SOCIOECONOMIC CHARACTERISTICS OF COMMUNITIES WITH NATIONAL FORESTS IN THE UNITED STATES

by

KATLYN SEPSEY

(Under the Direction of Pete Bettinger)

ABSTRACT

The U.S. Forest Service contributes ecological and economic benefits to the public through its management of the National Forest System. Previous research has indicated that protected natural areas have positive, negative, and no effect on surrounding communities. This research examined the median household income, percentage below poverty threshold, and unemployment rate in counties containing national forests in the United States and compared them to counties without national forest. On a national scale, counties containing national forest have indications of lower socioeconomic position than counties without national forests. On a regional scale, the intermountain west and Rocky Mountain states have implied higher median household income in counties containing national forests. On a state scale, states west of Texas, except for Washington, had no statistical differences between county groups. East of Texas, there were indications of higher, lower, and no difference in socioeconomic position for counties with national forest.

INDEX WORDS: spatial analysis, socioeconomic analysis, poverty, unemployment, income

SOCIOECONOMIC CHARACTERISTICS OF COMMUNITIES WITH NATIONAL FORESTS IN THE UNITED STATES

by

KATLYN SEPSEY

BS, Presbyterian College, 2015

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirements for the Degree

MASTER OF SCIENCE

ATHENS, GEORGIA

2017

SOCIOECONOMIC CHARACTERISTICS OF COMMUNITIES WITH NATIONAL FORESTS IN THE UNITED STATES

by

KATLYN SEPSEY

Major Professor:	Pete Bettinger
Committee:	Jacek Siry
	Roger Lowe

Electronic Version Approved:

Suzanne Barbour
Dean of the Graduate School
The University of Georgia
August 2017

DEDICATION

To Elizabeth Bagley, my family, and friends for their endless love and support.

ACKNOWLEDGEMENTS

I would like to thank Dr. Pete Bettinger for being my major advisor and for the opportunity to come to the University of Georgia to study forestry. Thank you to Dr. Jacek Siry and Dr. Tripp Lowe for taking the time to be on my committee, read, discuss, and meet with me. Thank you to the Warnell School of Forestry and Natural Resources, the U.S. Forest Service, and the University of Georgia for my funding. Thank you to my professors, colleagues, and classmates at UGA for a challenging and wonderful year.

I would like to thank Dr. Suann Yang for her endless support, mentoring, and friendship that has afforded me every opportunity I have had thus far in my career.

Thank you to my family, especially my parents who always encourage, love, and support me to be the best version of myself I could possibly be.

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

CHAPTER 1

INTRODUCTION

The United States Forest Service was established in 1905 as part of the U.S. Department of Agriculture in response to concerns about natural resources and conservation. Today the Forest Service has 35,000 employees that manage 192.5 million acres of land (Williams 2004). The mission of the Forest Service is "to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations," or in short, "caring for the land and serving people." The organization not only strives to achieve quality land management, but also provides work to the unemployed, underemployed, and disadvantaged (USDA Forest Service 2017a). There are individual, social, economic, and environmental benefits from public natural resource lands (Bedimo-Rung et al. 2005).

The Forest Service's management of millions of acres of land provide many environmental and ecological benefits. Reforestation, soil and water resource improvements, wilderness preservation, wildlife habitat restoration, and forest research are just a few areas that have contributed to the preservation of natural resources (Williams 2004). National forests create and provide many economic benefits on a local scale (USDA Forest Service 2017a). Forest Service employees, special employment programs, national forest receipts, timber harvest, fishing, hunting, mining, recreation, and tourism are services that have economic benefits for communities (Williams 2004).

The socioeconomic position of citizens in the United States has been correlated to morbidity and mortality (Krieger et al. 1997). Socioeconomic factors such as income and

employment can be used to determine one's socioeconomic position. The economic benefits provided by the national forests may contribute to individuals' (who live in close proximity to national forests) socioeconomic position and ultimately their health. It is important to analyze the socioeconomic position of communities benefiting from the economic impact of nearby national forests so that policy makers can make informed decisions concerning not only the ecological, but also economic regulation of the national forests (de Groot et al. 2012). The aim of this research is to compare and contrast socioeconomic characteristics of counties that do and do not have national forests in close proximity to their communities.

1.1 U.S. Forest Service

The Forest Service manages 28 Job Corps Civilian Conservation Centers that have the capacity to educate 6,200 youth a year to complete their GED, high school diploma, college classes, and occupational training. Through contributions to the American economy through various activities, the US Forest Service indirectly supports nearly 450,000 jobs across the nation. In addition to jobs directly related to forestry, the Forest Service invests in research and development to "lead the world in the next generation of cutting-edge [forestry] innovations." This creates new jobs for research scientists and increases economic activity (USDA Forest Service 2017a). The recreation and tourism surrounding national forests provides 4,100 private businesses to employ 139,000 members of surrounding communities. Between 1904 and 2004, volunteers have contributed work for the Forest Service that is valued at $38 million (Williams 2004).

National forest ecosystem services are estimated at a value between $96.5 billion to $5.7 trillion annually. These estimates provide a value of $303 to $17,857 for each American every year (de Groot et al. 2012). The Forest Service contributes $36 billion a year to the American

economy, of which $13 billion comes from forest visitors. There are 27 million annual visitors to 154 national forests, 122 ski areas, 4,300 campgrounds, 158,000 miles of trails, 9,100 miles of Scenic Byways, 5,000 miles of Wild and Scenic Rivers, and 9 national monuments. The Forest Service collects $229 million in receipts from states and counties and $967.8 million in federal receipts. Receipts are collected from timber sales, grazing, recreation, mineral extraction and special use authorizations, such as firewood, Christmas trees, and resorts. Grazing sheep and cattle on public forest lands contribute $7 million annually to the Forest Service receipts. The global timber market has grown (USDA Foreign Agricultural Service 2015) and the U.S. Forest Service timber sales generate $164 million in gross revenues. Recreational fishing on Forest Service lands has an estimated economic value of $8.5 billion (USDA Forest Service 2017d).

Natural resource areas and amenities have been attracting migrants since the early 1970s. The "rural turnaround" in the 1970s was a shift in migration from rural-to-urban to urban-to rural. The influx of people to natural areas were young adults and retirees (Johnson and Stewart 2007). This "green migration" is due to Americans seeking clean air, clean water, scenic beauty, and recreation opportunities. Environmentalism is a high priority for people moving to natural areas. In addition to environmental priorities, the economic characteristics of rural communities are changing due to the in-migration of young healthy adults and aging baby boomers (Jones et al. 2003).

