

EXAMINING ENVIRONMENTAL JUSTICE IN CONTEXT OF FEDERAL AND STATE LANDS IN ILLINOIS: A GIS-BASED CASE STUDY

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Abstract

This study used GIS-based spatial analysis to examine the sociodemographic patterns of census block groups in Illinois, particularly those within a 5 kilometer (5km) radius of federally and state owned outdoor recreation lands. Using the environmental justice framework, this study aimed to determine any possible inequalities in access to federally and state owned outdoor recreation lands in Illinois. Sociodemographic variables of race, gender, median household income, median household value, median retirement income, education, and occupation were examined. The socio-demographics of census block groups within a 5 km radius of federally or state owned outdoor recreation lands were compared to census block groups outside the 5 km radius. The results show a stronger presence of a high income retired population, and a high income white non-college degree holding population within 5 km of federally or state owned outdoor recreation lands. These populations have the best access to the use and non-use benefits of outdoor recreation lands, while populations located further from these lands, such as minorities and low-income populations, have limited access, if any, to the use and non-use benefits of these lands.

1.0 Introduction

The environmental justice movement started in the late 1970's, with the Love Canal incident in New York, and the subsequent creation of the Super Fund (Bullard, 1990). Soon after Love Canal, political activists claimed that certain neighborhoods, specifically those with racial minorities, were more likely to be chosen for construction sites of facilities that have a negative impact on surrounding land, such as landfills, hazardous waste sites, and power plants. Though many studies have explored the relationship of various populations, negative land uses, and their effects on those populations (Hamilton, 1995; Hird, 1993; Mennis, 2002), very few studies have inquired about the relationship between populations and positive land uses (Porter & Tarrant, 2001; Sister, Wolch, & Wilson, 2009; Zhang, Tarrant, & Green, 2008). Examining the effects of negative land use on populations is important for policy makers when making decisions concerning the placement of such land, but it is also important to consider the effects of positive land uses, such as parks, wilderness, and other lands designated for outdoor recreational uses (Salazar, 1996).

1.1 Purpose

The purpose of this study is to use an environmental justice framework to investigate possible inequalities related to access to federally and state owned outdoor recreation lands in the state of Illinois, using GIS based spatial analysis. The demographics of census block groups (CBGs) within a 5 kilometer radius of federally and state owned outdoor recreation lands were compared to CBGs outside a 5 km radius to determine whether there is equal access to federally and state owned outdoor recreation lands among all populations in Illinois. By applying the environmental justice framework and using GIS spatial analysis, this study attempts to extend the research based on an understanding of the location of minority and low-income populations in relation to outdoor recreational lands.

1.2 Theoretical framework

Salazar and Oliver (1998) stated that investigating environmental “bads” (p. 52), such as pollutants, is an important aspect of environmental justice. They suggest that researchers should also consider the availability of environmental “goods” (p. 53) in order to fully examine environmental justice, such as wildlife habitat, outdoor recreation lands, and clean air and water. Ensuring that all populations have equal access to environmental “goods” is an important, yet often overlooked, aspect of environmental justice (Salazar, 1996). In 1999, the United State Environmental Protection Agency (USEPA) published a guide to aid federal agencies in applying and executing proper procedures in regards to environmental justice. This guide states that when assessing an area, federal agencies must examine “impacts on the natural or physical environment and related social, cultural, and economic impacts” (USEPA, 1999, p. 8). This guide clearly includes non-use impacts, which are traditionally seen as negative in terms of locally undesirable land uses (LULUs) (e.g., air pollution); however, many federal and state recreational lands offer a variety of positive impacts as well (e.g., clean air, clean water, scenery) (Porter & Tarrant, 2001).

While public policy has mandated the consideration of benefits in the context of programs, policy, and activities available to all people, most research has concentrated on discrimination, specifically exploring LULUs and the populations surrounding them (Hamilton, 1995; Hird, 1993; General Accounting Office, 1983). There is a small but growing body of research examining populations and their ability to obtain benefits from locally desirable land uses (LDLUs) (see Abercrombie, Sallis, Conway, Frank, Saelens, & Chapman, 2008; Lindsey, Maraj, & Kuan, 2001; Nicholls, 2001; Porter & Tarrant, 2001; Sister et al., 2009; and Zhang et al., 2008) yet past studies have not investigated access to use and non-use benefits of federally and state owned outdoor recreation lands throughout an entire state.

