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Habitat Selection by the Greater Roadrunner (geococcyx Californianus) in Rural North Texas

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An Honors Thesis

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Habitat selection by the Greater Roadrunner (*Geococcyx californianus*) in rural north Texas[1]

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ABSTRACT

Greater roadrunners (*Geococcyx californianus*) are a terrestrial bird species native to much of the southwestern United States. While observational accounts of roadrunner ecology exist, little work has been done toward quantifying their resource use. During the late spring and early summer of 2016, we ran call/response surveys for roadrunners at 46 points divided between three areas in North Texas. The area of each cover type within a 200 m radius of each survey point were quantified using ArcGIS software, and these values were compared to the presence or absence of roadrunners using stepwise logistic regressions. This test produced no significant results. However, when the scale of the study was expanded by assuming that roadrunners move between survey points, and therefore considering roadrunners to be present at any point where they were observed at a neighboring location, roadrunners were found to negatively select for area of road (p = 0.0370). These findings suggest that roadrunners select their home ranges on a scale much larger than a 200 m radius, and that they avoid areas with high quantities of roads.

INTRODUCTION

Greater roadrunners (*Geococcyx californianus*) are an iconic bird species native to much of the southwestern United States. Native American societies respected the roadrunner as a medicine bird with supernatural powers to ward off evil, provide people with stamina and swiftness, and lead lost travelers to a trail (Hughes and Poole 1996). Within their broad range, roadrunners occupy many types of available habitats, including suburbs of outlying cities in the southwestern reaches of its range. Though commonly recognized as Warner Brothers' comedic antagonist of Wile E. Coyote, the habits and ecology of the species have not been explored until recent studies.

As their name suggests, roadrunners are a primarily terrestrial bird species, spending large amounts of time on the ground in preference to flying. These birds are highly mobile predators, hunting generally and opportunistically for small mammals, reptiles, and invertebrates. Roadrunners are a diurnal species (Calder 1965; Maxon 2005; Hughes and Poole 1996) that have been shown to preferentially select for areas of woody shrubs (Kelley et al. 2011; Folse Jr and Arnold 1978) and avoid areas of bare ground (Montalvo et al. 2014a). Roadrunners utilize trees and woody shrubs for roost sites (Montalvo et al. 2014a) and to regulate body temperature (Calder 1965; Vehrencamp 1982). Bright light increases their activity levels, and by contrast, the birds are less active on overcast days (Kavanau and Ramos 1970). Home range size varies throughout the roadrunners' geographic range based on resource availability (Kelley et al. 2011). In a previous study in west Texas, individuals located with the use of radio transmitters were found close to edges of woody cover (Montalvo et al. 2014b). The size of woody patches in an area does not appear to correlate with the presence of roadrunners (Mendelsohn 2005).

An animal's habitat provides it with the resources that the individual needs to survive, and animals make hierarchical spatial decisions regarding how they select habitat (Johnson

1980). Extensive studies performed on various species have addressed habitat requirements and selection, revealing how methods of habitat selection vary greatly between species. In urban habitat fragments in San Diego, California, different species can be associated with various criteria, including intensive development, utilities, roads, water availability, and plant bulk and permanence (Markovchick-Nicholls et al. 2008). Presence and abundance of bird species in Midwestern forests can be related to vegetative and landscape variables. Among birds observed in Midwestern forests, each species was sensitive to different variables, or combinations of variables (Howell et al. 2000). For example, golden-cheeked warblers on Edwards Plateau in central Texas select home ranges based on percent woodland cover, rather than on landscape structure (Magness et al. 2006).

While general characteristics can be described for the species as a whole, roadrunners are associated with variable vegetation patterns in different portions of their range. The typical habitat of roadrunners is described as semiarid and arid open country with scattered shrub cover. However, different types of scrub, woodlands, grasslands, valleys, and riparian areas are utilized throughout their range. In all portions of their range, roadrunners can be found occasionally in farmland, but avoid urban areas. However, they are found in less typical habitats on the edges of their range, necessitating regional studies to fully understand the habitat selection of roadrunners (Hughes and Poole 1996).