1.2 Socioeconomic Position

The phrase "socioeconomic status" is not as clear as "socioeconomic position" because "status" can imply rank or prestige that is not quantifiable. Socioeconomic position is a measure of someone's available social resources and assets (income, wealth, educational credentials), and their status in a social hierarchy (access to goods, services, and knowledge). Social class is

interdependent on economic and legal relationships that place people in a location within the economy. Economic investments (employment status, capital land, etc.), educational credentials, and skill assets all contribute to social class location. Evaluating both social class and socioeconomic position help conceptualize the social relationship between communities and their surroundings (Krieger et al. 1997).

There is not one factor that can determine one's socioeconomic position (Krieger et al. 1997). Researchers have developed methods to measure socioeconomic position with several different social and economic factors. Percentage working class, unemployment, percentage below poverty line, percentage of residents with university degrees, median household income, percentage of managerial and professional positions, median value of dwelling, median gross rent of dwelling, percentage of homeownership, and percentage of households with a vehicle are some factors used to evaluate socioeconomic position. (Krieger et al. 2003, Darden et al. 2010). I will focus on three measures of socioeconomic position: (1) median household income, (2) unemployment rate, and (3) percentage below poverty threshold. These three measurements are well known factors that are frequently used to determine socioeconomic position (Krieger et al. 2003, Darden et al. 2010). They are appropriate for this study because the US Forest Service boasts economic benefits to communities in the form of jobs and income (USDA Forest Service 2017a). Poverty is included because it encompasses more than just employment and income, and it is easy to calculate and interpret (Darden et al. 2010).

1.3 Previous Research

Studies have shown that communities that are near or inside national parks, reserves, or conservation areas have reduced or similar poverty compared to communities without these natural areas. In Costa Rica and Thailand, it was found that communities with protected areas

(conservation areas) have reduced poverty when compared to communities without protected areas (Andam et al. 2010). Researchers used matching methods to examine the effect of protected areas on poverty in protected area communities. Non-parametric and semi-parametric econometric estimators were used to study the effects of protected areas on local and indigenous communities. In Bolivia's protected areas there was no significant difference between communities with and without protected areas (Hanauer and Canavire-Bacarreza 2015). Protected areas were not "poverty traps" and did not impact indigenous populations.

In other countries, communities with protected areas are less well-off. A study conducted in Minas Geris, Brazil (Sálvio et al. 2016) looked at the correlation between two socioeconomic development indicators and conservation areas. The researchers used the Human Development Index (HDI) and the Gini Index (GI) to compare municipalities with and without conservation areas. HDI is location based and uses life expectancy of its citizens at birth, access to education, and per capita income to help determine socioeconomic position. GI is a measure of inequality where 0 is perfect income equality and 1 is perfect income inequality and concentration. The two indexes were used to compare total municipality conservation areas, sustainable conservation areas, and fully protected conservation areas with municipalities without conservation areas. The sustainable and fully protected conservation areas are similar to the U.S. Forest Service lands because some are accessible to recreation and sustainable land use practices such as grazing or harvest, and other areas are fully protected and off limits to any type of disturbances. Comparing the HDI, there was no significant difference between municipalities with conservation areas and municipalities without conservation areas for all, sustainable, and fully protected conservation areas. However, the GI comparisons showed a significant difference between municipalities with conservation areas (all, sustainable, and fully protected) and municipalities without conservation

areas. The GI was higher in municipalities with conservation areas in all three cases (all, sustainable, and fully protected). These results are an indication of higher social inequalities in municipalities with conservation areas (Sálvio et al. 2016).

These countries have their own unique government systems to manage conservation or protected areas. Just as the United States has the Forest Service to manage national forestland, other countries have government agencies that are equipped (or ill-equipped) to manage natural lands. The case for socioeconomic prosperity in regions with conservation areas should be taken on a country by country basis due to unique geography, government agencies, and politics (McShane et al. 2011; Andam et al. 2010).

1.4 Rationale and Significance

Nationally, US Forest Service lands provide the American economy with millions of dollars annually. State and local economies can also benefit from federally funded and managed lands. It is important to examine national forests' impact because forestry may a large part of the regional, state, and local economies. The large economic benefits of national forests have been widely examined (Williams 2004, USDA Forest Service 2017d). Surveys have been conducted to examine environmental attitudes of residents near national forests and natural resource areas (Fortmann and Kusel 1990, Jones et al. 2003). In addition to environmental priorities, the economic characteristics of rural communities are changing due to the in-migration of young healthy adults and aging baby boomers.

While the previous studies summarized above have evaluated economic benefits of U.S. national forests on a nation-wide or other large scale, none of them have examined the benefits of national forests on local residents' socioeconomic position. Natural resource values (ecosystem services), recreational income (hunting and fishing), and jobs are just a few examples

of the broad economic characteristics that the Forest Service reported in their annual fiscal budget overview (USDA Forest Service 2017d). Studies found that residents who reside near national forests tend to be more environmentally conscious and utilize the forests for recreational opportunities that add to the local economy, but there was no supporting data on how much the presence of the forests added to the local economy (Fortmann and Kusel 1990, Jones et al. 2003). Although there are positive attitudes towards the aesthetic (Jones et al. 2003) and recreation benefits of national forests, the local economic benefits of national forests have yet to be examined.

Evaluating socioeconomic factors such as income and employment at the county, state, and regional levels allows for an examination of some of the local socioeconomic impacts national forests could provide to their immediate communities (Krieger et al. 1997). Policy makers and natural resource managers should be aware of the impacts that national forests have on local communities when considering the future of the U.S. Forest Service. If there are few local socioeconomic benefits of national forests, rural towns could have lower economic prosperity, leading to less education, a lower quality of life, higher risk of morbidity and mortality, and numerous other risks to individuals of low socioeconomic position (Kreiger et al. 1997). This research examining socioeconomic characteristics of communities with national forests will give policy makers information to explore the further integration national forests into communities to provide jobs and other economic benefits to national forest neighbors. If a community with national forest has an implied lower socioeconomic position, the Forest Service could provide new jobs, educational opportunities, outreach programs, volunteer opportunities, vocational training, and other services to the local residents, thus fulfilling its goal to “serve the people.”

1.5 Hypotheses

The overall goal of this research is to use socioeconomic factors to study the local economic characteristics of communities that are in close proximity to national forests. The specific objectives of the study will be to:

1. Compare median household income for national forest areas and areas without national forests.

   Hypothesis: Median household income will be higher in areas in close proximity to national forests than in areas lacking national forests.

2. Compare unemployment rates for national forest areas and areas without national forests.

   Hypothesis: The unemployment rate will be higher in areas without national forests than in areas in close proximity to national forests.

3. Compare percent of the population in poverty for national forest areas and areas without national forests.

   Hypothesis: Percent of the population in poverty will be higher in areas without national forests than in areas in close proximity to national forests.