1.2.1 Outdoor recreation land use and non-use values and desirability. National Forests, National Parks, National Recreation Areas, and National Wildlife Preserves as well as state owned outdoor recreation lands, including state parks, state fish and wildlife areas, state conservation areas, and state forests can be considered LDLUs in terms of both use and non-use benefits. Use benefits include an increase in economic activity from tourism on the surrounding communities (Porter & Tarrant, 2001). There are also positive benefits of having access to, or being in close proximity to outdoor recreation lands in both urban and rural settings. Outdoor recreation lands offer a space for people to engage in a variety of activities. People may use and value recreation lands to enjoy the scenery and escape from the stress of daily life. They may

also value these lands as a place for solitude and contemplation, or to partake in a favorite activity or hobby, such as bird watching, kayaking, hiking, and other outdoor recreational activities (Porter and Tarrant, 2001). Recreational lands also offer non-use benefits and values, which expand beyond park borders. Non-use benefits include positive environmental attributes such as clean air, clean water, and pleasing aesthetics (Porter & Tarrant, 2005). Non-use values include knowing that protected places are in existence.

Resource based recreation lands that provide positive environmental benefits are considered “public goods,” and therefore should be distributed equally among all populations (Aldy, et al., 2010). Having access to outdoor recreation areas, as well as the economic and environmental benefits, all contribute to the non-use values of outdoor recreation areas enabling them to be classified as LDLUs.

1.2.2 Environmental justice in rural areas. Much of the past research exploring environmental justice has focused on small urban areas (Hamilton, 1995; Hird, 1993; Sister et al., 2009), which is logical when investigating LULUs, as trends show that many hazardous waste sites are located in urban areas. In Illinois, 23 percent of the state’s Super Fund sites are located within Chicago city limits (USEPA, 2013). Alternatively, rural areas are more likely to have state or federal owned recreational lands (Zhang, et al., 2008). Therefore, these rural areas should be considered when examining those populations that are most likely to obtain use and non-use benefits from recreational lands.

2.0 Methods

2.1 Data

The data set includes shapefiles and attributes for federally and state owned outdoor recreation lands in Illinois, as well as all CBGs. CBGs were chosen as the unit of analysis since they are the smallest unit of measurement taken by the census bureau including all variables investigated (Census Bureau, 2013a), and past research using GIS to analyze environmental justice also used CBGs (Kriessel, Centner, & Keeler., 1996; Tarrant & Cordell, 1999; Tarrant & Porter, 2005; Tarrant & Porter, 1999). CBG data were obtained from the American Community Survey (ACS) 5 year, from The National Historical Geographic Information System (NHGIS) website (2011). The data set of federally owned outdoor recreation lands was created by downloading shapefiles from the National Atlas website (2013). The data set of state owned outdoor recreation lands was created by downloading shapefiles from Illinois Department of Natural Resources, Illinois Geographic Information System CD-ROMs (1996). The state owned outdoor recreational land files are in ArcGIS export format, (.e00) so they were converted to shapefiles in order to perform spatial analysis.

2.2 Variables of interest

To investigate the demographics of each CBG, this study examines independent variables defined in the following manner. (1) Race is designated as the total percent of white versus non-white residents. (2) Median household income is measured as a continuous level variable of dollars per household. (3) Median household value is measured as a continuous level variable of worth of property. (4) Median retirement income is measured as a continuous level variable of the average household retirement income per CBG. (5) Gender is determined by percent male

compared to percent female. (6) Occupation measures percent white collar versus blue-collar workers. (7) Education is categorized by the percent of the population graduating from any college (i.e. associate's degrees to PhD's) versus the percent of non-graduates or those who did not attend any college. The dependent variable in this study is whether a census block group is within a 5 kilometer (km) distance of Illinois federally and state owned outdoor recreation land or further than 5 km. A radius of 5 km was chosen because people within this radius *may* receive the use and *do* receive the non-use benefits of outdoor recreation lands.

2.3 Data preparation

Census block group data were obtained from The National Historical Geographic Information System (NHGIS) website (2013) for the ACS 5 year. A shapefile for all CBG's in Illinois was downloaded and imported into ArcMap 10 (ESRI, 2011). The attribute tables for each independent variable were downloaded, and data were sorted by preparing variable names, isolating the needed variables, and deleting unneeded fields (e.g. land codes, area codes, etc.). Once editing was complete, the attribute tables were imported to ArcMap 10 and joined to the CBG shapefile, using a procedure called a spatial join. Each individual independent variable was joined to the CBG shapefile. Thus, the final join combined all attribute databases within one primary shapefile.

