	x	x	22.33	3.75	22.72	11.59	3.88	x	x	x	11.01	194.89
Side oats gramma (Bouteloua curtipendula)	x	x	x	x	3.42	x	x	x	x	x	x	x	x	x	x	3.42
Scribner dichanthelium (Dichanthelium scribnerianum)	x	x	1.51	x	x	x	x	x	1.24	x	x	x	x	x	x	2.75
White sedge (Dichromena nivea)	x	x	x	x	x	x	x	x	x	x	x	x	x	.99	x	.99

Appendix 1. continued.

SPECIES	SAMPLE PLOT 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL
Prairie goldenrod (<u>Solidago</u> <u>missouriensis</u>)	x	x	x	x	x	x	x	x	x	x	x	.76	39.33	x	x	40.09
Western ironweed (<u>Vernonia</u> <u>baldwini</u>)	x	x	x	x	x	x	x	x	x	x	x	x	41.40	x	x	41.40
TOTAL FORBS	27.3	46.9	8.6	24.4	35.6	104.3	110.6	93.6	162.8	204.2	208.1	86.6	91.6	160.1	0.0	1364.74
Downy brome (<u>Bromus</u> <u>tectorum</u>)	64.47	57.48	93.22	77.54	99.03	75.06	34.57	69.82	88.77	24.37	54.74	73.97	x	64.78	x	877.82
Crab grass (<u>Digitaria</u> spp.)	x	.36	x	x	x	x	x	x	x	x	x	x	x	x	x	.36
Green foxtail (<u>Setaria</u> <u>viridis</u>)	2.90	x	x	x	x	x	x	x	x	x	x	x	104.85	x	x	107.75
TOTAL GRASSES	67.4	57.8	93.2	77.5	99.0	75.1	34.6	69.8	88.8	24.4	54.7	74.0	104.9	64.8	0.0	985.93
TOTAL	94.7	104.7	101.8	102.0	134.7	179.4	145.1	163.5	251.5	228.6	262.9	160.6	196.5	224.9	0	2350.67

Appendix 3. continued.

SPECIES	SAMPLE PLOT 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL
Switch grass (*Panicum virgatum*)	x	x	x	x	x	x	x	x	x	x	x	x	16.38	x	x	16.38
Foxtail (*Setaria glauca*)	x	x	x	x	x	1.24	x	x	x	x	1.30	x	x	x	x	2.54
Tall dropseed (*Sporabilus asper*)	3.60	x	x	x	x	2.59	x	x	x	x	x	x	x	x	x	6.19
TOTAL GRASS	38.6	102.1	68.1	72.7	93.6	73.5	75.4	106.9	70.5	58.8	75.9	117.9	94.3	100.1	63.4	1211.71
TOTAL	41.7	103.1	79.3	85.5	101.0	89.1	79.9	107.8	85.1	86.1	78.4	142.7	96.0	106.4	75.3	1357.37

Appendix 4. Small mammal capture data for Emporia landfill.