4. Use three different spatial resolutions: nationwide, U.S. Forest Service regions, and states to evaluate income, unemployment, and poverty.

   Hypothesis: States will show more statistically significant differences because of the relatively small spatial resolution.

CHAPTER 2

METHODS

2.1 Income

Income is defined by the Census Bureau as "income received on a regular basis (exclusive of certain money receipts such as capital gains) before payments for personal income taxes, social security, union dues, Medicare deductions, etc." Not included in the income measurements are non-cash benefits such as food stamps, health benefits, full or partial payments by business for retirement programs, and educational expenses (United States Census Bureau 2017d). The 2015 median household income data from the Census Bureau will be used because this is a common factor used to determine one's socioeconomic position (Krieger et al. 1997).

2.2 Poverty

To compute poverty status, multiple incomes are used to set a threshold for different family sizes and compositions. Poverty thresholds are updated annually for inflation and do not vary geographically, meaning they are the same throughout the entire United States. Earnings, unemployment compensation, workers' compensation, social security, supplemental security income, public assistance, veterans' payments, survivor benefits, pension or retirement income, interest, dividends, rents, royalties, income from estates, trusts, educational assistance, alimony, child support, assistance from outside the household, and other miscellaneous sources are used to determine poverty status (United States Census Bureau 2017c). Percentage below poverty threshold will be used because it is often a stand-alone measure of community economic prosperity (Krieger et al. 1997).

2.3 Unemployment

Employment and unemployment levels are measured by the Census Bureau. The Census Bureau collects data that classifies the worker, their occupation and industry, and categorizes them by age, race, gender or household composition. Employment is measured at various geographic levels to help planners and policy makers identify different community needs (United States Census Bureau 2017a). The 2015 unemployment rate data from the Census Bureau will be used because unemployment rate is often used to evaluate community economic outlook (Krieger et al. 1997).

2.4 Spatial Data

The National Forest boundaries and U.S. Forest Service regional boundaries were downloaded from the U.S. Forest Service Geodata Clearinghouse. The National Forest shapefile from the U.S. Forest Service Geodata Clearinghouse contained national forests and national grasslands. For this paper, they will both collectively be referred to as "national forest" or "national forest areas." National grasslands are managed in similar ways as national forests so they are equitable to national forests. The most recent data available at the time of analysis was from 2015.

I examined the three socioeconomic factors at three different spatial resolutions. The different drawn boundaries or "shapes" are (1) the contiguous United States (whole and varying percent of national forest), (2) U.S. Forest Service regions, and (3) states (Figures 1 and 2). I selected U.S. Forest Service region boundaries because each region varies by different regional goals, geographies, and leadership. Comparing different regions would be beneficial to see which regions are more involved with their communities and focus on social or economic benefits. States were also examined because natural resource laws vary across states and the

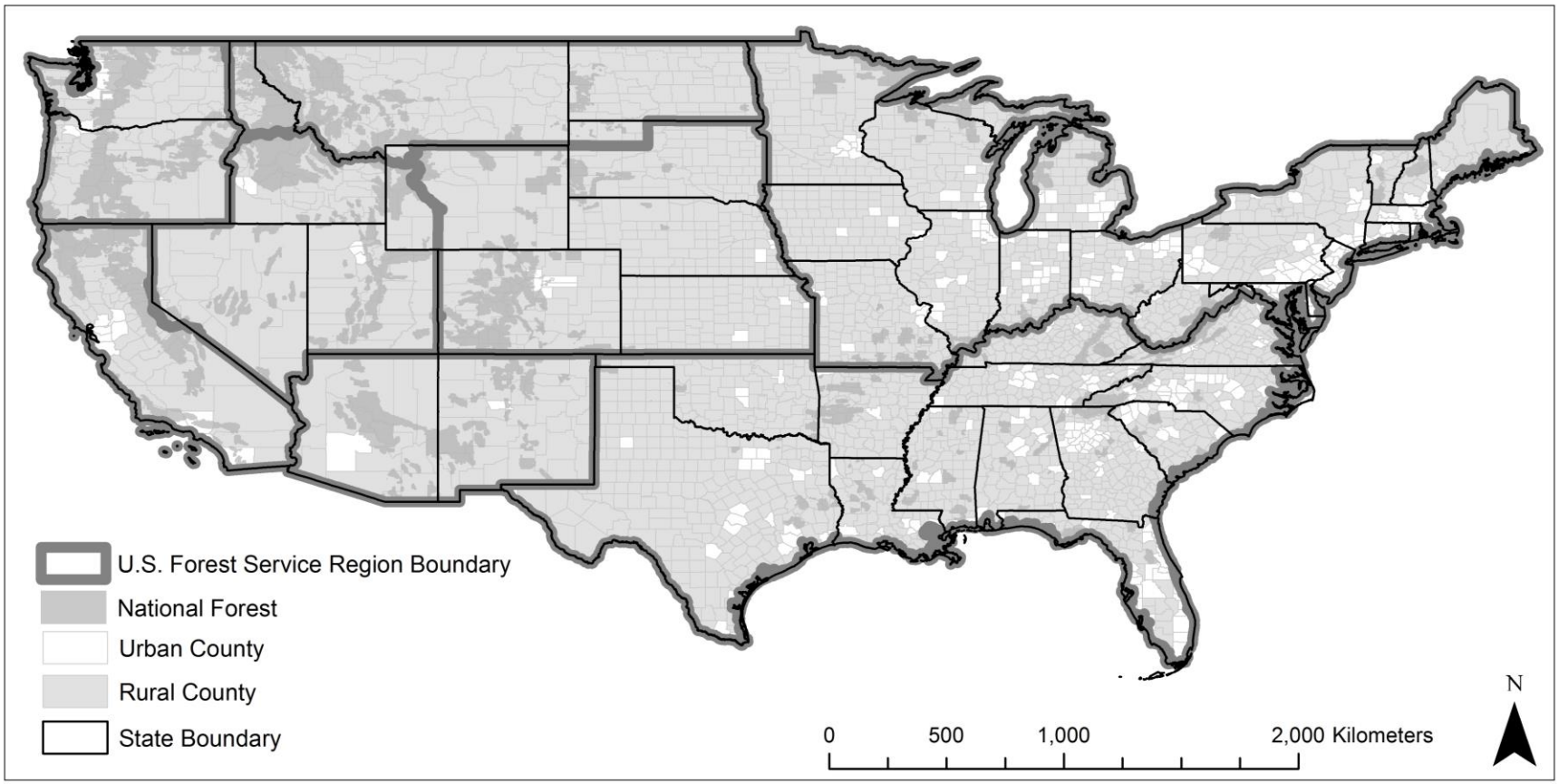

Figure 1. The state and regional boundaries of the study area.