2.3.1 Federally and state owned recreation lands. Federally owned land data were downloaded from the National Atlas website (2013) as a shapefile. Since not all federally owned land is intended for recreational purposes (e.g., federal penitentiaries, federal laboratories, federal naval bases), these lands were deleted from the shapefile by deleting them from the shapefile's attribute table.

State owned outdoor recreation land data were obtained from Illinois Department of Natural Resources Illinois Geographic Information System CD-ROMs (1996). Four shapefiles were downloaded and joined into one shapefile: state parks, state fish and wildlife areas, state conservation areas, and state forests.

The shapefiles for both federally and state owned outdoor recreation lands were imported to ArcMap10. These layers were spatially joined, to create one shapefile that includes all federally and state owned outdoor recreation lands. Then, to prepare the data for spatial analysis, the outdoor recreation land data were layered over the CBG data.

2.3.2 Spatial analysis

After the two maps (CBG and lands) were layered, those CBGs that were fully encompassed or partially within 5 km of federally and state owned recreation lands were selected in ArcMap. The 5km was measured from the boundary of the federally or state owned recreation land using Euclidean distance, which was chosen because Porter (2009) found a .99 correlation between network and Euclidean distance. Additionally, Euclidean distance would give an accurate measure of non-use benefits to surrounding populations. Once these lands were selected, a column was added to the attribute table to code CBGs within and outside the 5km distance. CBGs within 5 km were dummy coded as a "1," and those outside were dummy coded as "0."

2.3.3 Statistical analysis

Data were imported to R version 2.15.2 (R Core Team, 2013) and a logistical regression was performed to determine the relationships between the dependent variable of proximity and the multiple independent demographic variables. Several studies using the environmental justice framework have used logistic regression analysis to investigate the relationships between the demographics of a population and their proximity to LULUs (Hamilton, 1995) or LDLUs (Porter & Tarrant, 2001; Tarrant & Cordell, 1999).

The residual deviance of these results was then used to compute a Chi square value to confirm that the model displayed “goodness of fit.” The Chi-squared method compares observed data to values that are predicted by the model. The result of this calculation is then compared to a Chi-square value table to establish if the model is “good” (Rodriguez, 2012).

3.0 Results

3.1 Descriptive results

Descriptive statistics were calculated for all CBG’s in Illinois (n = 9,689). The results show the sociodemographic composition of Illinois as being predominantly white, with 38.77% of workers being blue-collared. The median household income is \$58,608.32, the median household value is \$216,600.04, and 6.60% of households have retirement income. The portion of the male population was 48.74%, and 23.83% of the population have graduated from college.

Descriptive statistics including the dependent variable of CBG’s within and outside a 5 km radius surrounding federally and state owned outdoor recreation lands in Illinois were also calculated. The results show that in comparison to the CBGs outside a 5 km radius federally and state owned outdoor recreation lands the population within 5 km has a higher percentage of white residents, with lower median household incomes, lower median household values, and a higher percentage of households with retirement income. The results also show a population that has a lower percentage of college educated residents and a higher percentage of blue-collar workers when compared to the CBGs outside a 5 km radius of federally or state owned recreation lands. Additionally, 14.7% of CBG’s in Illinois have access to federally or state owned recreation lands. This

A logistic regression of the effects of the independent variables (i.e., socio-demographics) on the dependent variable (i.e., within or outside 5 km) was performed. The results of the logistic regression are presented in Table 1. All variables were statistically significant, with percent of white residents, median household income, median household value, percent of households with retirement income, and percent of college educated residents being highly significant. The results show that within 5 km of federally or state owned recreation lands there is a higher white population, with a higher household income, but lower household value. The results indicate that there is an increase in households with retirement income. The results also show an increase in the male population and a decrease in the population that has obtained a college degree. The residual deviance is 6,749.3 on 9681 degrees of freedom and showed goodness of fit with a Pearson’s Chi Square value of 6,749.3, 9681.