CASE NO.	DATE	TOE CLIP	TRAP NO.	SPECIES	SEX	WEIGHT (g)	FOOT (mm)	TAIL (mm)	RECAPTURE
001	061990E	0001	03	Sh	F	45	20	73	
002	061990E	0001	07	Pm	M	18	19	52	
003	061990E	0002	14	Pm	F	13	16	45	
004	061990E	0003	19	Pm	M	19	18	53	
005	061990E	0004	21	Pm	M	18	16	47	
006	061990E	0010	29	Pm	M	23	18	50	
007	061990E	0001	31	Sh	M	76	25	73	
008	061990E	0011	34	Pm	M	18	16	50	
009	061990E	TAIL	43	Sh	M	130	29	30	
010	061990E	0002	47	Sh	M	140	30	75	
011	061990E	0003	48	Sh	M	138	30	74	
012	061990E	0004	57	Sh	F	128	29	80	
013	061990E	X	68	Sh	X	58	X	X	ESCAPED
014	061990E	0010	78	Sh	M	68	30	80	
015	062090E	0001	01	Sh	F	45	20	73	X
016	062090E	0012	03	Pm	M	19	15	50	
017	062090E	0001	07	Sh	M	17	17	75	
018	062090E	0013	09	Pm	M	21	15	55	
019	062090E	0002	15	Pm	F	16	16	45	X
120	062090E	0011	20	Sh	M	74	25	80	
021	062090E	0014	21	Pm	M	16	15	50	
022	062090E	0003	23	Pm	M	18	18	53	X
023	062090E	0010	24	Sh	M	134	30	60	
024	062090E	0011	26	Pm	M	18	16	50	X
025	062090E	0020	28	Pm	M	20	18	50	
026	062090E	0021	29	Pm	M	28	20	50	
027	062090E	X	30	Pm	M	18	17	48	
028	062090E	0011	31	Sh	M	220	32	75	
029	062090E	0012	33	Sh	M	96	27	85	
030	062090E	0013	34	Sh	M	132	29	85	
031	062090E	0014	39	Sh	F	92	29	90	
032	062090E	0020	43	Sh	M	140	25	55	
033	062090E	TAIL	44	Sh	M	124	29	30	X
034	062090E	0003	45	Sh	F	54	22	85	
035	062090E	0021	48	Sh	M	164	30	65	
036	062090E	0022	49	Sh	M	128	29	85	
037	062090E	0004	53	Sh	F	52	26	90	
038	062090E	0022	57	Pm	F	20	15	55	
039	062090E	0010	67	Sh	F	54	22	80	
040	062090E	0011	75	Sh	M	68	29	90	
041	062190E	0012	03	Pm	M	19	15	50	X
042	062190E	0023	05	Pm	M	14	18	52	
043	062190E	0024	14	Pm	M	18	19	55	
044	062190E	0025	17	Pm	M	17	17	55	
045	062190E	0003	19	Pm	M	12	18	50	X
046	062190E	0026	22	Pm	F	20	16	50	
047	062190E	0027	27	Pm	F	16	18	50	
048	062190E	0010	28	Pm	M	23	18	50	X
049	062190E	0020	29	Pm	M	20	18	50	X
050	062190E	0001	30	Pm	M	18	20	73	X
051	062190E	0003	32	Sh	F	126	30	74	X
052	062190E	0023	34	Sh	M	150	30	96	
053	062190E	X	41	Sh	X	X	X	X	ESCAPED
054	062190E	0024	46	Sh	M	122	25	70	
055	062190E	0025	48	Sh	F	120	28	80	
056	062190E	0026	49	Sh	X	142	X	X	DEAD
057	062190E	0012	56	Sh	M	56	26	85	
058	062190E	0022	59	Pm	F	20	15	55	X
059	062190E	0027	62	Sh	M	124	29	70	
060	062190E	0013	61	Sh	F	54	30	85	
061	062190E	0014	72	Sh	M	52	29	90	