Based on current knowledge, the greatest impact that humans have on roadrunners is the result of habitat degradation due to urbanization. Urbanization simultaneously introduces exotic foliage species and reduces the abundance of insects and small vertebrates. This removes both food sources and nesting materials necessary for survival, making habitats unsuitable for roadrunner occupation (Hughes and Poole 1996). While the effects of urbanization are understood, the impacts of agricultural development have not been explored. The impact that human development has on roadrunners is of particular interest for large scale conservation due to the potential for roadrunner presence to be a predictor of species richness. Further, because of the large home ranges of roadrunners, by implementing conservation practices to protect them, an abundance of other species will also be protected (Chase et al. 2000). An important question to be answered about the relationship between humans and roadrunners is which aspects of human systems attract individuals and support their needs. This question is currently the focus of a major thrust in avian research known as occupancy modeling (MacKenzie 2006).

The purpose of this study is to quantify the spatial distribution of roadrunners in north Texas, with the intent of determining specific landscape predictors of roadrunner presence or occupancy in highly fragmented agriculturally dominated habitats in rural Hunt and Delta Counties in the northern Blackland Prairie ecological region of Texas. Several studies have illustrated roadrunner preference for areas of woody shrubs and edge areas (Kelley et al. 2011; Montalvo et al. 2014b). Given the apparent reliance on woody shrubs and tree cover, I predict that 1) roadrunner occurrences will increase with increasing proportions of woody cover, and 2) there will be a threshold beyond which woody cover is too high relative to open area, causing a decrease in edge space, which will cause roadrunner presence to decline.

METHODS

Study Area

This study was conducted within Hunt and Delta Counties of Northeast Texas, in an area that lies within the Blackland Prairie ecological region. Prior to human occupation, the area was an open tallgrass prairie maintained by frequent fire and grazing by herds of bison (*Bison bison*). The topography of the region is nearly level to gently rolling, with average annual rainfall of 35 to 45 inches supporting communities of perennial and annual grasses and weeds. Since the 1870s, the land has largely been converted to farmland and pastures of Bermuda grass and Bahaia grass, and the influence of fire has essentially been removed. These changes have led to the cultivation of dense patches of small trees among the agricultural lands (TPWD, website).

The primary land use of the study area is agriculture, namely farming and ranching. As a result, the native vegetation is fragmented into parcels, divided by crop fields of various sizes and cultivated pastures for grazing cattle, along with residential buildings.

Within the rural areas of Hunt and Delta Counties, I chose three survey routes along county roads with low levels of traffic. These study sites were selected due to their rural setting, along with the presence of a gridwork of county roads from which to survey.

Each study site is referred to as the name of a significant feature within or near the site. The "*Clymer*" site identifies the survey route surrounding The Nature Conservancy's Clymer Meadow Preserve near Celeste, Texas. A second survey route – "*Pecan*" – was chosen between Pecan Gap and Ladonia, south of FM 64, and the third survey route was located north of Highway 224 near Neylandville ("*Neylandville*"). Figure 1 depicts the location of each survey area relative to the cities and major highways in the area.

At each site, survey points were established at 1.6 km intervals, unless the survey point was directly in front of an occupied home or farm. In such cases, the survey point was moved approximately 100 m further down the road. Each survey point was given a permanent coordinate using GPS, allowing a precise ability to relocate the point on subsequent surveys.

Surveys were conducted weekly between March and June, beginning at sunrise and concluding before noon, when calling behavior typically ceased. At each predetermined survey point, the observers parked their car, turned it off, and then stepped out of the vehicle to complete the survey. Prerecorded roadrunner calls, including “coo” sounds, beak clacking and barking, were played from a game speaker for five minutes, while the observer listened for a response. At the end of the five minutes, the observer recorded whether a roadrunner call was heard, along with visual observations of roadrunners, before continuing to the next point and repeating the procedure.

Quantifying Cover Type

I quantified landscape habitat attributes associated with each survey point using ArcGIS software. The GPS location of all survey points for each route were imported as a layer of a Geographic Information System satellite image of the study site. Each point was buffered with a 200 m radius circle. I then mapped the proportional area of each circle that corresponded with the following categories: Road, Woody Cover, Grass Land, Crop Land, Human Structures, and Surface Water. Crop Land was distinguished from Grass Land by the presence of vegetation planted in rows, or by empty, tilled soil.

Statistical Analysis

Utilizing the statistical analysis program Statistix 10.0, stepwise logistic regressions were run for the presence or absence of roadrunners against the area of each cover type present within the 200 m radius of each survey point. This test was repeated for each individual study area, as well as for the cumulative data from all three areas.