Table 1
Summary of Logistic Regression

Socioeconomic Variables	β	S.E.	F-Value
Percent White	1.24	1.29	9.66***
Median Household Income	1.76	3.37	7.44***
Median Household Value	-1.01	5.65	-17.89***
Percent of households with Retirement Income	5.94	7.29	8.17***
Percent Male			
	1.04	4.75	2.19*
Percent Blue-Collar Workers	-6.60	3.20	-2.06*
Percent College Educated	-3.15	4.64	-6.79***

***p<0.001 *p<0.05

4.0 Discussion and conclusions

When examining the results, two populations appear to emerge with greater frequency within 5 km of federally or state owned outdoor recreation lands: (1) a higher income retired population; and (2) a higher income, white, non-college degree holding population. The results also indicate that housing values in these areas are more likely to be of a lower value than those outside 5 km. Each of these populations will be discussed separately, and then discussed in conjunction with each other.

4.1 Stronger presence of higher income retired population

The results show a statistically significant increase of residents receiving retirement income within a 5 km radius of federally or state owned outdoor recreation lands. These results correspond with previous research (Porter & Tarrant, 2005). There are several possible explanations for these results. Retirees could be moving to these areas because of the lower median household value. In Illinois, the majority of federal and state owned recreation lands are located in rural areas, which are associated with lower household values. Higher household values tend to cluster around the urban centers of the state (e.g., Chicago, Springfield). Considering that many retirees are on a fixed income, living and owning a home of low value may be desirable.

Another explanation could be the desire of a specific group of retirees to spend their retirement enjoying the use and non-use outdoor recreation opportunities these lands provide. According to data from the National Survey on Recreation and the Environment (NSRE), walking for pleasure ranks the most popular outdoor activity among retirees with more than 50% of retirees reporting participating in this activity. Retirees also reported partaking in other outdoor recreation activities including: viewing natural scenery, (average of 42% of retirees), visiting nature centers (average of 30.5% of retirees), and day hiking (average of 14.3% of retirees) (Society of Outdoor Recreation Professionals, 2005). Retirees who are active and involved in outdoor recreation activities may be more likely to seek locations near outdoor recreation areas, so they have easy access to these benefits. Since the population within 5 km consists of residents with higher income, they may have the monetary means to move and purchase a home in a location they desire.

This finding has implications concerning the use and non-use values of outdoor recreation lands. Retirees, though they may not be *using* the outdoor recreation lands that are adjacent to their homes, will be beneficiaries of the non-use benefits that the outdoor recreation land provides (e.g. clean air, scenic views). When considering that retirees have a higher incident rate of health related problems than the general population, non-use benefits, such as clean air, may be of higher importance to them (Porter & Tarrant, 2005). In terms of use benefits, these higher income retirees have the best access to outdoor recreation lands. Previous studies have shown that individuals with access to recreational lands will be more likely to use them (Allen, 1991). This may benefit this retired population by increased physical activity, which may decrease health related issues, such as heart disease. Also, if this retired population has worked in urban settings, retiring with outdoor recreation in their backyard may be a welcome change and a setting to experience solitude and reflection.

These findings also indicate that low income retirees receive very few, if any, of the use or non-use benefits of living near and outdoor recreation land. Living further away may also prevent them from traveling to outdoor recreation sites. Their low income coupled with increasing gas prices and a lack of public transport may be influential factors determining whether they are able to visit outdoor recreation lands. Also, health related issues might also prevent them from being able to travel to areas, especially for a prolonged period of time. The results of this study indicate that income may be an important, influential factor determining whether retirees can move to more desirable locations and reap the benefits that these locations provide.

4.2 Stronger presence of higher income White non-college degree holding population

These findings suggest that a white, higher income population, less likely to hold any level of college degree resides within a 5 km radius of federally or state owned outdoor recreation lands. Since many of the federally and state owned recreation lands in Illinois are situated in rural areas, this finding supports past research which found that urban residents are more likely to hold a college degree than rural residents (Gibbs, 1995). It is also possible that this finding occurs because of the higher population with retirement income, who are less likely to hold a college degree. However, the retirement population probably accounts for only a very small portion of this finding.