CASE NO.	DATE	TOE CLIP	TRAP NO.	SPECIES	SEX	WEIGHT (g)	FOOT (mm)	TAIL (mm)	RECAPTURE
062	111890E	0001	01	Sh	F	70	30	90	
063	111890E	0002	03	Sh	M	105	30	100	
064	111890E	0003	04	Sh	M	65	28	85	
065	111890E	0001	05	Pm	M	9	18	70	
066	111890E	0004	06	Sh	F	112	30	100	
067	111890E	0005	07	Sh	F	54	28	88	
068	111890E	0010	08	Sh	M	118	31	111	
069	111890E	0002	11	Pm	F	18	20	60	
070	111890E	0005	13	Pm	M	14	18	60	
071	111890E	0004	15	Pm	F	12	19	60	
072	111890E	0011	17	Sh	F	68	29	95	
073	111890E	0012	20	Sh	M	80	31	90	
074	111890E	0013	24	Sh	M	65	30	90	
075	111890E	0014	26	Sh	F	80	31	100	
076	111890E	0010	28	Pm	M	15	19	59	
077	111890E	0011	31	Pm	M	11	18	55	
078	111890E	0014	33	Sh	M	30	25	70	
079	111890E	0015	35	Sh	M	90	31	110	
080	111890E	0020	37	Sh	M	70	29	95	
081	111890E	0021	38	Sh	F	70	31	90	
082	111890E	0012	39	Pm	M	12	18	58	
083	111890E	0014	45	Pm	F	15	18	61	
084	111890E	0015	47	Pm	M	12	18	52	
085	111890E	0022	76	Sh	F	98	32	91	
086	111890E	0023	77	Sh	M	70	29	83	
087	111890E	MUT	78	Sh	F	62	M	31	
088	111990E	0024	02	Sh	M	100	34	100	
089	111990E	0001	03	Sh	F	69	30	90	X
090	111990E	0025	04	Sh	F	54	29	82	
091	111990E	0030	05	Sh	M	125	32	63	
092	111990E	0020	06	Pm	M	20	20	65	
093	111990E	0031	07	Sh	F	78	30	100	
094	111990E	0021	08	Pm	M	11	20	56	
095	111990E	0001	10	Pm	M	10	18	70	X
096	111990E	0002	11	Pm	F	24	20	60	X
097	111990E	0032	14	Sh	M	53	31	75	
098	111990E	0033	15	Sh	M	86	31	89	
099	111990E	0034	16	Sh	F	112	32	111	
100	111990E	0022	17	Pm	F	23	19	67	
101	111990E	0035	18	Sh	F	72	26	87	
102	111990E	0040	23	Sh	F	54	28	80	
103	111990E	0041	24	Sh	M	46	26	81	
104	111990E	0042	25	Sh	F	128	34	128	
105	111990E	0043	26	Sh	F	96	31	95	
106	111990E	0023	27	Pm	M	18	18	54	
107	111990E	0044	28	Sh	F	34	24	74	
108	111990E	0005	29	Pm	X	16	X	54	
109	111990E	0045	32	Sh	F	32	28	67	
110	111990E	0050	33	Sh	F	66	30	85	
111	111990E	0051	34	Sh	M	110	32	98	
112	111990E	0052	35	Sh	F	52	28	88	
113	111990E	0053	38	Sh	M	108	33	112	
114	111990E	0012	39	Pm	M	15	18	58	X
115	111990E	0054	40	Sh	M	85	31	84	
116	111990E	0055	41	Sh	F	145	31	80	
117	111990E	0100	42	Sh	F	68	30	40	
118	111990E	0001	43	Bh	M	10	18	18	
119	111990E	X	44	Pm	M	12	19	51	ESCAPED
120	111990E	0101	45	Sh	F	60	27	83	
121	111990E	0024	47	Pm	F	11	18	47	
122	111990E	0102	48	Sh	F	72	31	87	
123	111990E	X	49	Sh	X	X	X	X	ESCAPED
124	111990E	0103	52	Sh	F	120	35	88	
125	111990E	0025	53	Pm	F	14	18	48	

CASE NO.	DATE	TOE CLIP	TRAP NO.	SPECIES	SEX	WEIGHT (g)	FOOT (mm)	TAIL (mm)	RECAPTURE
126	111990E	0001	75	Pl	M	32	22	84	
127	111990E	0104	76	Sh	M	66	30	82	
128	111990E	MUT	77	Sh	F	64	X	31	X
129	111990E	0105	79	Sh	F	90	29	91	
130	112090E	0000	01	Sh	F	120	32	111	
131	112090E	0000	02	Sh	F	134	30	110	
132	112090E	0001	03	Sh	F	68	30	90	X
133	112090E	0000	04	Sh	F	86	31	87	
134	112090E	0021	05	Sh	F	108	31	90	X
135	112090E	0010	06	Sh	M	110	31	111	X
136	112090E	0033	07	Sh	M	84	31	89	X
137	112090E	0000	08	Sh	F	84	30	100	
138	112090E	0005	09	Pm	M	22	18	60	X
139	112090E	0000	10	Bh	X	15	18	20	DEAD
140	112090E	0000	11	Sh	M	96	34	103	
141	112090E	0002	12	Pm	F	22	20	60	X
142	112090E	0000	14	Sh	F	72	28	85	
143	112090E	0000	15	Sh	M	70	30	95	
144	112090E	0000	16	Sh	F	70	29	82	
145	112090E	0011	17	Sh	F	71	29	95	X
146	112090E	0020	18	Pm	M	25	20	65	X
147	112090E	0000	19	Sh	M	48	28	70	
148	112090E	0000	21	Pm	F	28	19	63	
149	112090E	0000	23	Sh	F	52	26	75	
150	112090E	0022	24	Sh	F	82	32	91	X
151	112090E	0000	25	Sh	M	44	25	68	
152	112090E	0013	26	Sh	M	68	30	90	X
153	112090E	0000	27	Sh	F	82	31	85	
154	112090E	0042	28	Sh	F	128	34	128	X
155	112090E	0000	29	Pm	F	18	18	55	
156	112090E	0000	30	Bh	X	14	14	22	DEAD
157	112090E	0045	31	Sh	F	40	28	67	X
158	112090E	0015	33	Sh	M	86	31	110	X
159	112090E	0000	35	Sh	F	84	32	95	
160	112090E	0050	36	Sh	F	68	30	85	X
161	112090E	0000	37	Sh	M	68	30	95	
162	112090E	0053	39	Sh	M	102	33	112	X
163	112090E	0000	40	Sh	F	132	32	110	
164	112090E	0000	41	Sh	F	82	30	95	
165	112090E	0100	42	Sh	F	74	30	40	X
166	112090E	0055	43	Sh	F	152	31	80	X
167	112090E	0101	44	Sh	F	64	27	83	X
168	112090E	0103	45	Sh	F	118	35	88	X
169	112090E	0000	46	Sh	F	108	31	100	
170	112090E	0001	47	Bh	X	14	X	X	ESCAPED
171	112090E	0000	48	Pm	M	18	19	55	
172	112090E	0000	49	Sh	M	60	28	87	
173	112090E	0000	50	Sh	M	70	27	97	
174	112090E	0102	51	Sh	F	76	31	87	X
175	112090E	0000	52	Sh	F	66	28	86	
176	112090E	0000	63	Pm	F	12	19	48	
177	112090E	0000	71	Pl	F	32	24	87	
178	112090E	0023	75	Sh	M	75	29	83	X
179	112090E	0000	76	Sh	M	77	31	91	
180	112090E	MUT	77	Sh	F	64	X	31	X
181	112090E	0000	78	Sh	M	147	34	116	
182	112090E	0104	79	Sh	M	64	30	82	X
183	052191E	0030	6	Pm	F	11	16	48	
184	052191E	0105	58	Sh	M	154	29	95	
185	052191E	0031	62	Pm	F	10	16	40	
186	052191E	0032	63	Pm	M	16	17	62	
187	052191E	0033	64	Pm	F	14	19	52	
188	052191E	0034	66	Pm	M	12	19	55	