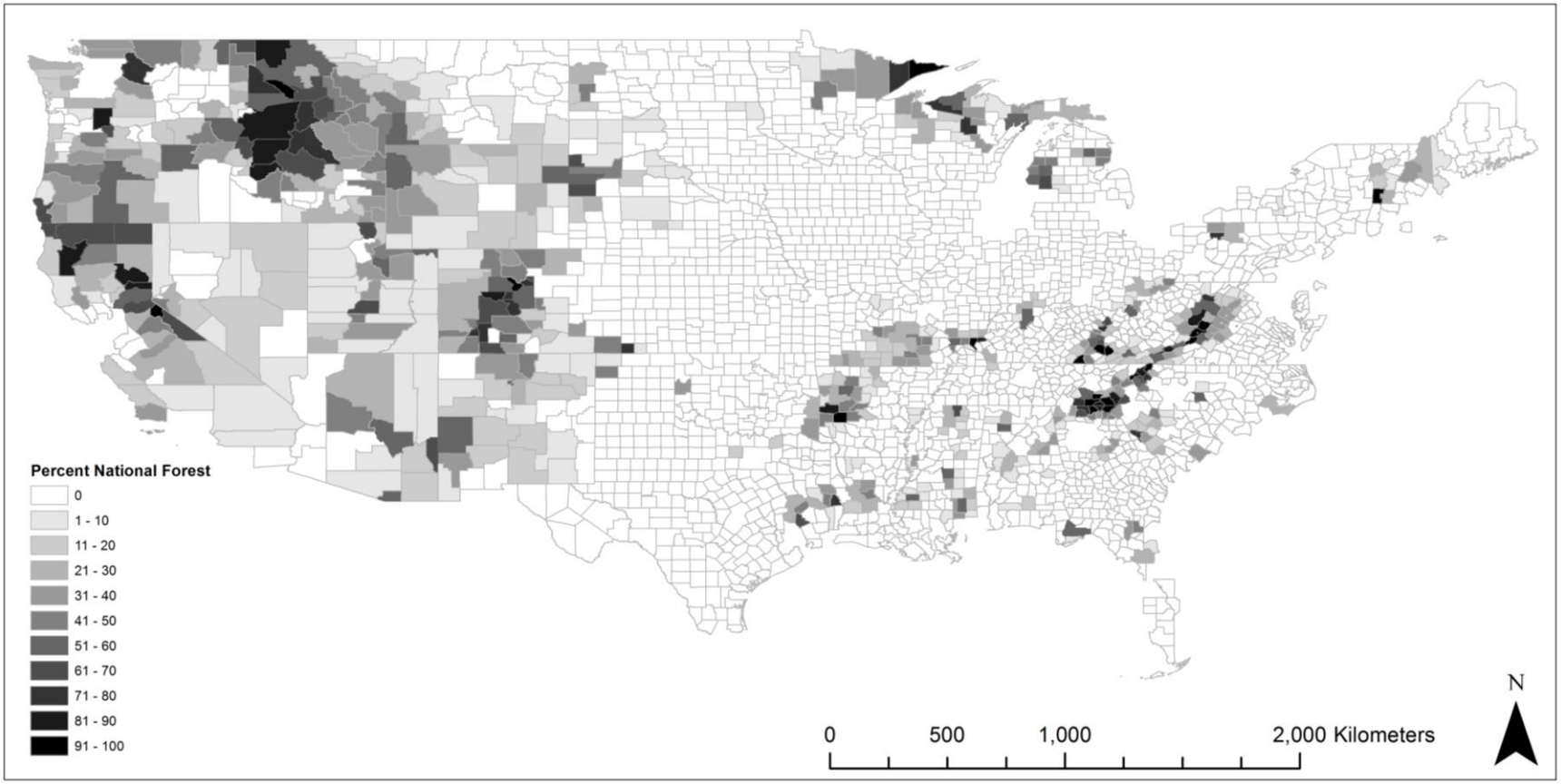

Figure 2. Differing percent of national forest within counties.

federal government pays states in lieu of taxes for tax-exempt federal lands. Federal lands include lands managed by the Bureau of Land Management, the National Park Service, the U.S. Fish and Wildlife Service, the U.S. Forest Service, federal water projects and some military installations (U.S. Department of the Interior 2017).

I evaluated each socioeconomic factor for each spatial resolution (shape) on a county level. The smallest spatial unit should be used to analyze socioeconomic disadvantage or position (Tervonen et al. 2016; Briant et al. 2008). I chose counties as my smallest spatial unit because counties were originally drawn to provide government services in rural areas. New counties often formed out of local pride, where like-minded people lived near others of the same capacity (Jackson 2017). Census tracts and block groups are smaller in size and people may not be living and working in the same census tract. I wanted to evaluate counties instead of census tracts or block groups because those tend to follow people (United States Census Bureau 2017b) and it is more likely that an individual lives and works in the same county rather than the same census tract or block group. Counties that were drawn before there were even settled people in the area (Jackson 2017) will likely be less political. Counties are often used in socioeconomic analyses (Krieger et al. 1997).

The "urban areas" are from the 2015 "Cartographic Boundary Shapefiles – Urban Areas" provided by the Census Bureau. To compare counties of similar characteristics, the percent of rural land area was calculated for all counties and census tracts in the contiguous United States. Only counties with at least 90% rural land by area (rural counties) were included in the study (Figure 3). Ninety percent rural area was selected because it includes a large majority (82.5%) of all counties in the U.S. ArcGIS 10.4.1 for Desktop was used to create all maps included in this research.

2.5 Statistical Analysis

Median household income, unemployment rate, and percent in poverty for counties that contain national forest will be averaged together and compared to the averages of counties without national forests. The "overall picture" varies less when values are averaged instead of summed (Briant et al. 2008). Welch Two Sample *t*-tests were used to evaluate differences between means and determine statistical significance ($p \leq 0.05$). The Welch *t*-test assumes normality, accounts for equal or unequal variances, and is robust when data is skewed or heterogenous (Welch 1938, Ruxton 2006, Fagerland and Sandvik 2009). All statistical tests were done in R, version 3.3.2.

