

SPATIAL ACCESSIBILITY TO PUBLIC OUTDOOR RECREATION
DESTINATIONS FROM AUSTIN TEXAS, 2010

THESIS

Presented to the Graduate Council of
Texas State University-San Marcos
in Partial Fulfillment
of the Requirements

for the Degree

Master of SCIENCE

by

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San Marcos, Texas
May 2012

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ACKNOWLEDGEMENTS

I am grateful for all that have contributed to the completion of this document. Special thanks to my advisor, Dr. Fred Day and to my committee members, Dr. Edwin Chow and Dr. Ben Zhan.

Texas Parks and Wildlife Department, City of Austin, Capital Area Council of Governments provided rich datasets which contributed to the preparation of this document, so I acknowledge the great work of the G.I.S. departments in those respective agencies.

This manuscript was submitted on February 27, 2012.

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ABSTRACT

SPATIAL ACCESSIBILITY TO PUBLIC OUTDOOR RECREATION

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by

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May 2012

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Is there considerable difference in the travel distance to “the outdoors” from different neighborhoods in Austin, in terms of their relative levels of income, education and ethnicity? In this research study, we explore the distribution and composition of public lands in Central Texas. We develop an index of spatial accessibility to public outdoor wilderness areas from origins within the Austin urban areas to determine relative levels of accessibility to the outdoors from the urban core. We also seek to discover demographic characteristics of those with a high or low degree of spatial accessibility to the outdoors.

CHAPTER I

INTRODUCTION

Objective

The research question we seek to answer is: Are there considerable differences in the travel distance to “the outdoors” from different neighborhoods in Austin, in terms of their relative levels of income, education and ethnicity? In this research study, we explore the distribution and composition of public lands in Central Texas. We develop an index of spatial accessibility to parks from origins within the Austin urban area to determine which parts of the urban core have a high degree of spatial accessibility to parks and which parts have a low degree of spatial accessibility. The resultant spatial accessibility index can contribute to further research which may seek to reveal defining characteristics of populations with high or low spatial accessibility to large Public Outdoor Wilderness Destination (POWD).

Orientation to the Thesis

This research is about spatial accessibility to recreational opportunities, in the realm of environmental geography with demographic dimensions. It is concerned with the neighborhood locations in Austin and how people interact with societal structures such as the provision of parks as public services, roads infrastructure and settlement

patterns. In this study, we will evaluate the linkages and regional patterns of public outdoor recreation opportunities in terms of spatial accessibility. In the research, we investigate the nexus between human populations and use of public goods, individual/society interactions, or population geographers following the logical positivist tradition.

In this research study, I will explore the distribution and composition of public lands in Texas. To shed further light on the status of public lands in my study area, I will also ask if there are any defining characteristics evident in the populations with high spatial accessibility to public lands. First, in Chapter 1, I will orient the reader to the intellectual space and purpose of the study. Chapter 2 will be a review of the literature which has influenced my research path. Chapter 3 is an in-depth definition of the term public outdoor wilderness destinations (POWDs) as used in this study; and likewise in Chapter 3 I will show the spatial distribution of these various types of public lands. In Chapter 4, I will explicate the spatial accessibility model which I have developed for this study, and present my findings about spatial accessibility to public lands for Central Texans. In Chapter 5, we will consider the demographic characteristics of populations and their ratings on the spatial accessibility index, and expound upon the attributes of the populations with high and low spatial accessibility to POWDs. The final chapter will reflect on the results and conclusions which park planners and future researchers can draw from this work.

CHAPTER II

LITERATURE REVIEW

Access to Wilderness

There are many important factors influencing spatial accessibility to “the outdoors”. The broader issue behind the question is about finding the right balance of spending on public services and discovering what factors influence use and allocation of such services. There is a broad pool of literature addressing the subject of accessibility to public space. Some authors study spatial accessibility to public services as an indicator of social justice or a contributor to public health conditions among various populations. Many authors have observed disparities in spatial access to parks related to ethnic or socio-economic populations. However, space is not the only variable contributing to the accessibility of outdoor park facilities.

In the “polar counterpart” to his own central place theory, Christaller explored the geography of tourism. He observed the powerful draw of tourism sites away from a higher order settlement’s centralized sphere of influence (Christaller 1933). In fact, tourism draws people to the periphery areas of settlements (Hall 2006). Such a tourism flow concept is the basis of other studies on the subject. For example, it has been observed that individuals who place a high value in the on-site experiential tourism will

overcome great distances and friction of spatial proximity in order to reach their destination in pursuit of natural beauty (Hall 2006).

It is helpful to develop an understanding of the term “access”. A classical definition comes from Ribot and Peluso (2003) in their article “A Theory of Access”, where they state the meaning of access as simply “the ability to benefit from things”, but they further elucidate their definition by citing that access is also represented by a process in which people are able to benefit from not only things, but also abstractions like institutions and symbols. Spatial accessibility is a very small piece of the access analysis field, and while our study only looks at the roads network as a means of transport to POWDs, review of this article reminds us that there is a broader atmosphere of accessibility. Policies and other societal structures determine ease of access. Often policies are determined by those that seek to reserve control of the right to, or manner in which populations access resources (Pibot and Peluso 2003)

Public access to wilderness can reveal clues about physical and non-physical barriers existing in societal structures. According to its legal definition, wilderness is a place where one goes to escape the organization and noise of civilized society (Wilderness Act of 1964). Public wilderness should be available to all since it exists on public land. However, academics and scholars have a lively discourse about whether or not the concept of wilderness is accessible to many segments of society.

In a study of traditionally marginalized groups in American society, and their own perceptions of factors constraining them from participating in outdoor recreation,

Johnson et al. (2001) found results relating to African-Americans, women and rural dwellers. They found that women are the most likely to feel constrained by concern for their own personal safety, inadequate facilities or information, lack of funds, or the perception of the presence of outdoor pests (Johnson et al. 2001).

Several studies have revealed structural and psychological challenges to participation in outdoor recreation activities faced by blacks, women and rural dwellers in their literature review; however the results were somewhat contradictory (Johnson et al. 2001). Indeed, race was “immaterial” to determine someone’s likelihood of feeling constrained from participating in their favorite outdoor recreation activity. Notably, universal perceptions shared across all groups showed that most individuals felt constrained from pursuing their favorite outdoor recreation activities due to lack of time and money (Johnson et al. 2001).

In another study about wilderness values in America, Johnson et al. (2004) gauged how people value wilderness vis-a-vis their immigrant status or ethnicity. The findings corresponded with literature cited in the same study noting that outdoor recreation and the wilderness experience is focused on the white, male, well educated and middle to upper classes. Indeed, these authors found that immigrants, as well as U.S. born Asians, Latinos, and Blacks agree to the value of the continued existence of wilderness, but were much less likely to gain any value through on-site use of wilderness areas. The authors cite four previous studies of on-site wilderness visitors all finding that

indeed the majority of visitors fell into the predicted category of white, middle to higher income, and higher educated (Johnson et al. 2004).

Wilderness as a Public Good

Regardless of whether individuals gain value from visiting POWD's, there is clearly in general, a high regard for wilderness. In fact many scholars argue that nature is priceless due to its intrinsic value (McCauley 2006). However, existing policies are ascribing a *de facto* value for ecological systems in the form of private and public expenditures and tax referendums for open space, parks or conservation land (Crompton and Nicholls 2006; Kotchen 2006; Nelson 2007). One way to measure the value attributed to wilderness and parkland expenditures is to gauge populations' general public interest or voter support of such endeavors as public expenditures on open space and parks. In his study of people living in wilderness counties all over the nation, Rudzitis (1991) notes that there is high political support for conservation and parkland expenditures even in the face of economic downturns and crises. In fact, 76% of all proposed tax referendums to increase municipal spending on open space have passed in the period between 2000 and 2004 (Nelson 2007). Moreover, a number of studies have noted that voters show clear political support for conservation of landscape amenities even without the expectation of receiving any considerable economic benefit. (Waltert and Schlapfer 2010).