CASE NO.	DATE	TOE CLIP	TRAP NO.	SPECIES	SEX	WEIGHT (g)	FOOT (mm)	TAIL (mm)	RECAPTURE
189	052291E	0035	4	Pm	F	19	X	53	
190	052291E	0110	36	Sh	F	212	29	97	
191	052291E	0032	38	Pm	M	16	17	62	X
192	052291E	0111	41	Sh	M	157	29	99	
193	052291E	0031	43	Pm	F	12	16	40	X
194	052291E	0000	46	Pm	X	X	X	X	
195	052291E	0033	50	Pm	F	13	19	52	X
196	052291E	0112	60	Sh	F	123	29	101	
197	052291E	0105	66	Sh	M	158	29	95	X
198	052291E	0034	67	Pm	F	11	18	48	X
199	052391E	0113	3	Sh	M	18	30	76	
200	052391E	0034	16	Pm	M	14	X	X	X
201	052391E	0031	42	Pm	F	13	X	X	X
202	052391E	0032	44	Pm	M	18	X	X	X
203	052391E	0040	48	Pm	M	13	16	50	
204	052391E	0041	57	Pm	M	17	16	50	
205	052391E	0114	60	Sh	M	136	30	18	
206	052391E	0034	65	Pm	F	13	X	X	X
207	052391E	0020	72	Sh	F	102	X	X	
208	052391E	0115	76	Sh	F	120	29	92	
209	071191E	2000	12	Sh	M	30	27	81	
210	071191E	2001	15	Sh	F	48	26	80	
211	071191E	2002	24	Sh	M	176	29	88	
212	071191E	2003	25	Pm	M	22	18	55	
213	071191E	0110	27	Sh	F	220	29	97	
214	071191E	0020	37	Sh	F	138	29	95	
215	071191E	2004	38	Sh	F	55	26	86	
216	071191E	2005	40	Sh	M	52	27	82	
217	071191E	2010	41	Sh	F	12	16	45	
218	071191E	0000	42	Sh	F	132	30	100	DEAD
219	071191E	2011	49	Sh	M	103	29	95	
220	071191E	2012	57	Pm	M	21	18	25	
221	071291E	2031	X	Sh	M	58	28	79	
222	071291E	0110	X	Sh	F	X	X	X	
223	071291E	2032	X	Pm	F	18	18	55	
224	071291E	2033	X	Pm	M	20	17	54	
225	071291E	2000	X	Sh	M	55	27	81	X
226	071291E	X	X	Sh	X	47	X	X	ESCAPED
227	071291E	0000	X	Pm	M	X	18	55	DEAD
228	071291E	2034	X	Sh	M	212	X	X	
229	071291E	2002	X	Sh	M	172	29	88	X
230	071291E	0000	X	Sh	F	138	32	114	DEAD
231	071291E	0004	X	Pm	F	18	16	47	
232	071291E	0000	X	Sh	M	134	31	105	DEAD
233	071291E	2035	X	Sh	M	153	X	105	
234	071391E	0020	16	Sh	F	170	25	55	X
235	071391E	2040	28	Sh	F	35	26	73	
236	071391E	2033	37	Pm	M	20	17	54	X
237	071391E	2041	42	Sh	M	132	30	109	
238	071391E	2042	46	Sh	M	53	28	85	
239	071391E	2043	57	Sh	F	82	29	100	
240	071391E	0033	X	Pm	F	21	19	52	
241	071391E	2044	X	Pm	M	18	18	48	