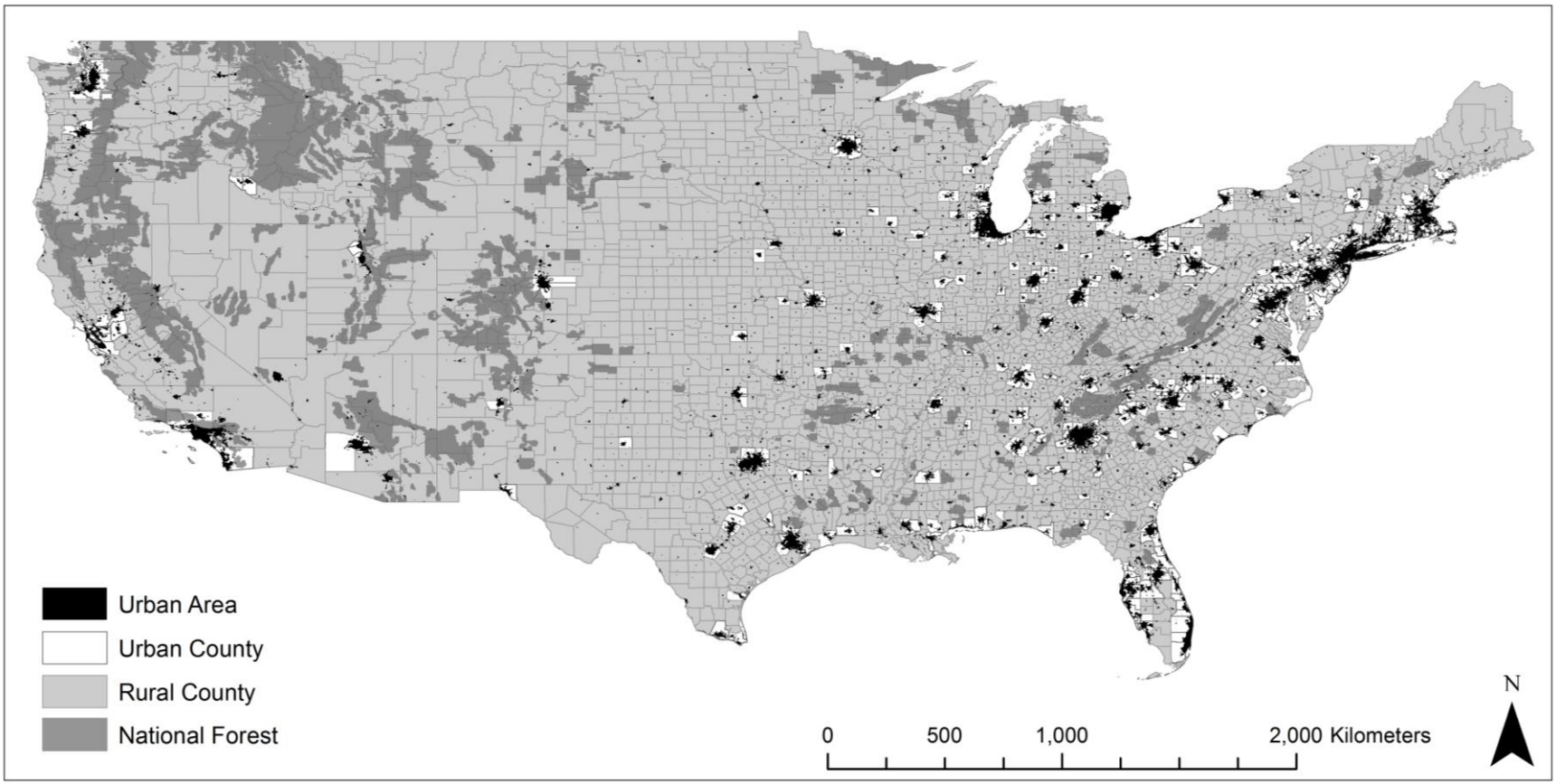

Figure 3. Rural counties (light gray) that are at least 90% rural by land area and urban counties (white) that are less than 90% rural by land area.

CHAPTER 3

RESULTS

There are 2,624 counties in the contiguous 48 states that are at least 90% rural by land area. Two of the 48 states, Rhode Island and Delaware, were not included in any analyses because they did not contain any rural counties. Iowa, Maryland, New Jersey, Connecticut, and Massachusetts were included in the nationwide analyses, but not the state analyses because none of their counties contained any national forests. Utah was included in the nationwide analyses but not the state analyses because every county had national forests. One county, Mineral County, Colorado, was excluded from data analysis because there was no median household income, unemployment rate, or percentage below poverty provided by the 2015 U.S. Census Bureau.

3.1 Nationwide

In all rural counties in the contiguous United States, 662 counties contained national forests. The remaining 1,961 counties did not contain national forests. Median household income was lower in counties that contained national forests ($p < 0.001$). Percentage below the poverty threshold and unemployment rate were higher ($p < 0.001$) in counties that contained national forests (Table 1). Counties containing different percentages of national forest by land area were compared to counties with no national forest. Counties containing 1-30% national forest had lower median household income, higher percentage below the poverty threshold, and higher unemployment rate, than counties with no national forest ($p < 0.001$). Counties with 31-40%, 51-60%, and 81-90% national forest had statistically high unemployment rates. The average median

household income was higher in counties without national forests when compared with counties that had 91-100% national forest (Table 1).

Table 1. Average income, poverty, and unemployment rate for counties with and without national forest in all counties and counties with varying percentages of national forest.

	Average Median Household Income ($)		Average Percentage Below the Poverty Threshold (%)		Average Unemployment Rate (%)	
Percent National Forest (%)	National Forest Counties	No National Forest Counties	National Forest Counties	No National Forest Counties	National Forest Counties	No National Forest Counties
1-10	42,907*	44,987*	19.3***	16.8***	8.7***	7.5***
11-20	42,080*	44,987*	18.8*	16.8*	8.7***	7.5***
21-30	43,390*	44,987*	18.1*	16.8*	9.0***	7.5***
31-40	44,233	44,987	17.3	16.8	8.2*	7.5*
41-50	44,193	44,987	17.5	16.8	8.3	7.5
51-60	44,565	44,987	17.3	16.8	8.3*	7.5*
61-70	44,734	44,987	17.0	16.8	8.5	7.5
71-80	42,047	44,987	16.5	16.8	8.6	7.5
81-90	42,258	44,987	17.0	16.8	9.6*	7.5*
91-100	38,969*	44,987*	19.8	16.8	9.4	7.5
All Counties	43,186***	44,987***	18.2***	16.8***	8.6***	7.5***

* Significant at the 0.05 probability level
*** Significant at the 0.001 probability level

The average median household income for all counties (in all 46 states included in the analysis) that contain national forests was $43,186 and the average for counties that do not contain national forest was $44,987. The average percent of the population in poverty for counties containing national forest was 18.2 compared to just 16.8 in counties without national forest. Lastly, the average unemployment rate was 8.6% in counties with national forest and just 7.5% in counties without national forest.

Counties that contained 1-30% and 91-100% national forest had an average median household income between $38,969 to $43,390, which was statistically lower than counties without national forests whose average median household income was $49,987. Percent below poverty threshold was higher in counties with no more than 30% national forest by 1.3-2.5%. The unemployment rate was higher by 0.8-2.1% in 1-40%, 51-60%, and 81-90% national forest counties.