Considering the high public interest in conservation and open space lands through referendums and bond approvals, experts and academics should review the way the practice is implemented. Previous researchers have found that there are measurable factors that determine political support for open space and land conservation in general. These data can predict “hotspots”, “coldspots”, and areas where increased scrutiny should be paid to protect the public good delivered through fair spending on ecological or open space conservation (Kotchen 2006; Waltert and Schlapfer 2010). Nelson (2007) found that higher affluence and higher education and areas experiencing rapid growth were the major characteristics of places passing open space referendums. Interestingly, there is a difference between the threshold dollar amount approved in state and county referendums and the threshold amount usually approved in municipal level referendums. In a nation-wide study, Kotchen (2006) found that voters show more support for higher funding rates at the state and county level, compared to the municipal level. It is germane to integrate open space and conservation land considerations as components to the regional planning process (Nicholls and Crompton 2005; Crompton and Culpepper 2006; Crompton and Nicholls 2006; Albers 2008).

The Central Texas Study Area

It is very important to build on the valuable contributions that Sutton and Day (2004) and Day and Vaughn (2011) proffer about spatial variation of contemporary demographic and economic growth in Central Texas. In their exploration of the most

rapidly growing counties of the U.S. in the period between 1970 and 1990, Sutton and Day (2004) found that the counties immediately to the south and west of Travis County have attracted suburban and retirement growth since 1970. Austin itself is considered to be one of America's fastest growing areas in the time since 1960 (Day and Vaughn 2011). The entire corridor of regional development between Austin and San Antonio has an interesting bi-polar disposition when comparing characteristics between a dividing line marking closely along the Interstate Highway 35 (I-35).

Of the variables that demonstrate division between the two sides of the interstate are land prices, median income and racial diversity. Non-Hispanic whites are found to be living on the west side of I-35, on land that is more expensive and in larger houses than folks living on the east side of I-35 (Day and Vaughn 2011). Also of note in the same study is the finding that the east side of I-35 has similar accessibility by car to the western side of the Texas Hill Country terrain (Day and Vaughn 2011).

I will consider these trends and preferences in the context of public outdoor places within my study area of Central Texas. I will thus examine the access to public open space in Central Texas and explore ethnicity, education, and income in relationship to proximity as factors for those enjoying varying degrees of spatial accessibility to outdoor experiences on public land. Such discussions are germane in the field of recreation planning, as was noted by a Wilderness Society panel of wilderness advocates, researchers and other constituencies who asked: "Is wilderness in its statutory or

historically advocated form relevant for the expanding demographic diversity of the United States?” (Johnson et al. 2004).

Furthermore, while other studies have shown that minority groups have less interaction with wilderness, we should not generalize about access to wilderness based on national-scale studies without carefully controlling for geographic distribution disproportionalities between the urbanized Eastern U.S. and the open-space of the Western U.S. Such issues seem to validate the importance of conducting regional studies on the subject.

With a cautious awareness of the shortcomings of travel behavior generalizations, most conclusions cite two budgetary factors when deciding how far to travel and by what means to travel: time and money. One survey on travel behavior noted that people in households defined as low-income made half the annual long distance trips (at least 100 miles from home) than the rest of the population. Also, low-income populations do not travel as far on trips as do higher income individuals (Hall 2006).

GIS and Spatial Accessibility

Not all studies on tourism and public outdoor wilderness recreation utilize Geographic Information Systems (GIS) spatial accessibility analysis frameworks. A number of authors have designed methodologies to examine spatial accessibility in other

contexts and it is helpful to study their concepts and how to apply them to our subject of outdoor wilderness in Central Texas.

Some of the techniques and variables used in other spatial accessibility models included inventorying the number of parks per population measure within a certain catchment using Euclidian nearest neighbor calculations (Brown 2008), kernel density (Maroko 2009), population weighted distance using euclidian distance (Zhang 2011), network analysis “Service Area” technique measuring outwards from park access points in urban areas (Nicholls 2001). Other studies used Gaussian 2 step floating catchment analysis (Dai 2011), and the O-D Cost Matrix using network analysis (Liu 2004). Hewko (2001) observed that network distance for measuring spatial accessibility the most suitable for complex measurements, and in contexts where there is a high likelihood that travel will take place along the roadway to reach each destination.

CHAPTER III

P.O.W.D. PROPERTIES IN TEXAS

Public Outdoor Wilderness Areas (POWDs)

The City of Austin has ten categories of parks, which are listed as: District, Golf Course, Greenbelt, Metro, Nature Preserve, Neighborhood, Planting Strips, Pocket, School, and Special. It is clear that a variety of experiences can be available at each of these types of parks, and the outdoor wilderness experience can be possible on a small piece of public land. However, for the purpose of this study, we will consider only the parks which were most likely created with the intention of providing an outdoor wilderness experience. They are listed as: District Parks, Greenbelts, and Nature Preserves.

The other set of destination parks on which we focus this study are the public lands held by Texas Parks and Wildlife Department (TPWD) within a 150-mile Euclidian radius of Central Austin. The mission of Texas Parks and Wildlife is “To manage and conserve the natural and cultural resources of Texas and to provide hunting, fishing and outdoor recreation opportunities for the use and enjoyment of present and future generations” (www.tpwd.state.tx.us). We assume that all properties owned by Texas Parks and Wildlife are owned with the intention of providing an outdoor wilderness experience in fulfillment of the mission of the Texas Parks and Wildlife organization.

Though there may be some anomalous Texas Parks and Wildlife properties that do not contain camping sites or hiking trails, preliminary data quality checks have revealed that such anomalous properties will probably not skew the results of the present spatial accessibility model.

For this analysis, we will consider all public parks held by Texas Parks and Wildlife or City of Austin (district parks, greenbelts and nature preserves) as natural area destination parks. One assumption of this study is that a visitor's main motivation to go to these places is for outdoor recreation, or getting closer to "wilderness" through nature viewing, camping, hiking, etc. Therefore, we will define these publicly accessible and destination park areas as Public Outdoor Wilderness Destinations (POWDs).

Spatial Distribution of POWDs

The City of Austin's POWD resources (Figure 1) broadly range in size and shape throughout the Austin area. The linear-shaped areas have been aptly named "greenbelts". The POWDs with more evident acreage in a polygonal shape are the natural areas. It should be noted that greenbelt hiking areas can extend fully within the boundary designated natural areas. There appears to be at least one POWD available in close proximity to a broad distribution of the population in Austin. However, clearly larger acreages and more POWD clustering of areas exist in the southern and western portions of the Austin area.

Our analysis consists of 68 natural areas and greenbelts owned by City of Austin. The minimum size of these designated areas is 1.2 acres and the maximum size is 1,107 acres. The total acreage which is designated as a greenbelt or natural area within Austin is 7,058, with the average size per property being about 103 acres.