TAIL - Identified by lack of tail.
MUT - Identified by missing toes on a mutated foot.

Appendix 5. continued.

CASE NO.	DATE	TOE CLIP	TRAP NO.	SPECIES	SEX	WEIGHT (g)	FOOT (mm)	TAIL (mm)	RECAPTURE
062	112290R	0014	70	Pl	M	30	22	76	X
063	112290R	0005	72	Pm	M	20	20	56	X
064	112290R	0010	76	Sh	F	78	29	85	X
065	112390R	0001	5	Pm	F	18	18	58	X
066	112390R	0002	9	Pm	F	18	18	50	X
067	112390R	0005	13	Pm	M	16	20	56	X
068	112390R	0004	15	Sh	M	122	34	120	X
069	112390R	0003	16	Sh	F	76	30	98	X
070	112390R	0004	20	Pl	F	26	23	75	X
071	112390R	0000	25	Pl	M	30	22	82	
072	112390R	0000	26	Pl	F	22	22	75	
073	112390R	0000	27	Pl	F	20	23	71	
074	112390R	0000	33	Pl	F	20	23	72	
075	112390R	0010	37	Pl	F	29	23	100	X
076	112390R	0011	48	Sh	F	60	30	86	X
077	112390R	0000	49	Sh	F	92	33	90	
078	112390R	0024	54	Pm	M	18	19	50	X
079	112390R	0030	55	Pm	F	18	20	50	X
080	112390R	0020	57	Pl	F	20	23	90	X
081	112390R	0013	64	Pl	M	26	22	72	X
082	112390R	0021	66	Pm	M	24	18	52	X
083	112390R	0014	68	Pl	M	28	20	76	X
084	112390R	0000	70	Pm	F	16	18	50	
085	112390R	0012	73	Sh	M	70	30	85	X
086	112390R	0013	74	Sh	M	78	30	100	X
087	112390R	0000	76	Pl	M	24	22	70	
088	112390R	0015	77	Pl	F	38	22	85	X
089	051891R	0010	1	Pm	M	18	17	45	
090	051891R	0011	4	Pm	F	20	18	47	
091	051891R	0001	39	Pm	M	17	18	49	
092	051891R	0012	41	Pm	F	17	18	47	
093	051891R	0051	43	Pl	F	32	21	76	
094	051891R	0010	52	Pm	F	14	18	50	
095	051891R	0013	64	Pm	M	13	18	44	
096	051991R	0010	1	Pm	M	18	17	45	X
097	051991R	0014	6	Pm	M	13	16	44	
098	051991R	0015	8	Pm	F	10	17	43	
099	051991R	0015	20	Pl	M	15	22	65	
100	051991R	0020	21	Pm	M	15	20	60	
101	051991R	0011	24	Pm	M	16	18	49	X
102	051991R	0021	28	Pm	M	15	17	44	
103	051991R	0022	32	Pm	F	9	18	43	
104	051991R	0023	34	Pm	F	10	18	48	
105	051991R	0013	38	Pm	M	12	18	44	X
106	051991R	0012	42	Pm	F	16	18	47	X
107	051991R	0010	43	Pm	F	16	18	50	X
108	051991R	0024	51	Pm	F	26	20	71	
109	052091R	0013	3	Pm	M	13	18	44	X
110	052091R	0014	5	Pm	M	13	16	44	X
111	052091R	0015	8	Pm	F	11	17	43	X
112	052091R	0015	20	Pl	M	15	22	65	X
113	052091R	0021	25	Pm	M	15	17	44	X
114	052091R	0010	26	Pm	M	18	17	45	X
115	052091R	0023	29	Pm	F	10	18	48	X
116	052091R	0001	31	Rm	F	9	15	59	
117	052091R	0012	37	Pm	F	17	18	47	
118	052091R	0011	38	Pm	M	16	18	49	X
119	052091R	0020	45	Pm	M	15	20	60	X
120	052091R	0110	48	Pl	M	9	20	58	
121	052091R	0024	49	Pm	F	28	20	71	X
122	052091R	0051	50	Pm	F	32	21	76	

Appendix 5. continued.