Logistic regressions work with datasets where the dependent variable is categorical, and the independent variable is continuous. The purpose of this analysis is to determine the probability that a given value of the independent variable will coincide with a specific category of dependent variable within the population sampled (Zar 2010). For this study, the categorical variable is the presence (1) or absence (0) of roadrunners, and the independent variables are the area of each cover type. The results of the regression indicate if a relationship exists between the area of any given cover type and the presence of roadrunners. Stepwise logistic regressions were used, rather than simple logistic regressions, so that each cover type could be compared independently.

Because roadrunners can occupy large home ranges (Kelley et al. 2011), a lack of detection at any given survey point may not indicate the absence of a roadrunner. In order to address this possibility that roadrunners move between survey points, an additional set of data was compiled, where roadrunners were considered present if they were located at an adjacent survey point. I then re-ran the stepwise logistic regression analysis by study area as well as cumulatively across survey routes.

RESULTS

The Neylandville route included eight survey points, six of which had roadrunners present in at least one of five surveys. The twenty-four survey points in the Pecan route were surveyed between two and seven times, revealing roadrunners at five locations. After five surveys, seven roadrunners were heard at the 13 survey points of the Clymer route.

For each survey route, the average cover type was computed for the compilations of survey points where roadrunners were heard, along with the points where roadrunners were not heard. These averages are recorded in Table 1.

Appendix A details the area (in hectares) of each cover type located at each survey point, along with the frequency of detection of roadrunners during the surveys.

My initial analysis of the data revealed no significant habitat predictors of roadrunner presence. All variable probabilities were well above 0.1, and approached unity in many cases. However, when including the presence of roadrunners in neighboring survey points for all routes combined, I found a significant negative relationship between roadrunner presence and the area of roads (p = 0.0370, Table 2). For this set of data, roadrunners were considered present at every survey point where they were observed, along with the survey points 1.6 km immediately before and after the survey points where roadrunners were observed.

DISCUSSION

I found no significant relationships between occupancy of roadrunners and any landscape variable. This is unexpected based on the findings of prior research (Kelley et al. 2011; Folse Jr and Arnold 1978; Montalvo et al. 2014a, 2014b). This could be explained by two possibilities: Landscape attributes could exist either beyond or below some threshold determining roadrunner presence, or roadrunners could be operating on a scale larger than my sampling scheme.

The later of these possibilities is supported by the results of this study, since I found that statistical significance existed when incorporating adjacent study sites to the regression analysis. This set of data, compiled from all three study areas, showed a very strong relationship between roadrunner presence and the area used for roads. The stepwise model showed a negative coefficient for roads, indicating that roadrunners selectively avoid areas with high proportions of roads. This finding supports the previous knowledge that a lack of roads is positively associated with roadrunner presence (Mendelsohn 2005).

For this analysis, roadrunners were considered to be present at a survey point based on the actual detection of roadrunners at a neighboring point. If roadrunners move between survey points spaced a mile apart, then they are selecting their habitats at a larger scale than the 200 m radius used in this study, and a 200 m radius will not encompass all of the resources that they are utilizing. A much larger scale would be needed to accurately determine habitat selection.

An additional concern is the variable calling behavior of roadrunners, in which birds often do not call at all (Ransom, personal communication), as well as the distance from which roadrunner calls can be heard and accurately identified. On days where wind or traffic affect the observers' ability to detect responses to recorded calls, false absences could be increased. If roadrunner home ranges are larger than the distance from which their calls can be identified, then a call and response survey might not accurately depict roadrunner presence.

If roadrunners selectively avoid roads, data collected from surveys that utilize roads would provide skewed results. This could explain why no other significant relationships were found. Not only was data collected on a scale that is smaller than the roadrunners probably select on, but they could also be uniformly avoiding the study areas because of the presence of roads throughout. Recording false absences in presence/absence surveys is a common problem because individuals often go undetected at locations that they frequent (MacKenzie 2006).

Further studies should be conducted to verify what this study suggests. These studies should expand the scale of the surveys, placing greater distance between survey points, and analyzing the cover types of a larger radius around each point. Further accuracy could be gained by obtaining permission to perform the survey on private land, and so remove the bias of the roads.