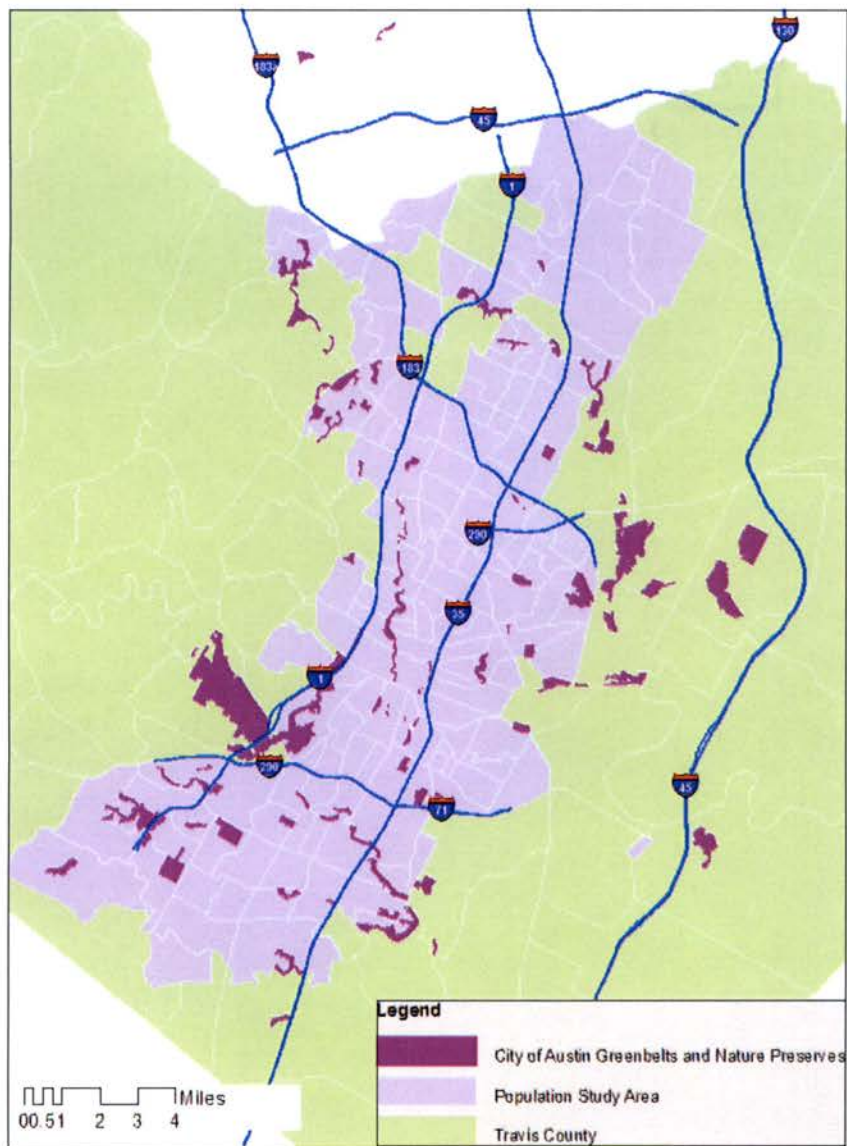


Figure 1: The Study Area: City of Austin POWDs.

Texas Parks and Wildlife and Federal POWDs are both listed in Figure 2.

However, for this study, we are only concerned with Texas Parks and Wildlife POWDs within roughly a two-hour drive time of Austin, and we assume that these destinations are therefore within a reasonable day trip or weekend camping trip distance. Therefore, our analysis includes only POWDs within 150 miles of the center of Austin. The federal properties which specialize in camping and wilderness experiences are not within the dotted circle indicated in Figure 2. Of those POWD resources within the 150-mile radius of Austin, we see that the distribution is also quite even, with a number of smaller parks located in generally the same latitude as the settled area between Austin and San Antonio. Upon a visual review, we can see that larger number of POWDs do exist on the western side of I-35. The much larger POWD areas outside of the focal area (dotted line in Figure 2) are over 150,000 acres in size and include Big Bend National Park, Sam Houston National Forest, Padre Island National Seashore and Big Bend Ranch State Park. This size of POWD property is outside the focal area of this study.

The portion of our analysis concerning non-City of Austin properties are consists of 64 Texas Parks and Wildlife park properties within 150 miles from the center of Austin. The minimum size of these designated areas is 0.4 acres and the maximum size is 5,835 acres. The total acreage of POWD properties within our focal area in Central Texas 63,630 acres, with the average size per property being about 995 acres.

Regardless of the clustering pattern of the POWDs, based on the spatial representation in relation to each other, it does appear that populations in most parts of

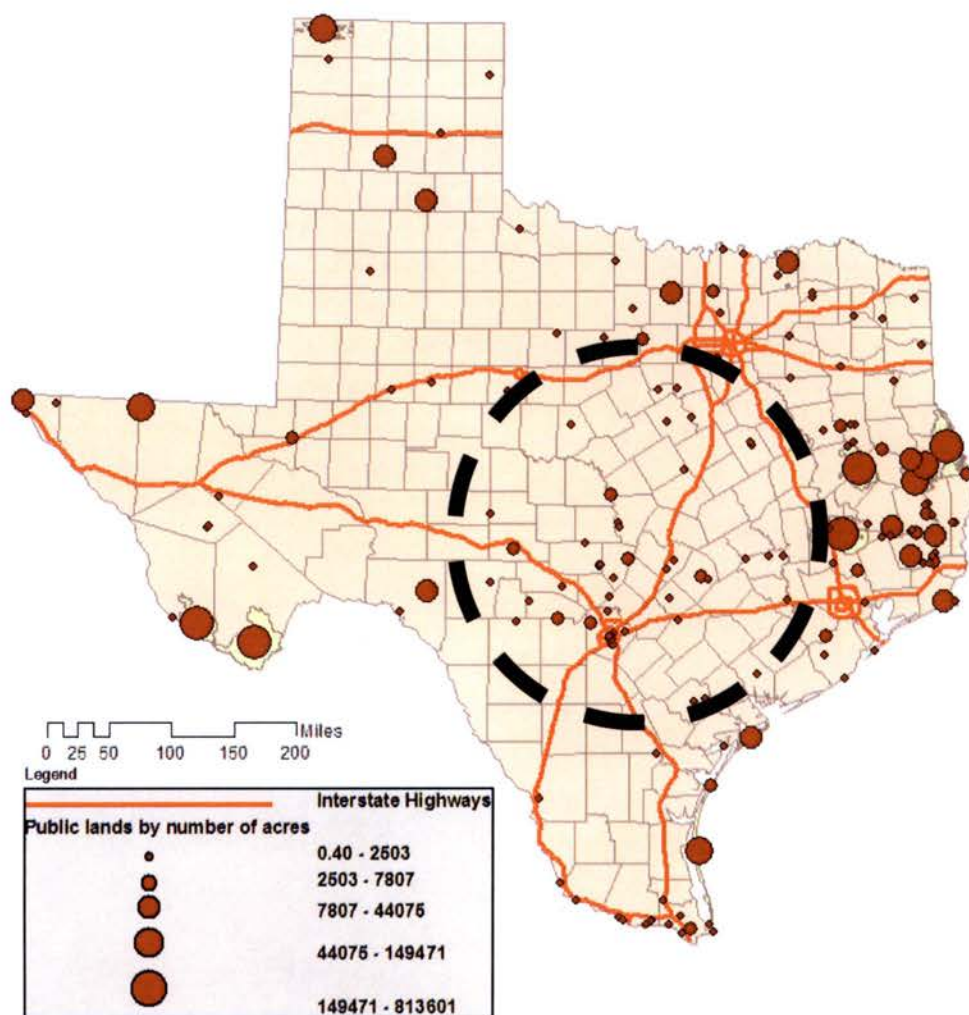


Figure 2: The Study Area: Texas with State and National POWDs.

the study area have an opportunity to enjoy public outdoor recreation. However with our analysis of spatial accessibility to these public assets, we examine which populations have the most choice and accessibility to the largest diversity of POWDs. Thus the spatial accessibility analysis on the roads network in the context of as we address in forthcoming sections will offer additional geographic insight about POWDs.

CHAPTER IV

SPATIAL ACCESSIBILITY MODEL

Components of the Spatial Accessibility Model

The present study is focused on the availability of destinations with a “wilderness” experience. In this study, we shall look at the accessibility to such properties with public outdoor recreational use opportunities like camping and hiking within a 150 mile radius of Central Austin. Though past research has looked at the accessibility of urban parklands, most of the urban parks in our subject study area do not provide the wilderness outdoor experience with which this study is concerned.

This study investigates Austin by census tract. In order to narrow the study area to the urban Austin population, we have removed from our analysis the least densely populated 2010 census tracts within Travis County (Census tracts with less than 0.762 people per km.²). We used no particular academic premise was used to inform the choice of population concentration threshold value, but our intent was to make a reasonable cut-off to show density. Therefore, our study area includes the top 75% most densely populated census tracts in Austin which, interestingly, were visibly clustered in a corridor following the north/south oriented Interstate 35, US 183 and Mopac roadways, and never exceeding a width of about 10 miles, while the length of the population study area along

the north-south axis extends almost 25 miles (Figure 1). The density requirement narrowed our study area to 150 census tracts within the City of Austin.