CASE NO.	DATE	TOE CLIP	TRAP NO.	SPECIES	SEX	WEIGHT (g)	FOOT (mm)	TAIL (mm)	RECAPTURE
123	052091R	0025	51	Pm	M	8	18	54	
124	052091R	0030	51	Pm	M	8	18	54	
125	071191R	2013	13	Pl	M	30	22	80	
126	071191R	2014	15	Pl	F	30	21	74	
127	071191R	2015	21	Pl	M	25	21	70	
128	071191R	2020	32	Pm	F	29	17	50	
129	071191R	0012	34	Pm	F	33	17	47	
130	071191R	0015	33	Pm	F	21	17	43	
131	071191R	0000	35	TURTLE		300			
132	071191R	2021	X	Sh	M	103	29	99	
133	071191R	0021	X	Pm	M	23	18	52	
134	071191R	0020	X	Pl	M	26	23	90	
135	071191R	0024	X	Pl	F	30	20	71	
136	071191R	2022	X	Pl	M	26	22	74	
137	071191R	2023	X	Pl	F	21	21	68	
138	071191R	2024	X	Nf	F	172	36	134	
139	071191R	X	X	X	X	22	X	X	ESCAPED
140	071291R	0015-2015/25@		Pm	F	21	17	43	X
141	071291R	2014	X	Pl	M	25	21	74	X
142	071291R	2020	X	Pm	F	29	17	50	X
143	071291R	0012	X	Pm	F	29	18	48	
144	071291R	0023	X	Pm	F	21	18	48	
145	071291R	0021	X	Pm	M	27	18	52	X
146	071291R	0024	X	Pl	F	33	20	71	X
147	071291R	2025	X	Pl	F	28	21	69	
148	071291R	0020	X	Pl	M	31	23	90	X
149	071291R	0023	X	Pl	M	23	X	X	
150	071291R	2030	X	Pl	M	28	22	74	
	071291R	Also caught 4 box turtles and a king snake.							
151	071391R	2015/25	05	Pm	F	19	17	43	X
152	071391R	0011	06	Pm	F	20	18	47	
153	071391R	0002	13	Pl	F	30	20	50	
154	071391R	2013	14	Pl	M	31	22	80	X
155	071391R	2014	15	Pl	F	31	21	74	X
156	071391R	2045	22	Pl	F	20	20	69	
157	071391R	2020	24	Pm	F	27	17	50	X
158	071391R	0012	26	Pm	F	22	18	47	X
159	071391R	TURTLE	33						
160	071391R	0010	37	Pm	M	19	17	45	
161	071391R	2050	48	Rm	M	10	16	63	
162	071391R	0021	53	Pm	M	22	18	52	X
163	071391R	2051	54	Pl	F	26	21	69	
164	071391R	2025	58	Pl	F	23	21	69	X
165	071391R	0024	60	Pl	F	27	20	71	X
166	071391R	0020	61	Pl	M	21	23	90	X
167	071391R	TURTLE	75	TRAVIS					
168	071391R	2052	77	Pl	M	22	21	79	

@=Individual originaly caught as 0015, later marked as 2025, so it will be refered to as 2015/25.
TURTLE = Box turtles caught in traps.

Appendix 6. Small mammal capture data for Chase County.