Another explanation for this higher income population may be that there are a large number of residents commuting to urban areas to work, where there are more job opportunities. Thus, there is a greater opportunity to earn a higher income in an urban area, while making the sacrifice of a longer commute to take advantage of the lower household value in rural areas near outdoor recreation sites. Many of the outdoor recreation sites in this study are within commuting distance of metropolitan areas. These residents may desire to live near outdoor recreation lands to be closer to the use and non-use benefits of the outdoor recreation land while still being able to access good jobs in urban areas. In addition to living near an area that provides clean air, clean water, scenic views, opportunity for recreation, and solitude, higher income populations may also be able to take advantage of buying a larger house in these areas than they could in urban areas because the housing values are lower. It is also possible that they can purchase a home and not need a large amount of property since they are in close proximity to federal or state managed outdoor recreation land that is easily accessible. Also, the cost of transportation to urban centers

for work or obtaining goods and services may not be a major consideration for these populations, since they have a higher income.

Some white populations have better access to outdoor recreation lands, however these populations tend to be higher income. The higher income white population is able to take advantage of the use and non-use benefits of outdoor recreation lands, as well as afford to commute to urban centers for work, goods, and services. Lower income white populations may be more concentrated in urban areas, where they have very limited access, if any, to outdoor recreation lands. This not only limits their ability to benefit from outdoor recreation lands, but also indicates that they are more likely to be exposed to negative environmental effects associated with urban life (e.g., air pollution).

Though the higher income population within 5 km of federal and state lands is less likely to hold a college degree, they may still be able to earn a higher income due to the diversity of high paying blue-collar jobs (e.g., Boeing, Caterpillar, Kraft Foods, etc.) located in Illinois. Though these companies tend to be located in urban centers, the higher income population would be able to commute as noted above.

4.3 Lower minority presence near federally or state owned recreation lands

A higher white population living in close proximity to federally or state owned outdoor recreation lands is consistent with past research (Cordell & Tarrant, 1999; Porter & Tarrant, 2001; Porter & Tarrant, 2005; Zhang et al., 2007). In Illinois, minorities are more likely to reside in and near urban areas, while a majority of the federally and state owned recreation lands are located in rural areas.

Minority residents, being less likely to live within 5 km of state and federal outdoor recreation lands, are also more likely to experience the potential negative effects of living in an urban environment and having limited access to outdoor recreation lands. Urban areas typically have higher rates of air pollution, due to the increased numbers of sources (e.g., factories and cars) that emit pollutants such as sulfur dioxide and smoke.

Being situated further from outdoor recreation areas also leaves these populations with limited access to outdoor recreation lands and access to the use, and especially in the context noted above, the non-use benefits (i.e., clean air) they provide. So, not only are minority populations exposed to a great number of LULUs, they have the worst access to LDLUs. In addition to their limited access, minority populations also have a larger proportion of low-income individuals than white populations (Census Bureau, 2013b). Based on this, their income status may also contribute to their limited access, as they may have very limited means to travel to an outdoor recreation site and *use* it. Additionally, some minorities may place a higher value on living with a close-knit community than outdoor recreation lands, thus preferring residences in more urban locations.

4.4 Implications for outdoor recreation management

The results of this study lead to several suggestions for outdoor recreation managers. Following Salazar's (1996) ideas of "environmental goods" it is important to ensure that these good are equally distributed among all populations. Currently, in Illinois, the "environmental goods" of

federally or state owned outdoor recreation lands are not equally distributed among all populations. Thus, when planning and developing new outdoor recreation lands, federal and state land managers should consider land closer to urban centers so low-income and minority populations have an equal opportunity to obtain *at least* the use, if not the non-use benefits of outdoor recreation lands. Managers should explore the possibilities of acquiring small parcels of land to provide local residents with the use-benefits of outdoor recreation land (e.g., having access to perform recreational activities), even if the non-use benefits become somewhat limited (e.g., less land equates to less opportunity to create clean air).

Another important factor recreation managers should consider when planning such areas is the “proximity principle” which indicates that land located closer to parks are more likely to have increased value, and the residents pay more in taxes (Crompton, 2001). In context of environmental justice, when an outdoor recreation land is sited in an urban environment, managers must take care that low-income and minority residents near that land are not displaced due to gentrification resulting in increased taxes and property value. Additionally, programmers within federal and state owned outdoor recreation lands should consider creating programs catered to the retired population which has access to these sites. As mentioned earlier, retirees cited walking as one of their main outdoor activities, as well as visiting nature centers and day hikes. Managers should begin to create shorter trails to accommodate limited physical activity to enable more retirees to use the recreational lands near their homes. Also, managers may include trails with more rest areas, which may be more appealing to retirees. Since visiting nature centers is an activity enjoyed by many retirees, managers should attempt to change the exhibits in their centers frequently, to encourage more frequent visits from retirees. Also, many retirees are willing to volunteer their time. Managers should take advantage of their potential volunteer force and encourage retirees to join local organizations that support the recreational land.