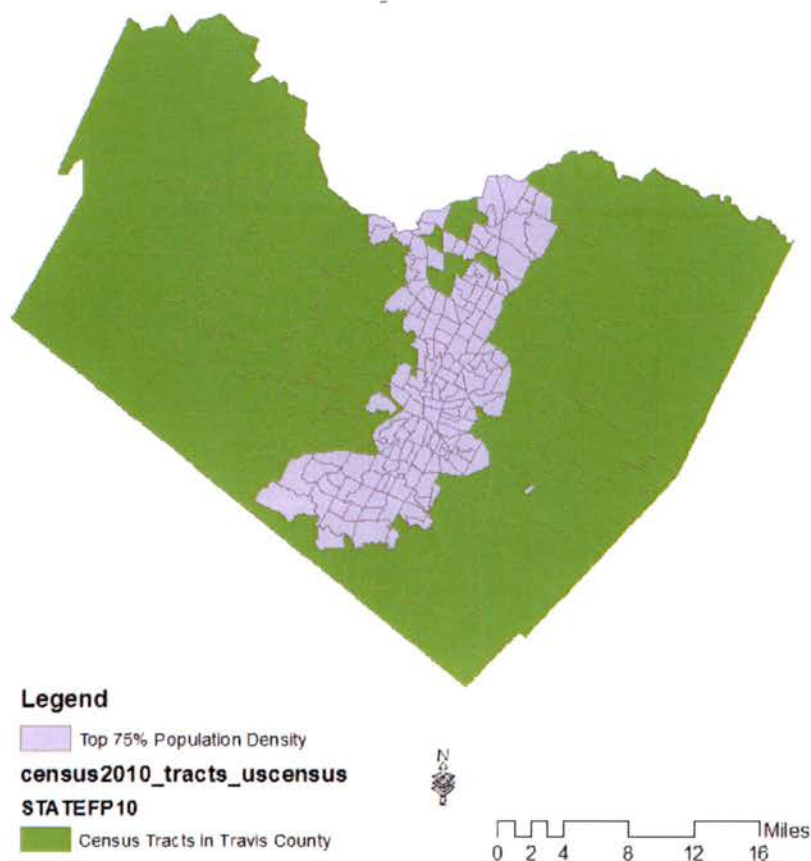


Figure 3: The Study Area: Densely Populated Census Tracts.

In order to measure the spatial accessibility from the densely populated areas in Austin, the final consideration in our model is the road network on which we measure distance to the POWD destinations. All roads are represented in the road network, including, interstate highways, county roads, and city roads in residential, urban and rural settings in Central Texas.

Conceptual Model

The basic assumption underlying this analysis is that given an average distance to all POWD from each origin point within the study area, we can derive a normalized scale of accessibility to compare neighborhood areas within the built-up core of the City of Austin. In our model we define our origins as the centroids of the 150 census tracts. The destinations are grouped in two categories: The POWDs belonging to the Texas Parks and Wildlife within a 150 mile radius of Central Austin, and the POWDs belonging to the City of Austin. We create a network using the network analysis function available in ESRI's Arc10 software package using the network input: "TX_Roads" roads polyline, available for download from Texas Natural Resources Information System.

Subsequently, we use the Origin-Destination (O-D) Cost Matrix function in ESRI's Arc10 in order to measure the distances along the road network from each origin to all of the destinations in both the Texas Parks and Wildlife and City of Austin datasets. This operation creates a one-to-many relationship, between each 150 census tract origins and all of the POWD destinations. The resulting matrix lists all of the routes from each of the 150 census tracts to all of the 68 Texas Parks and Wildlife parks and also all of the 68 City of Austin parks which fit our criteria.

The O-D Cost Matrix analysis provides a travel distance from each of our origins to each of our destinations, so our next task is to find the average of all of the routes. With statistical functions from the Arc10 software package, we complete the mean travel distance calculations. By deriving the average distance from each point of origin to all POWDs, we successfully create an ordinal scale of spatial accessibility. Using this scale

of average travel distance, we can clearly compare spatial accessibility from different neighborhoods in the population core of the City of Austin to POWDs in Central Texas.

Demographic attributes of census tracts exist within both the U.S. Census Bureau TIGER/Line Shapefiles and the American Community Survey datasets (<http://www.census.gov>). We will map the independent variables to examine if there are any significant differences in spatial distribution or clusters based on ethnicity, level of income and level of education among the population within the study area. With these data we can compare socio-economic and demographic attributes with the indexed spatial accessibility score and can observe spatial accessibility as a function of the various characteristics of the census tracts of the urban core of Austin.

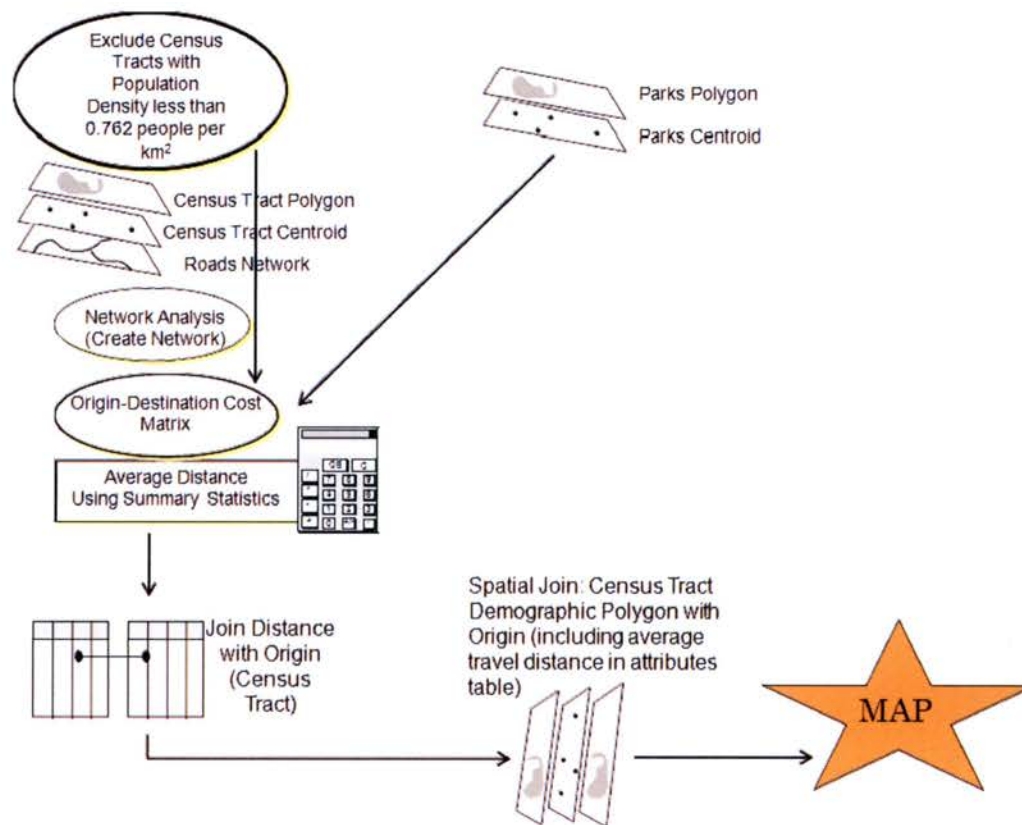


Figure 4: The Conceptual Model Guiding the Methodology.

Drawbacks of the Methodology

It should be noted that the two spatial accessibility indexes relate to two different scales of distance. City of Austin POWDs are much closer to the general population of Austin than the Texas Parks and Wildlife POWDs. One limitation of this research for Texas Parks and Wildlife destinations is that the POWDs were cropped at 150 miles Euclidian distance from the center of Austin so the O-D Cost Matrix did not reach to any distances outside of 150 miles. However, census tracts from the northern-most or southern-most areas could be up to 12 or 13 miles closer to POWDs on the same side of

town as the origin. The cropping did not consider the variation of origins spanning the 25-mile long study area (Figure 3). The spatial accessibility index model should be run again with a floating 150 mile limit extending from each origin rather than the fixed point at the center of Austin. Our flawed practice of using the 150 mile limit from central Austin reduces the certainty that the radial pattern of decreasing accessibility from the center of Austin is a true condition.

CHAPTER V

RESULTS

Spatial Accessibility for the Austin Neighborhoods

The map of spatial accessibility to POWDs owned by City of Austin (Figure 5), and spatial accessibility to POWDs owned by Texas Parks and Wildlife (Figure 6) shows a radial pattern of decreasing accessibility from the center of Austin. These maps attribute a five-level scale of accessibility relative to other parts of the study area within Austin. Though we are aware that an ordinal variable would also be informative on this map, for the sake of our analysis, we are interested in observing the geographic pattern, in the context of our inquiry into demographic variables and their relationship to spatial accessibility.