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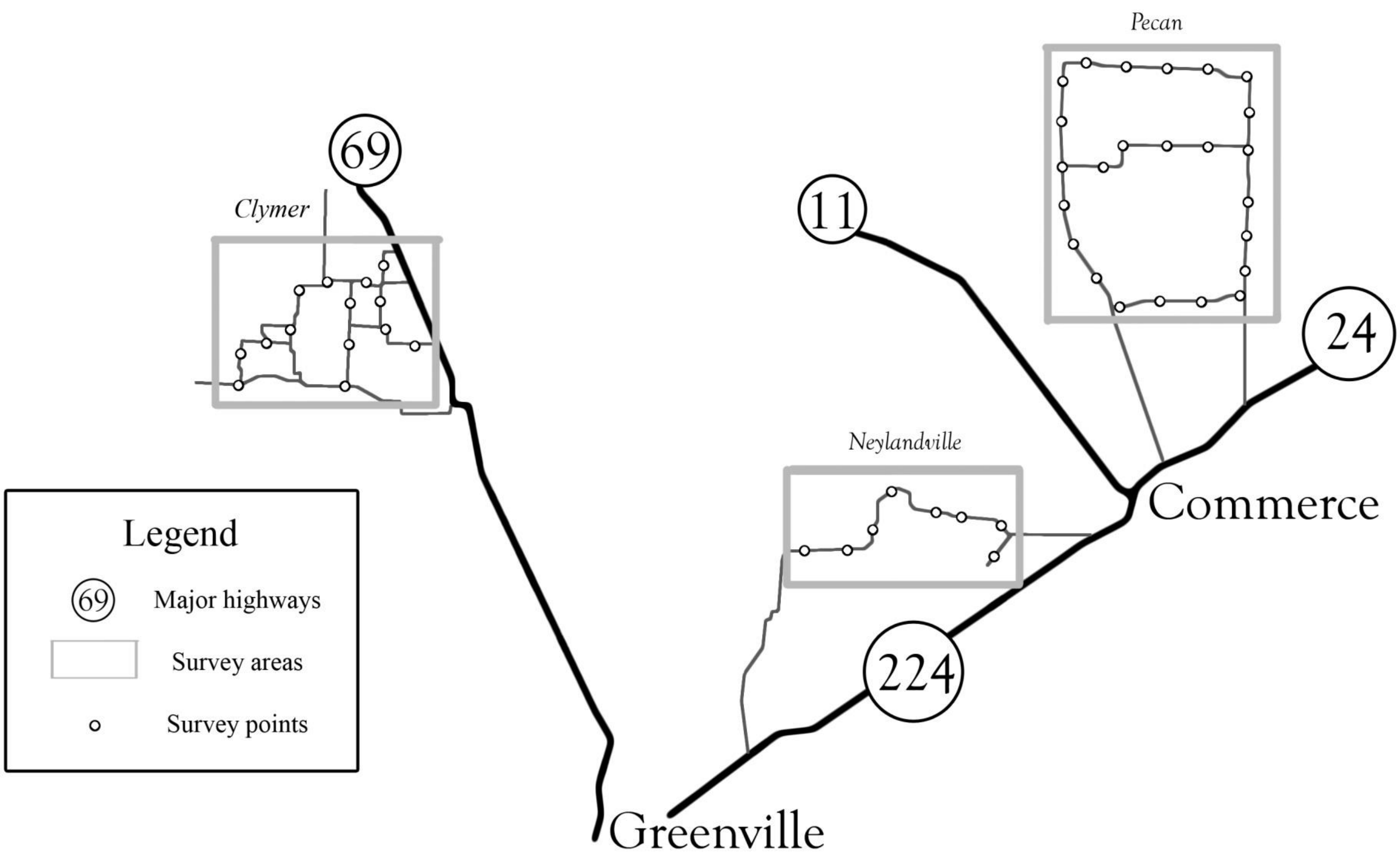

Figure 1:Map of survey routes in context of the surrounding cities and major highways.

Table 1. Mean percent coverage of each cover type per route for sites where roadrunners were and were not heard.

	Road	**Woody Cover**	**Grass**	**Crops**	**Buildings**	**Surface Water**
Neylandville – present	1.640	4.960	7.013	4.208	0.082	0.092
Neylandville – not present	1.945	1.615	8.185	5.615	0.095	0.540
Pecan - present	1.240	2.254	6.492	7.854	0.132	0.082
Pecan – not present	1.347	2.943	7.058	6.210	0.159	0.223
Clymer – present	0.756	2.551	10.62	3.724	0.150	0.261
Clymer – not present	1.017	3.749	9.701	3.003	0.136	0.583

Table 2. Stepwise model resulting from the stepwise logistic regression of presence of roadrunners against area of each cover type.