3.2 U.S. Forest Service Regions

The U.S. Forest Service has nine geographic regions: Northern, Rocky Mountain, Southwestern, Intermountain, Pacific Southwest, Pacific Northwest, Southern, Eastern, and Alaska (Table 2). The divisions of these regions closely follow state and county boundaries with

Table 2. Average income, poverty, and unemployment rate for counties with and without national forest in U.S. Forest Service Regions.

	Average Median Household Income ($)		Average Percentage Below the Poverty Threshold (%)		Average Unemployment Rate (%)	
Region	National Forest Counties	No National Forest Counties	National Forest Counties	No National Forest Counties	National Forest Counties	No National Forest Counties
Eastern	41,351***	48,015***	17.5***	14.1***	8.6***	6.9***
Intermountain	51,481*	45,921*	14.2	16.1	7.0	8.3
Northern	45,051***	51,966***	16.1*	12.5*	6.4***	3.2***
Pacific Northwest	44,961	47,527	17.4	17.6	10.0*	8.4*
Pacific Southwest	49,055	54,872	17.7	18.2	11.2	12.4
Rocky Mountain	50,665*	47,517*	14.0	13.5	6.1***	4.5***
Southern	37,834***	41,277***	21.4*	20.1*	9.6*	9.0*
Southwestern	41,695	37,937	21.4	21.2	9.8	9.0

* Significant at the 0.05 probability level
*** Significant at the 0.001 probability level

the exception of Idaho, Wyoming, and South Dakota. The counties that were split by a regional boundary were included in the region that had the land majority of the county within that region. The Northern Region includes North Dakota, the northwest corner of South Dakota, Montana, and the northern part of Idaho. It had 53 counties containing national forest and 69 counties without national forest. There were 73 counties containing national forest and 256 counties without in the Rocky Mountain Region (South Dakota, Wyoming, Colorado, Nebraska, and Kansas). New Mexico and Arizona comprise the Southwestern Region that had 34 national forest counties and 12 counties without national forest. The Intermountain Region, made up of the southern half of Idaho, Nevada, Utah, and eastern Wyoming, had 66 national forest counties compared to only 12 without national forest. California is the only state in the Pacific Southwest Region and had 35 counties with national forest and 9 without. Oregon and Washington make up the Pacific Northwest and had 48 national forest counties and 18 counties without national forest. The large Southern Region includes Texas, Oklahoma, Arkansas, Louisiana, Mississippi, Alabama, Florida, Georgia, South Carolina, North Carolina, Virginia, Tennessee, and Kentucky. There were 223 national forest counties and 889 counties without national forest. The Eastern Region had 130 counties with national forest and 696 counties without. The states that make up the Eastern Region that are included in this research are Minnesota, Iowa, Missouri, Wisconsin, Illinois, Michigan, Indiana, Ohio, West Virginia, Pennsylvania, New York, Vermont, New Hampshire, and Maine.

Income

Counties containing national forests had a higher median household income in the Intermountain Region ($p = 0.048$) and Rocky Mountain Region ($p = 0.023$). The Intermountain Region counties with national forest had an average median household income of $51,481 and

the counties without national forest had an average median household income of $45,921. In the Rocky Mountain Region, the average median household income was $50,665 for counties containing national forest and the counties without national forest only had an average median household income of $47,517. As seen in Figure 4, the Pacific Northwest, Pacific Southwest, and

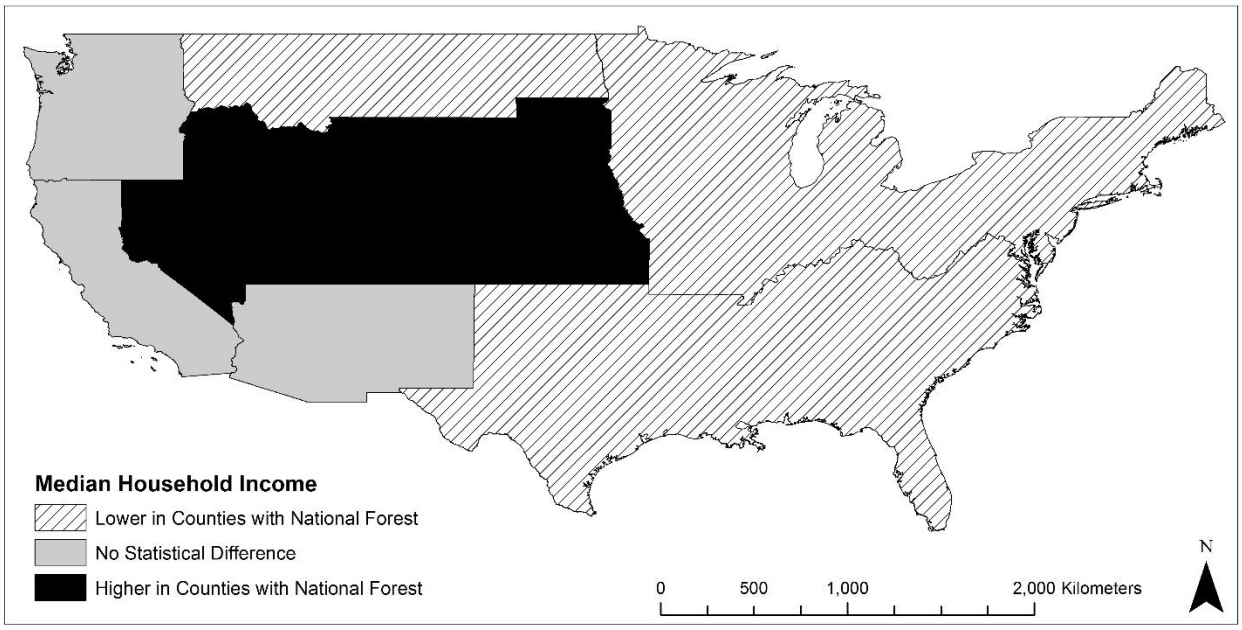

Figure 4. Median household income of counties with national forests compared to those without in U.S. Forest Service Regions.

Southwestern Regions had no statistical differences between counties containing national forests and counties without ($p > 0.05$). The Northern ($p < 0.001$), Eastern ($p < 0.001$), and Southern ($p < 0.001$) Regions' counties without national forests had higher median household incomes (Figure 4). The Northern Region counties without national forest had an average median household income of $51,966 and counties in this region with national forest had an average median household income of $45,051. The counties with no national forest in the Eastern Region had an average median household income of $48,015 compared to counties with national forest at $41,351. The Southern Region counties had the largest difference in median household

incomes. Counties with national forest had an average of only $37,834 compared to counties without national forest whose average median household income was $41,277.