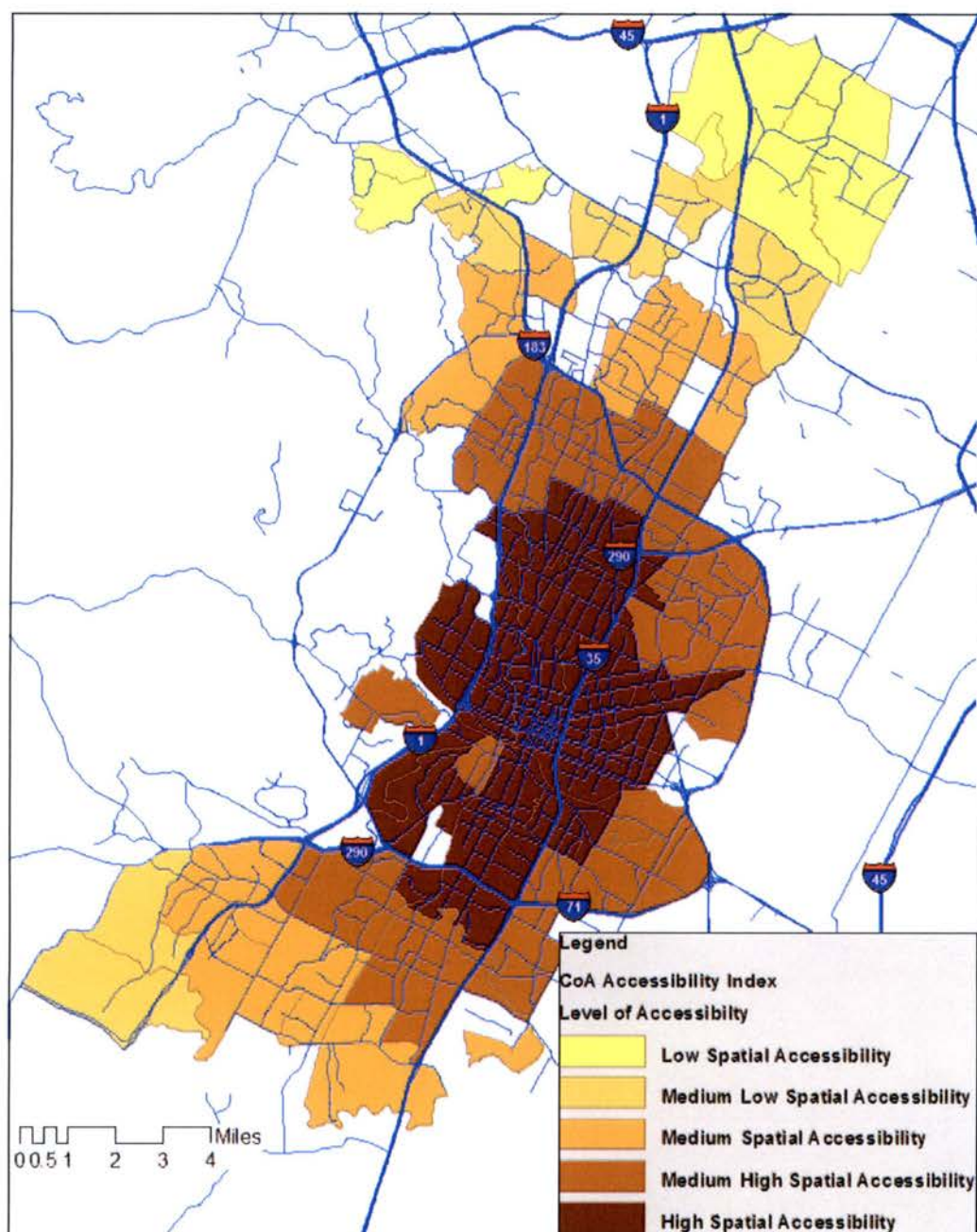


Figure 5: Spatial Accessibility to City of Austin POWDs.

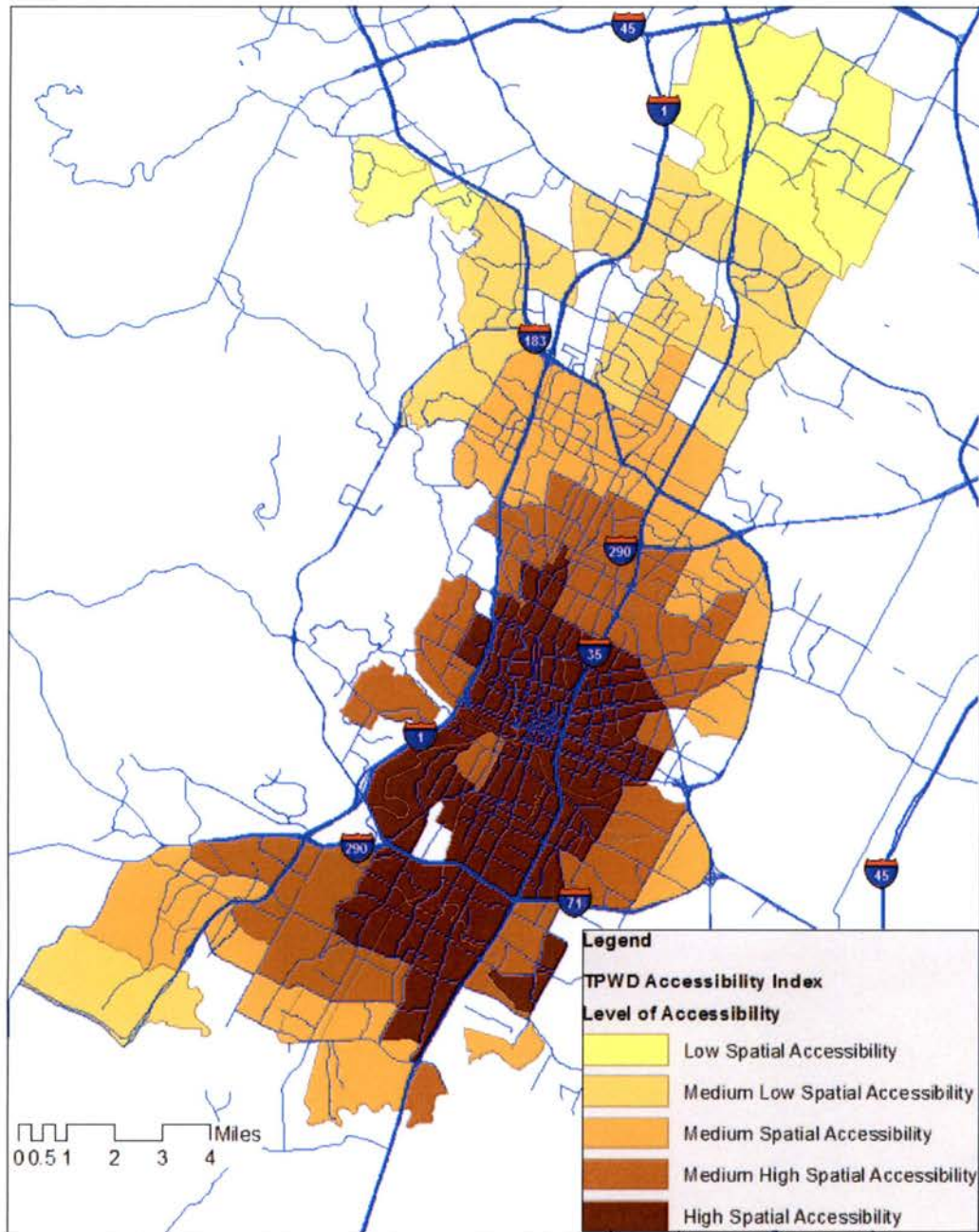


Figure 6: Spatial Accessibility to Texas Parks and Wildlife POWDs.