In order to encourage low income populations to the recreation lands, managers should attempt to create programs which offer free, or inexpensive transportation to the recreational land. Free programs may be offered at recreational lands, however getting to the location may be a barrier. Offering free or inexpensive transport may be the only way low income populations can visit an outdoor recreation land. Also, managers should try to work with urban schools and community centers to attempt to expose low income populations to federal and state outdoor recreation areas. Offering talks, bringing in photos and artifacts, and creating activities may initiate an interest in outdoor recreation lands, which will foster a willingness to visit these lands in the future. These methods can also be excellent options for populations with limited access to experiencing the opportunities lands have to offer even if they are virtual or second hand one.

4.5 Implications for future research

There are numerous implications for further research that can be derived from the results of this study. Further research should be conducted in different states, or possibly, regions (e.g., Rocky Mountains, desert southwest). States and regions with a higher percentage of federally and state owned recreation lands may yield different results and should be investigated. Examining sociodemographic patterns surrounding large and well-known parks may reveal interesting data in relation to variables addressed in this study, especially in context of environmental justice.

Since this study does add to the growing body of research conducted on income in relation to LDLUs and LULUs, it is suggested that further research be conducted on the relationship (or lack thereof) between race and income. Previous research has indicated that income is not a valid indicator of environmental justice. However, more research should be conducted before such a conclusion is drawn. The results of this study seem to lean heavily toward income as a contributing factor to issues of environmental justice.

Researchers should also examine length of residence to determine whether possible shifts are occurring in populations and whether retirees are moving to these areas as a retirement destination, or if they are long-time residents. If these areas are becoming retirement destinations, this has implications for rural planners and recreation managers who must be prepared for shifts in their local economy due to an increased retiring population. If an area does become a popular retirement destination, housing values may increase putting pressure on the current residents in terms of property taxes. Also, in smaller rural towns, even a slight increase in population may put more of a burden on infrastructure, local stores, and service providers.

Longitudinal research might be increasingly important as the baby boomer generation enters retirement. The influx of retirees mentioned above could possibly effect future local generations in these areas and explain how tourist based economies develop. Occupation should also be explored in context of income levels in close proximity to federal and state recreation lands. Examining where these higher income populations work would also be of interest, and may provide insight as to whether these residents are commuting to urban centers or working in the areas in which they live.

To summarize, there appears to be two populations that have the best access to federally or state owned outdoor recreation lands in Illinois, a higher income white retired population, and a higher income non-college degree holding white population. These populations are able to take advantage of the use and non-use benefits that these lands have to offer.

4.6 Study limitations

Several limitations to this study should be considered. First, the results of this study should be interpreted in context of the high number of CBGs used in data calculations. The lower z-scores may have resulted in significance due to the high 'n' and therefore the differences found may not accurately reflect reality. Second, this study only inspected seven sociodemographic variables. Other variables may also have a significant effect on a population's proximity to federally or state owned recreation lands. Additionally, multicollinearity was not tested among the variables. Third, this study only examined federally or state owned outdoor recreation lands. It did not investigate populations surrounding lands owned and maintained by local park districts. Though many of these parks are likely to be smaller urban outdoor recreation lands, incorporating them into the data many have produced different results. Fourth, this study did not account for the modifiable areal unit problem (MAUP), which is the tendency for results to shift based on the unit of analysis used (Mennis, 2002).

This study only examined CBGs, which is common in environmental justice research, demographic, and GIS studies and did not examine other units such as zip code tabulation areas (Cordell & Tarrant, 1999; Hope, Gries, Zhu, Fagan, Redman, Grimm,... & Kinzig, 2003; Iceland & Steinmetz, 2003; Porter & Tarrant, 2001; Porter & Tarrant, 2005; Zhang et al., 2007).

However, analyzing large areas such as zip codes would include populations living great distances from these recreational lands. Thus, it is possible that the results would change markedly if the unit of analysis were changed.

5.0 References

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