Variable	**Coefficient**	**Standard Error**	**Coefficient/SE**	**P-value**
Constant	2.630	1.043	2.52	0.0117
Road	-1.476	0.707	-2.09	0.0370

Appendix A. Frequency of roadrunner detection and area (in hectares) of cover types at survey points.

Name	Frequency	Road	Woody Cover	Grass	Crops	Human Structures	Surface Water
Neylandville 1	0	1.62	0.83	9.81	4.56	0.10	1.08
Neylandville 2	0.4	2.34	12.14	3.52	0.00	0.00	0.00
Neylandville 3	0	2.27	2.40	6.56	6.67	0.09	0.00
Neylandville 4	0.4	1.92	11.37	3.14	1.49	0.03	0.05
Neylandville 5	0.2	1.44	1.28	3.82	11.20	0.26	0.00
Neylandville 6	0.4	1.39	0.57	10.70	5.19	0.05	0.17
Neylandville 7	0.4	1.70	0.55	8.22	7.37	0.15	0.00
Neylandville 8	0.6	1.05	3.85	12.68	0.00	0.00	0.33
Pecan 1	0	2.09	2.31	5.55	7.96	0.00	0.21
Pecan 2	0	1.29	3.94	4.71	7.72	0.14	0.25
Pecan 3	0	0.96	2.28	5.70	8.87	0.18	0.07
Pecan 4	0	1.58	4.33	3.68	8.48	0.00	0.00
Pecan 5	0	1.44	0.42	11.56	4.36	0.05	0.24
Pecan 6	0	2.18	7.30	4.92	1.53	0.41	1.69
Pecan 7	0	0.98	1.90	7.76	7.23	0.12	0.09
Pecan 8	0	1.47	5.20	0.00	11.36	0.00	0.00
Pecan 9	0	1.81	0.00	2.69	13.42	0.09	0.00
Pecan 10	0.14	1.51	2.39	4.42	9.68	0.10	0.00
Pecan 11	0.14	0.95	3.49	4.92	8.68	0.00	0.00

Pecan 12	0.14	1.62	1.38	8.94	6.08	0.05	0.00
Pecan 13	0	1.10	7.34	7.92	1.56	0.00	0.12
Pecan 14	0	1.37	2.45	12.40	1.37	0.00	0.52
Pecan 15	0	1.55	3.57	9.85	2.72	0.12	0.08
Pecan 16	0	1.65	3.98	12.36	0.00	0.06	0.00
Pecan 17	0	1.67	0.68	11.28	4.25	0.18	0.00
Pecan 18	0.29	1.33	2.71	5.92	7.19	0.48	0.41
Pecan 19	0	0.97	1.44	8.22	6.94	0.44	0.05
Pecan 20	0.25	0.79	1.30	8.26	7.64	0.03	0.00
Pecan 21	0	0.85	2.82	7.25	6.88	0.00	0.24
Pecan 39	0	1.39	2.11	11.94	2.16	0.23	0.24
Pecan 40	0	1.37	3.23	3.39	8.63	1.00	0.43
Pecan 41	0	1.97	0.61	2.93	12.55	0.00	0.00
Clymer 1	0	1.24	1.92	12.58	1.36	0.18	0.76
Clymer 2	0	0.74	5.65	11.00	0.00	0.00	0.65
Clymer 3	0.2	0.72	1.03	15.69	0.00	0.09	0.59
Clymer 4	0.4	0.73	3.30	9.92	4.02	0.00	0.08
Clymer 5	0.2	0.84	0.89	16.21	0.00	0.00	0.11
Clymer 6	0.4	1.20	2.08	7.67	6.01	0.37	0.72
Clymer 7	0	0.38	5.30	11.12	0.28	0.01	0.95
Clymer 8	0.2	0.50	4.50	8.91	3.91	0.00	0.21
Clymer 9	0	1.64	3.40	13.58	0.00	0.25	0.21
Clymer 10	0	0.71	5.43	9.20	2.45	0.23	0.02

Clymer 11	0.2	0.62	3.89	6.34	7.04	0.17	0.00
Clymer 12	0.4	0.68	2.17	9.57	5.09	0.42	0.12
Clymer 13	0	0.57	4.54	10.43	0.73	0.28	1.49
Clymer 14	0	1.84	0.00	0.00	16.20	0.00	0.00

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