The range of spatial accessibility for the Texas Parks and Wildlife properties within 150-miles of Austin was 7.7 miles, with a minimum average distance from each census tract to all POWDs of 43.1 miles, a maximum average POWDs of 50.9 miles and a mean of 44.8 miles (Table 1). Fewer mean miles to POWDs within our range suggests that there are comparatively more census tracts with very high accessibility to Texas Parks and Wildlife POWDs. The spatial accessibility index for the City of Austin dataset was more meaningful than Texas Parks and Wildlife. The range of distribution was 9.02 miles, between the minimum average distance to POWDs per census tract of 6.2 miles and maximum of 15.2 miles. The mean of the distances to City of Austin POWDs on our accessibility index was 8.3 miles (Table 2). Again, we have a low mean distance within our range, suggesting that there are comparatively more census tracts with high accessibility.

Table 1. Descriptive Statistics for Texas Parks and Wildlife Spatial Accessibility				
<u>Range</u>	<u>Minimum</u>	<u>Maximum</u>	<u>Mean</u>	<u>Std. Deviation</u>
7.74 miles	43.1 miles	50.9 miles	44.8 miles	1.89 miles

Table 2. Descriptive Statistics for City of Austin Spatial Accessibility				
<u>Range</u>	<u>Minimum</u>	<u>Maximum</u>	<u>Mean</u>	<u>Std. Deviation</u>
9.02 miles	6.18 miles	15.2 miles	8.30 miles	2.12 miles

From these descriptive statistics, it appears that the City of Austin dataset is more revealing in drawing conclusions about spatial accessibility to POWDs. We can safely say that the difference between travelling an average of either 43.1 miles or 50.9 miles to

arrive at a destination is not meaningful enough to really differentiate. However travel to a City of Austin POWD does seem to be a different type of trip for Austin residents. The distances are less, suggesting that visiting the destination could be a short afternoon hiking trip. On this index, the difference between 6.2 miles for the highly accessible census tracts and 15.2 miles for the least accessible census tracts is notable. Given this range, travel distance might be a major factor whether one visits a City of Austin POWD or not.

It is exciting to observe the obvious radial pattern of decreasing accessibility as we move away from the center of Austin. This pattern could possibly be explained by the greater number of roads in the more urbanized areas of Austin. Further study might also reveal that accessibility may be linked to road layouts and transportation infrastructure patterns in urban versus suburban parts of the city. Whatever the case, the distance measure should better help us understand differential make-up of the populations with high or low spatial accessibility to POWDs.

Spatial accessibility is closely linked to the number of roads in an area. The northern portions of the study area, on the suburban periphery of the city appear to have less spatial accessibility to both City of Austin and Texas Parks and Wildlife POWDs. Remarkably, some of the least accessible places border the main thoroughfare of I-35, a characteristic that would seemingly increase the accessibility of a place. Perhaps more smaller-sized roads make a better path to accessibility than one large road.

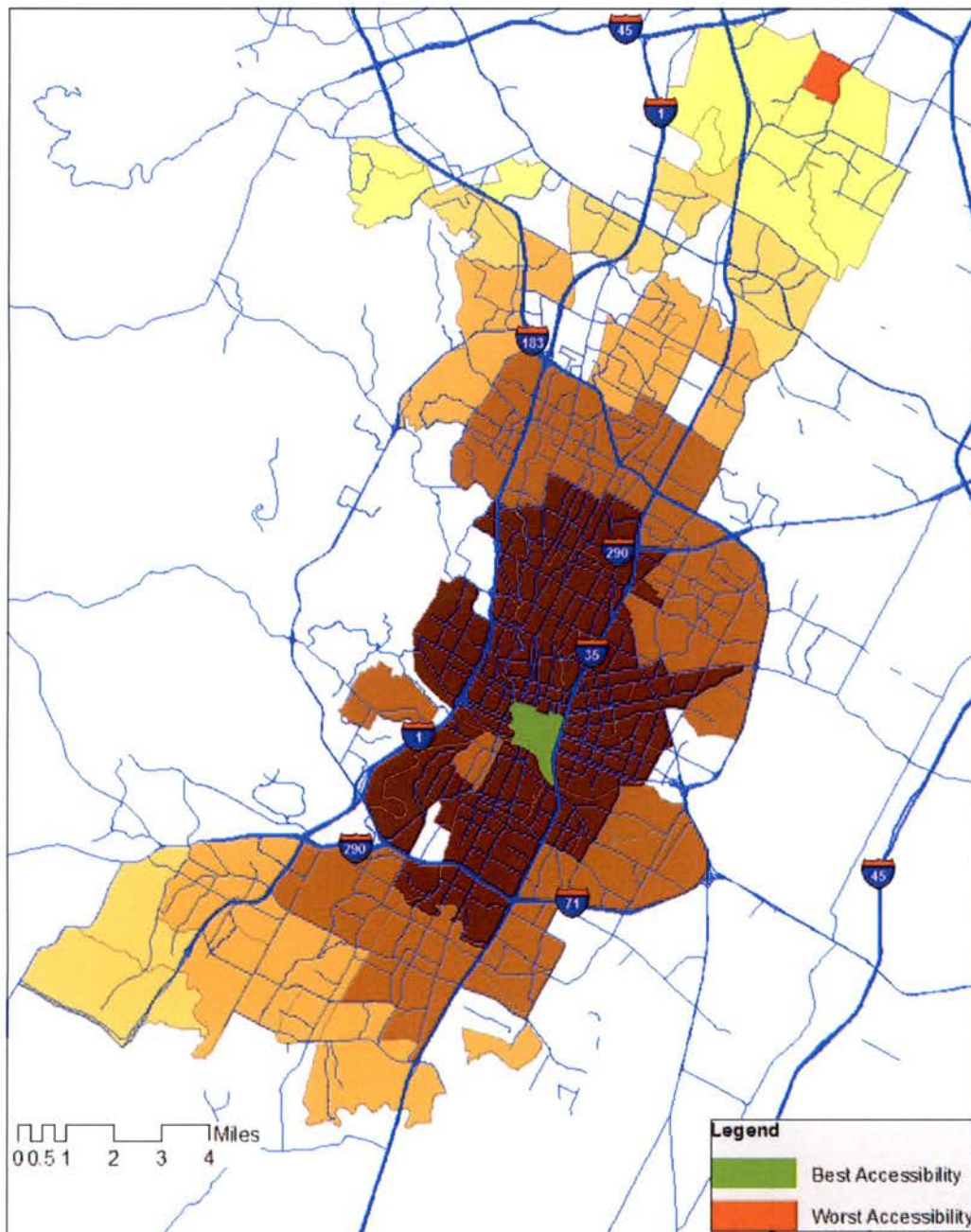


Figure 7: Best and worst accessibility to City of Austin POWDs.