Poverty

The regions that had statistically significant different averages of percentage below the federal poverty threshold were the Northern ($p = 0.004$), Eastern ($p < 0.001$), and Southern ($p = 0.005$) Regions (Figure 5). These regions had counties with national forests that had higher

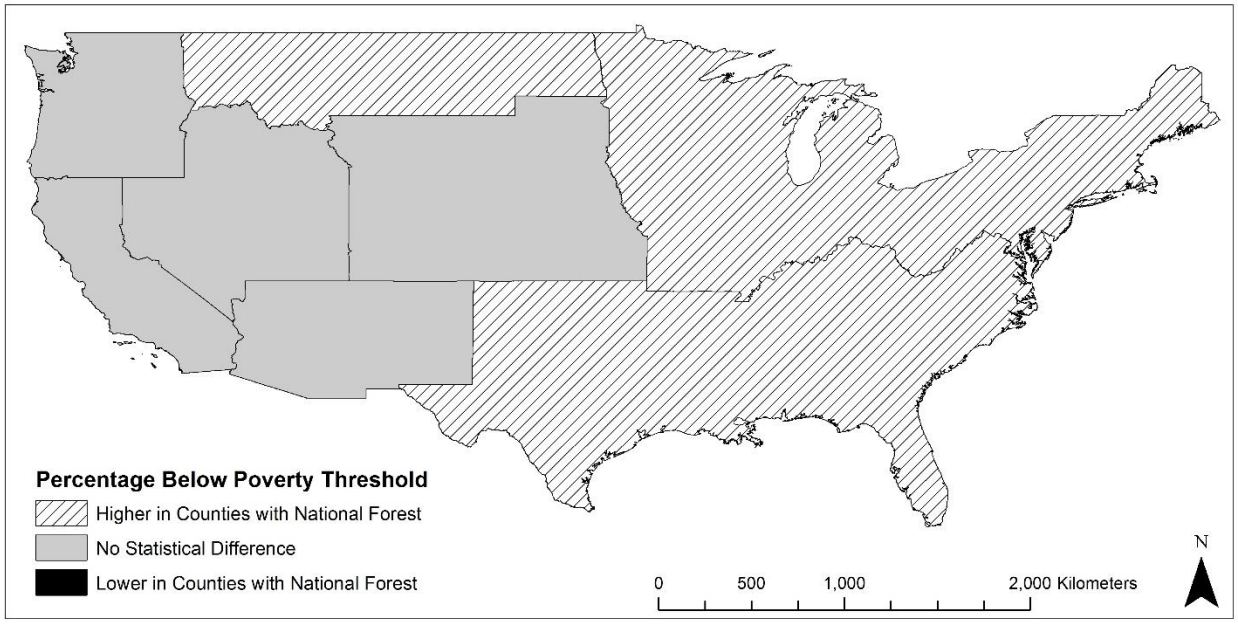

Figure 5. Percentage below poverty threshold of counties with national forests compared to those without in U.S. Forest Service Regions.

percentages in poverty than counties without national forests. The counties with national forest in the Northern Region had 16.1% of their population in poverty and only 12.5% in poverty in counties without national forest. In the Eastern Region, there was only 14.1% in poverty in counties without national forests compared to 17.5% of the population in poverty in counties with national forest. The Southern Region had the smallest significant difference with 21.1% in poverty in counties without national forest and 21.4% in poverty in counties with national forest.

There was no statistical difference ($p > 0.05$) between county groups in the Intermountain, Rocky Mountain, Pacific Northwest, Pacific Southwest, and Southwestern Regions (Figure 5).

Unemployment

The unemployment rate for counties containing national forest is statistically higher than counties without national forest in the Northern ($p < 0.001$), Eastern ($p < 0.001$), Southern (p 0.007), Rocky Mountain ($p = 0.001$), and Pacific Northwest (Figure 6) Regions ($p = 0.005$). The Northern Region's counties with and without national forest unemployment rates were 6.4% and 3.2%, respectively. The Eastern Region counties with national forest had an unemployment rate of 8.6% while the counties without national forest had an average unemployment rate of 6.9%. The Southern Region unemployment rates between counties was the smallest. The counties with national forest had an average unemployment rate of 9.6% only 0.6% higher than counties without national forest. National forest counties in the Rocky Mountain Region had an average

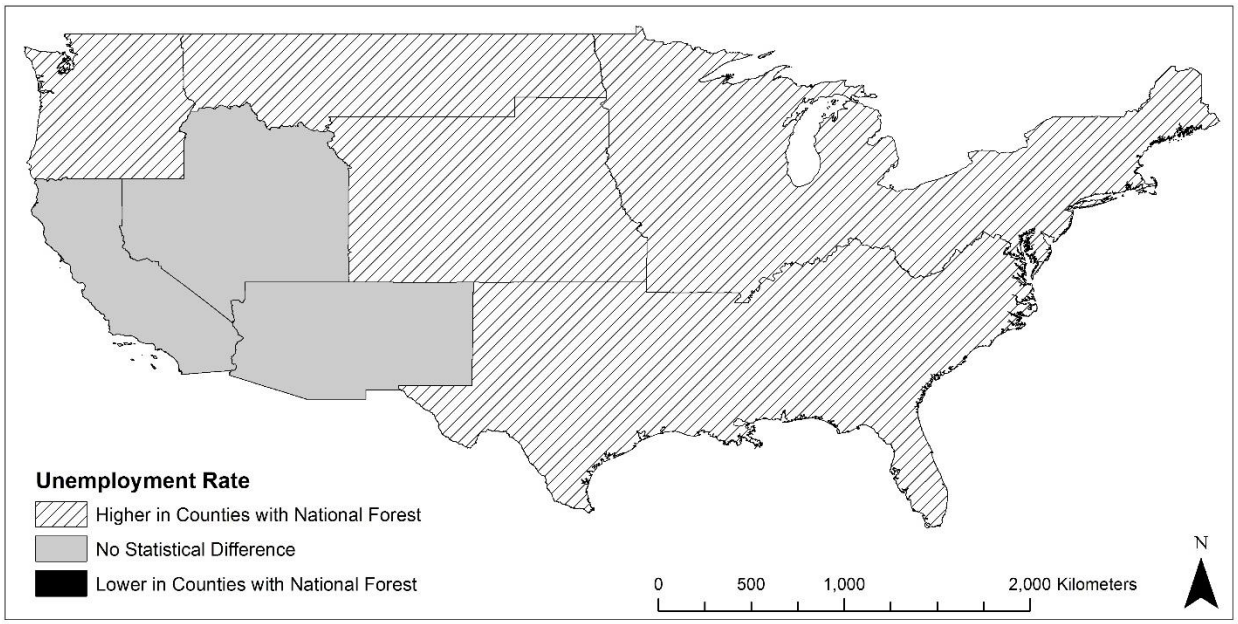

Figure 6. Unemployment rate of counties with national forests compared to those without in U.S. Forest Service Regions.

unemployment rate of 6.1% and counties without national forest in this region had an unemployment rate of 4.5%. The Pacific Northwest Region counties with national forest had an unemployment rate of 10.0% compared to counties without national forest that only had an unemployment rate of 8.4%. In the Pacific Southwest, Southwestern, and Intermountain Regions there was no statistical difference ($p > 0.05$) between counties with and without national forest for unemployment rate.