CASE NO.	DATE	TOE CLIP	TRAP NO.	SPECIES	SEX	WEIGHT (g)	FOOT (mm)	TAIL (mm)	RECAPTURE
001	062690C	0001	19	Pm	F	20	19	65	
002	062690C	0002	36	Pm	F	18	20	60	
003	062690C	0003	59	Pm	M	20	18	60	
004	062790C	0001	20	Pm	F	18	19	65	X
005	062790C	0002	35	Pm	F	17	20	60	X
006	062890C	0000	12	Pm	M	22	20	60	
007	062890C	0000	18	Pm	M	18	21	70	
008	062890C	0000	20	Pm	F	16	20	58	
009	062890C	0000	22	Pm	F	18	21	56	
010	062890C	0000	26	Mo	F	48	20	30	
011	062890C	0000	33	Pm	M	18	20	52	
012	062890C	0002	37	Pm	F	16	20	60	X
013	062890C	0000	46	Pm	M	20	21	55	
014	062890C	0000	56	Pm	M	20	19	58	
015	062890C	0000	60	Pm	M	22	20	55	
016	062890C	0000	76	Pm	M	18	20	60	
017	112690C	0001	42	Pm	F	20	20	55	
018	112690C	0001	67	Sh	F	132	32	100	
019	112790C	0000	2	Pm	F	28	20	58	
020	112790C	0000	5	Pm	M	28	20	56	
021	112790C	0000	15	Sh	F	92	30	90	
022	112790C	0001	24	Pm	F	25	20	55	X
023	112790C	0000	36	Sh	F	80	28	74	
024	112790C	0000	70	Sh	M	120	31	92	
025	052191C	0002	13	Mo	F	28	18	30	
026	052191C	0003	18	Mo	M	34	19	40	
027	052191C	0004	35	Mo	M	22	18	26	
028	052291C	0000	10	Sh	M	93	28	91	DEAD
029	052291C	0005	12	Mo	M	34	18	33	
030	052291C	0020	16	Pm	F	9	18	51	
031	052291C	0004	37	Mo	M	18	18	26	X
032	052391C	0010	18	Mo	F	X	X	X	
033	052391C	0004	36	Mo	M	X	X	X	X
034	052391C	0002	62	Mo	F	X	X	X	X
035	052391C	0020	64	Pm	F	X	X	X	X
036	071491C	2053	04	Pm	F	15	19	52	
037	071491C	2054	09	Mo	F	48	19	26	
038	071491C	0003	X	Mo	M	51	19	40	
039	071491C	0010	X	Mo	F	40	X	X	
040	071491C	0323	X	Sh	F	33	25	69	
041	071491C	2055	X	Sh	M	39	28	71	
042	071491C	3000	X	Mo	M	52	X	X	
043	071491C	3001	X	Mo	F	40	19	31	
044	071491C	3002	X	Pm	M	22	20	50	
045	071491C	3003	X	Mo	M	36	19	35	
046	071491C	0305	X	Pm	F	20	18	51	
047	071491C	0320	X	Pm	F	18	18	51	
048	071491C	0000	X	Mo	M	40	19	30	
049	071591C	2053	X	Pm	F	19	19	52	X
050	071591C	0003	X	Mo	M	49	19	40	X
051	071591C	0010	X	Mo	F	38	X	X	X
052	071591C	0302	X	Pm	M	17	X	X	
053	071591C	3034	X	Mo	M	30	18	53	
054	071591C	3004	X	Sh	F	40	26	79	
055	071591C	3002	X	Pm	M	21	20	50	X
056	071591C	3005	X	Mo	M	35	19	28	

Apendix 5. Small mammal capture data for Reading landfill.