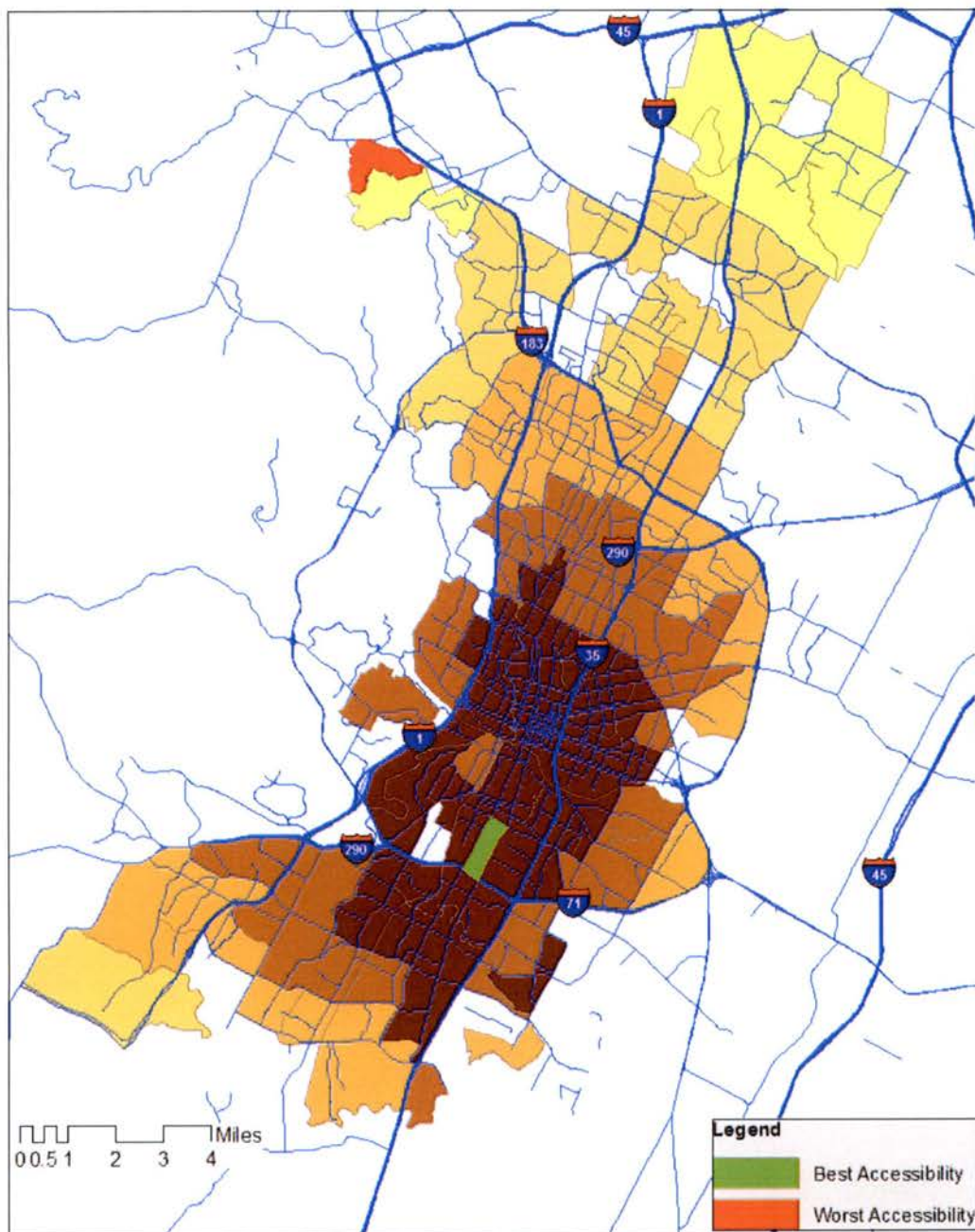


Figure 8: Best and worst accessibility to Texas Parks and Wildlife POWDs.

Relationship Between Demographic Character of Austin Census Tracts and their
Accessibility to POWDs

Statistical Methodology

Using the spatial accessibility index as our dependent variable with ethnic background, level of education and level of income as independent variables, we can examine the spatial patterns of accessibility to POWDs. We can also note which communities/census tracts have high or low accessibility to POWDs in terms of the physical infrastructure in the City of Austin.

In our statistical analysis, we selected only the census tracts with the 20% highest and 20% lowest rating of accessibility allowing an analysis of cases of either high or low accessibility. We subsequently conducted discriminant analysis and stepwise regression on these extreme cases of high and low accessibility. The statistical analyses helped to determine the relative association of each independent variable with accessibility (Level of Education, Racial Background, and Level of Income) with the dependent variable in our model, which was high or low level of accessibility. While it is not ideal to exclude samples, our analysis did only include extreme cases of high or low accessibility, which helped to highlight the demographic variables.

Results

The question this research seeks to answer is: can we ascertain the level of accessibility of a certain census tract by observing demographic variables such as level of education, racial or ethnic background and level of income of that census tract? To do this, we look at two sets of POWD resources in Central Texas: those POWDs owned and managed by City of Austin and those POWDs owned and managed by Texas Parks and Wildlife.

City of Austin Public Outdoor Wilderness Destinations

Our analysis of the extreme highest and lowest accessible places in Austin showed that the level of income and the percent of non-hispanic black population allowed us to predict whether a census tract had high or low spatial accessibility to POWDs (Table 4). According to our analysis, it appears that the higher the percent non-hispanic black population, the lower the accessibility for a census tract. Likewise, our model demonstrates that the higher the average income of a census tract, the lower the likelihood of it also having high accessibility to POWDs (Table 5).

In fact, a review of the compared means of these variables in discriminant analysis shows that the average income of the census tracts with low accessibility is about \$11,000 higher than the average income of the census tracts with high accessibility. While populations with the highest access had an average of 5% Black population, the

population with the lowest access had an average of about 10% black population (Table 5). Though these two predictive variables both are negatively correlated to spatial access to POWDs, our study does not suggest that they are correlated to each other.

Table 3. Variables Used for Demographic Analysis		
<u>Conceptual Category</u>	<u>Variable</u>	<u>Abbreviation</u>
Income	Annual Household Earnings	Earnings
Ethnicity	Percent population of non-hispanic black descent	NHBlack
	Percent population of non-hispanic white descent	NHWhite
	Percent population of hispanic descent	Hispanic
Education	Percent of population with high school education	HighSchlGrd
	Percent of population with bachelor degree or higher	HigherEd

Table 4. Stepwise Regression Results for City of Austin	
<u>Variable</u>	<u>Beta Values</u>
Earnings	3.984E-005
NHBlack	0.076
<u>Constant</u>	0.777
Notes: The variables are listed in order of importance. The variables not listed in the equation include HighSchlGrd, HigherEd, Hispanic, NHWhite. Variables listed above are significant at the .05 level. R-Square: 0.412	

Table 5. Discriminant Analysis Results for City of Austin			
<u>Variables</u>	<u>Univariate F-value</u>	<u>Mean of Low Access Group</u>	<u>Mean of High Access Group</u>
Earnings *	10.884	41,593	30,688
HighSchlGrd	.897	18.3	16.3
HigherEd	.036	43.6	44.6
Hispanic	4.861	26.4	36.6
NHWhite	.000	51.2	51.2
NHBlack *	9.255	10.52	5.4
Note: Variables with a star are significant at the .05 level.			

Texas Parks and Wildlife Public Outdoor Wilderness Destinations

In travel to Texas Parks and Wildlife parks from the highest and lowest accessible places in Austin, our analysis showed that the level of income and level of education variables had a significant association with a census tract with either high or low accessibility to POWDs. Using discriminant analysis, we can see that, similar to the City of Austin data, the higher a neighborhood's average income, the lower their accessibility to POWDs (Table 6). Differing from the City of Austin dataset, the Texas Parks and Wildlife data revealed that accessibility could be predicted by the percentage of a census tract's population with at least a bachelor degree – and that the racial/ethnic background was not associated with accessibility to POWDs (Table 7).

By looking at the compared means of the of these predictive variables, we see that the average income of the census tracts with high accessibility is

about \$8,000 lower than the average income of the census tracts with high accessibility (Table 6). Furthermore, we see that populations with the highest access had an average of 57% population with a bachelor degree or higher, while those with the lowest access have an average of 46% population with at least a bachelor degree.

Table 6. Discriminant Analysis Results Texas Parks and Wildlife			
<u>Variables</u>	<u>Univariate F-value</u>	<u>Mean of Low Access Group</u>	<u>Mean of High Access Group</u>
Earnings *	5.7313	43,735	35,670
HighSchlGrd	3.910	16.5	12.5
HigherEd *	4.853	46.5	57.1
Hispanic	.469	24.2	21.7
NHWhite	3.175	53.9	62.6
NHBlack	1.303	9.6	7.1
Note: Variables with a star are significant at the .05 level.			

Table 7. Stepwise Regression Results for Texas Parks and Wildlife	
<u>Variable</u>	<u>Beta Values</u>
Earnings	4.921E-005
HigherEd	-0.034
<u>Constant</u>	-1.05
Notes: The variables are listed in order of importance. The variables not listed in the equation include HighSchlGrd, Hispanic, NHWhite, NHBlack. Variables listed above are significant at the .05 level. R-Square: 0.378	

CHAPTER VI

CONCLUSION

Effectiveness of Methodology in Answering Our Research Question

The origin-destination matrix in network analysis permitted a derived index or spatial accessibility. For the purpose of measuring the linear distances from 150 census tracts to 128 POWDs along the roads network, our index was effective. The concentric pattern of accessibility radiating from the center of Austin was clear.

The discriminant analysis technique was particularly useful in showing which populations in Austin have high or low spatial accessibility to parks. Our results reveal that in the case of City of Austin and Texas Parks and Wildlife public outdoor wilderness destinations, level of income is the main difference between populations with high accessibility or low accessibility to POWDs. The inverse relationship between level of income and accessibility demonstrates that more wealthy populations do not necessarily live closer to the POWDs. Furthermore, stepwise regression techniques confirmed these results, and offered additional information about our secondary factors of education and percent black population while controlling for income.