CASE NO.	DATE	TOE CLIP	TRAP NO.	SPECIES	SEX	WEIGHT (g)	FOOT (mm)	TAIL (mm)	RECAPTURE
001	062290R	0001	04	Sh	F	124	30	105	
002	062290R	0002	08	Sh	M	188	29	85	
003	062290R	0003	09	Sh	F	54	24	78	
004	062290R	0001	27	Pm	F	27	20	65	
005	062290R	0002	44	Pm	M	15	18	46	
006	062290R	0004	54	Sh	F	136	27	84	
007	062390R	0002	06	Pm	M	14	18	48	X
008	062390R	0010	07	Sh	M	118	30	42	
009	062390R	0011	08	Sh	M	140	34	111	
010	062390R	0003	11	Pl	F	23	22	90	
011	062390R	0003	12	Sh	F	54	29	87	X
012	062390R	0004	28	Pl	M	27	22	85	
013	062390R	0004	35	Sh	F	136	27	84	X
014	062390R	0010	67	Pm	M	14	17	50	
015	062390R	0011	79	Pl	M	22	22	80	
016	062490R	0000	13	Pl	M	26	23	87	
017	062490R	0010	37	Sh	M	130	30	42	X
018	062490R	0000	39	Sh	M	174	32	95	
019	062490R	0001	41	Sh	F	124	30	105	X
020	062490R	0000	50	Sh	M	54	29	85	
021	062490R	0003	57	Pl	F	26	22	90	X
022	062490R	0000	66	Pl	M	32	22	87	
023	062490R	0000	79	Pl	M	20	21	79	
024	112190R	0001	03	Pm	F	28	18	58	
025	112190R	0001	05	Sh	M	78	29	92	
026	112190R	0002	06	Sh	F	82	31	75	
027	112190R	0002	12	Pm	F	26	18	50	
028	112190R	0003	14	Sh	F	94	30	98	
029	112190R	0004	15	Sh	M	135	34	120	
030	112190R	0004	20	Pl	F	26	23	75	
031	112190R	0005	21	Pm	M	20	20	56	
032	112190R	0010	27	Pl	F	30	23	100	
033	112190R	0020	38	Pl	F	36	23	90	
034	112190R	0030	39	Pm	F	18	20	50	
035	112190R	0010	44	Sh	F	66	29	85	
036	112190R	0011	55	Pm	M	25	18	53	
037	112190R	0012	60	Pl	F	29	21	85	
038	112190R	0001	62	Nf	M	205	37	140	
039	112190R	0013	64	Pl	M	30	22	72	
040	112190R	0014	65	Pl	M	32	22	76	
041	112190R	0011	71	Sh	F	75	30	86	
042	112190R	0012	74	Sh	M	78	30	85	
043	112190R	0015	77	Pl	F	40	22	85	
044	112190R	0013	78	Sh	M	85	30	100	
045	112290R	0021	03	Pm	M	18	18	52	
046	112290R	0011	06	Pm	M	22	18	53	X
047	112290R	0022	10	Pl	M	20	22	70	
048	112290R	0014	15	Sh	M	100	31	95	
049	112290R	0015	16	Sh	F	62	31	78	
050	112290R	0010	29	Pl	F	30	23	100	X
051	112290R	X	33	Pl	M	18	22	74	
052	112290R	X	37	Pl	M	20	23	70	
053	112290R	0020	38	Pl	F	30	23	90	X
054	112290R	0011	45	Sh	F	70	30	86	X
055	112290R	0010	47	Sh	F	62	29	85	X
056	112290R	0020	48	Sh	M	72	30	85	
057	112290R	0024	52	Pm	M	14	19	50	
058	112290R	0025	55	Pm	F	24	18	56	
059	112290R	0001	58	Pm	F	25	18	58	X
060	112290R	0010	63	Pl	F	27	23	100	X
061	112290R	0013	66	Pl	M	25	22	72	X

CASE NO.	DATE	TOE CLIP	TRAP NO.	SPECIES	SEX	WEIGHT (g)	FOOT (mm)	TAIL (mm)	RECAPTURE
057	071591C	0320	X	Pm	F	15	18	51	X
058	071591C	3010	X	Rm	M	11	X	66	
059	071691C	2053	X	Mo	F	18	19	52	X
060	071691C	1111	X	Mo	F	42	20	30	
061	071691C	3011	X	Mo	M	36	19	33	
062	071691C	3003	X	Mo	M	40	19	35	X
063	071691C	0312	X	Pm	F	20	19	53	
064	071691C	3012	X	Sh	M	49	27	80	
065	071691C	0323	X	Sh	F	42	25	69	X
066	071691C	3000	X	Mo	M	56	X	X	X
067	071691C	3002	X	Pm	M	24	20	50	X
068	071691C	0302	X	Pm	M	23	X	X	X
069	071691C	3005	X	Mo	M	38	19	28	X
070	071691C	3013	X	Pm	M	22	19	51	
071	071691C	0010	X	Mo	F	43	X	X	
072	071691C	0320	X	Pm	F	18	19	54	X
073	071691C	3014	X	Mo	F	26	18	30	
074	071691C	0003	X	Mo	M	54	19	40	X

I, Wade B. Fothergill, hereby submit this thesis to Emporia State University as partial fulfillment of the requirements for an advanced degree. I agree that the Library of the university may make it available for use in accordance with its regulations governing materials of this type. I further agree that quoting, photocopying, or other reproduction of this document is allowed for private study, scholarship (including teaching) and research purposes of a nonprofit nature. No copying which involves potential financial gain will be allowed without written permission of the author.

Wade B. Fothergill

Signature of Author

January 18, 1994

Date

Secondary Succession In Two Abandoned Landfills In East-Central Kansas

Title of Thesis

Signature of Graduate Office Staff Member

May 6, 1994

Date Received