Literature in leisure and recreation behavior suggests that more wealthy individuals participate in hiking and camping in wilderness settings than poorer individuals (Johnson et al. 2004). Our study makes no explanatory assertions about why

richer populations hike and camp more than poorer communities. However, it does clarify that in our study area of Austin and the Central Texas area, in general, the richer populations would have to travel farther distances to go hiking or camping at POWDs.

Reflections for Future Research

A further analytical step would be to compare actual visitation statistics for POWDs in the study area. Particularly of interest is the question of how many miles visitors travel to visit POWDs in Central Texas. If in fact visitors typically come from the higher income neighborhoods in Austin, then perhaps we should study what other societal or cultural factors influence the visitation of POWDs in Central Texas.

We observed that populations with higher incomes had lower accessibility to POWDs, yet the literature suggests that most of the visitors to wilderness areas have higher incomes. Also of note is the finding from previous studies that the main constraint that keeps people from enjoying the outdoors is lack of time and lack of money. Therefore, a provocative question to ask in further research would be: How much more money or time does a person need to have in order to engage in outdoor or wilderness activities? Is there a different threshold amount of money or time for various demographic segments of the population based on income, level of education or race/ethnicity?

What This Research Means For Park Managers

It was interesting to observe how segregated populations are based on level of education and by ethnicity. In our within-groups comparison of the independent variables, remarkably, Hispanics, Non-Hispanic Whites, and Non-Hispanic Blacks typically were not in the same census tracts. Also, the Hispanic and Non-Hispanic Black populations show a lower concentration of individuals with at least a bachelor degree when in comparison with the Non-Hispanic White populations. These findings were not the direct object of our research but they are nonetheless informative.

These demographic characteristics of Austin offer insight in reflection of The Wilderness Society's question mentioned earlier in this text. Does wilderness lose relevancy given the expanding demographic diversity of the country (or in our case, the Austin Area)? The results from our study point to the conclusion that expanding demographic diversity does not in fact threaten wilderness as much as does the lack of income diversity across the settled landscape.

Park planners struggle with the question of how to make outdoor recreation more accessible for a wider diversity of people. The site selection of a new POWD should be a decision based on the character or quality of a natural resource or wilderness area. It should not be based on the site's relation to geographies with prevalent underserved or otherwise targeted populations. Spatial accessibility does not necessarily influence visitation to POWDs. The present research shows that people will travel great distances to experience great natural beauty if they have the time and money to do so.

It appears that wilderness appreciation is a leisure activity. Class stratification, educational disparities, and income inequalities persist in geographically segregated nodes within Austin. Park planners are not assigned to re-arrange the societal dynamics of the society because structural and demographic dynamics of the landscape will not change based on the location of POWDs.

Park planners can however create opportunities to introduce the outdoors to all, regardless of any individual's circumstances. Trips to the outdoors can be seen as rewards for achievement and this can be particularly useful to encourage school-age kids. One recommendation to motivate school children to make good grades and improve their chances of pursuing higher education could be to offer rewards of outdoor recreation leisure time and wilderness experience field trips.

REFERENCES

- Albers, H., A.W. Ando, and M. Batz. 2008. Patterns of multi-agent land conservation: Crowding in/out, agglomeration, and policy. *Resource and Energy Economics*. 30 (2008). 492-508.
- Brown, G. 2008. A Theory of Urban Park Geography. *Journal of Leisure Research*. 40(4). 589-607.
- <http://www.census.gov> (last accessed 12/10/2011)
- Christaller, W. 1933. C.W. Baskin (trans.) Central Places in Southern Germany. Englewood Cliffs: Prentice Hall.
- Comber, A., C. Brunsdon and E. Green. Using a GIS-based network analysis to determine urban greenspace accessibility for different ethnic and religious groups. *Landscape and Urban Planning*. 86(2008). 103-114.
- Crompton and Culpepper. 2006. *The economic contributions of Texas State Parks in FY 2006*. Commissioned by Texas Coalition for Conservation.
- Crompton, John and Sarah Nicholls. 2006. An assessment of tax revenues generated by homes proximate to greenway. *Journal of Park and Recreation Administration*. 24(3). 103-108.
- Day, Frederick A. and James Vaughan. 2011(forthcoming). The evolving landscape of the Austin-San Antonio Corridor. Chapter in Agnew, Claval and Roca (eds.), *Landscapes, Identities and Development*. Farnum, UK: Ashgate Publishing.
- Dai, Dajun. 2011. Racial/ethnic and sociodemographic disparities in urban green space accessibility: Where to intervene? *Landscape and Urban Planning*. 102(2011).
- Freeman, Myrick. 1993. The measurement of environmental and resource values. Washington, D.C. Resources for the Future.
- Hall, Michael. 2006. Space-time accessibility and the TALC: The role of geographies of spatial interaction and mobility in contributing to an improved understanding of tourism. In *The Tourism Area Life Cycle*, ed. R.W. Butler, 83-100. Clevedon: Channel View Publications.
- Hewko, J., K. Smoyer-Tomic and J. Hodgson. 2001. Measuring neighborhood spatial accessibility to urban amenities: does aggregation error matter? *Environment and Planning*. 34. 2285-1206.

- Johnson, C., J. Bergstrom, and K. Cordell. 2004. Wilderness Values in America: Does immigrant status or ethnicity matter? *Society and Natural Resources*. 17. 611-628.
- Johnson, C., J. Bowker, and K. Cordell. 2001. Outdoor recreation constraints: An examination of race, gender, and rural dwelling. *Southern Rural Sociology* 17. 111-133.
- Kinnear, P. and C. Gray. 2004. SPSS 12 Made Simple. East Sussex: Psychology Press.
- Kirkpatrick, L. and B. Feeney. 2007. A Simple Guide to SPSS for Version 16.0. Belmont: Wadsworth, Cengage Learning.
- Kotchen, M.J. and M.J. Powers. 2006. Explaining the appearance and success of voter referenda for open-space conservation. *Journal of Environmental Economics and Management*. 51(1). 373-390.
- Lawrence, M.S., G. Gamst, and A. Guarino. 2006. Applied Multivariate Research: Design and Implementation. Thousand Oaks: Sage Publications.
- Liu, Suxia and Xuan Zhu. 2004. An integrated GIS approach to accessibility analysis. *Transactions in GIS*. 8(1).
- McCauley, D.J. 2006. Selling out on nature. *Nature*. 443. 27-28.
- Maroko, A. et al. 2009. The complexities of measuring access to parks and physical activity sites in New York City: a quantitative and qualitative approach. *International Journal of Health Geographics*. 8(34).
- Nelson, E., M. Uwasu, and S. Polasky. 2007. Voting on open space: What explains the appearance and support of municipal-level open space conservation referenda in the United States? *Ecological Economics*. 62 (2007). 580-593.
- Nicholls, S. and J. Crompton. 2005. Impacts of regional parks on property values in Texas. *Journal of Park and Recreation Administration*. Summer 2005. 23(2). 87-108.
- Ribot, J. and N. Peluso. 2003. A theory of Access. *Rural Sociology*. 68(2). 153-181.
- Rudzitis, G. and H. Johansen. 1991. How important is Wilderness? Results from a United States Survey. *Environmental Management*. 15(2). 227-233.
- Sutton, P and Frederick Day. 2004. Types of rapidly growing counties of the U.S. 1970-1990. *The Social Science Journal*. 41. 251-265.
- <http://www.tnris.org> (last accessed 12/2/11)

<http://www.tpwd.state.tx.us> (last accessed 12/2/11)

Waltert, F. and F. Schlapfer. 2010. Landscape amenities and local development: A review of migration, regional economic and hedonic pricing studies. *Ecological Economics*. 70(2010). 141-152.

Wilderness act of 1964 [Public Law No. 88-577, 78 Stat. 890, 890, codified as amended at 16 USC 1131©(1994)].

Zhang, X. et al. 2011. Modeling spatial accessibility to parks: a national study. *International Journal of Health Geographics*. 10(31).

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