3.3 States

County averages for median household income, percentage below poverty threshold, and unemployment rate were analyzed for 40 out of the 48 contiguous United States. Fifteen states had statistically significant differences between county means for at least one of the socioeconomic factors. The statistically significant states had either all three significant socioeconomic factors, only significant median household income and/or unemployment, or significant median household income and percentage in poverty (Table 3). No state had only statistically significant percentage below poverty threshold.

Income

Georgia was the only state that had statistically higher median household income in counties with national forest than counties without ($p < 0.001$). Georgia counties with national forest had an average median household income of $41,888 compared to counties without national forest, $36,602. Counties without national forests in Minnesota, Wisconsin, Michigan, Illinois, Ohio, Missouri, Kentucky, Virginia, and Texas had statistically higher median household income than counties with national forest ($p < 0.01$). These states' county differences ranged from about $4,000 higher median household income in counties without national forest in Missouri to a little over $10,000 in Illinois and Kentucky. The remaining 30 states showed no

Table 3. Average income, poverty, and unemployment rate for counties with and without national forest in statistically significant states.

	Median Household Income		Percentage Below Poverty Threshold (%)		Unemployment Rate (%)	
State	National Forest Counties	No National Forest Counties	National Forest Counties	No National Forest Counties	National Forest Counties	No National Forest Counties
Georgia	41,888***	36,602***	19.0***	24.3***	9.2	10.2
Illinois	38,741***	49,398***	20.4*	13.6*	10.6*	7.5*
Indiana	46,446	48,055	14.3	13.4	6.0*	7.4*
Kentucky	29,969***	40,062***	29.0***	20.5***	11.6***	8.9***
Michigan	38,876***	44,937***	18.5*	16.0*	11.0*	9.6*
Minnesota	47,288*	52,526*	14.9*	11.7*	6.9*	4.8*
Missouri	37,834*	41,835*	20.4*	17.6*	9.1***	7.1***
Mississippi	34,767	33,331	25.0	27.5	11.1*	13.1*
Nebraska	46,176	48,426	13.8	11.9	1.4*	3.4*
N. Carolina	38,635	39,920	20.0	20.4	9.2***	11.4***
Ohio	39,842***	48,054***	20.7*	14.6*	9.1*	7.8*
Texas	39,378*	45,931*	20.7*	17.0*	9.1*	6.6*
Virginia	45,112*	52,687*	14.6	13.8	6.8	7.3
Washington	46,165	48,750	17.1	17.9	9.7*	7.8*
Wisconsin	44,333***	50,270***	13.3	12.6	7.3*	5.9*

* Significant at the 0.05 probability level
*** Significant at the 0.001 probability level

statistically significant difference ($p > 0.05$) between counties with and without national forest for median household income (Figure 7).

Poverty

Similar to median household income, Georgia is the only state whose counties with national forest have implied higher socioeconomic position based on lower percentage below poverty threshold ($p < 0.001$). Georgia counties with national forest had an average percent of 19.0% in poverty compared to counties without national forest whose average percent in poverty was 24.3. Illinois, Kentucky, Michigan, Minnesota, Missouri, Ohio, and Texas all had a higher

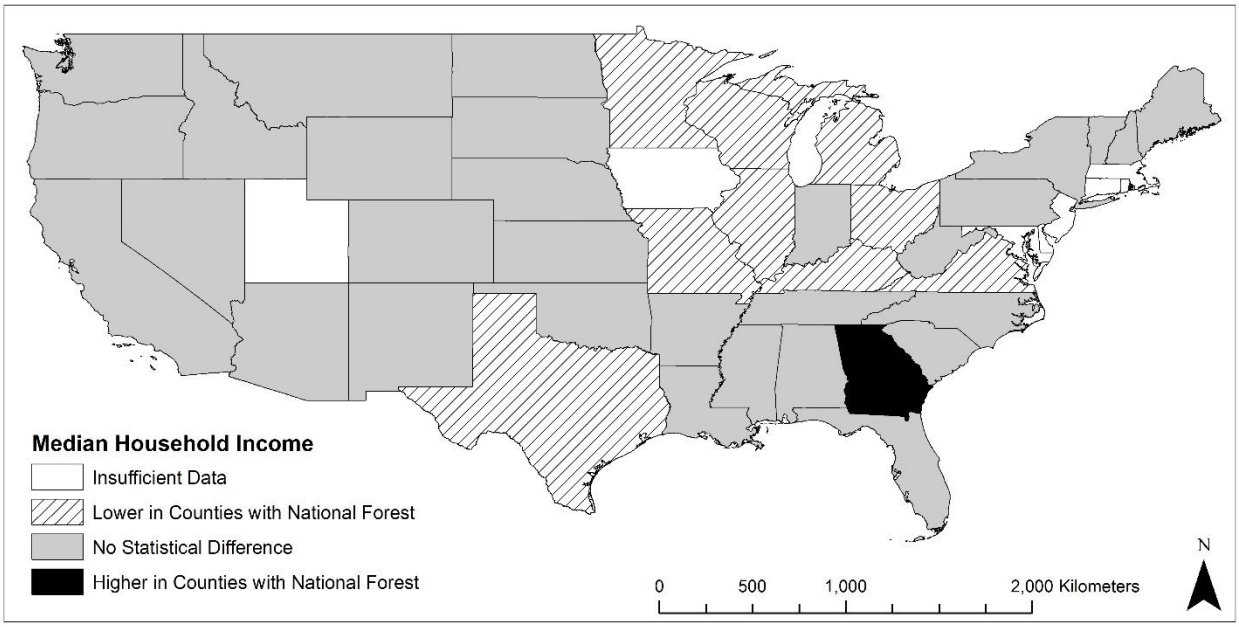

Figure 7. Median household income of counties with national forests compared to those without in the contiguous United States.

percent in poverty in counties with national forest than without ($p < 0.05$). The higher percent of the population in poverty for these states range from 2.4-8.5%. All other states do not have differences ($p > 0.05$) in their county poverty averages (Figure 8).

Unemployment

Nebraska, Indiana, Mississippi, and North Carolina's counties with national forest have a lower unemployment rate than their counties without national forests ($p < 0.05$). Their national forest counties' average unemployment rate is 1.4% to 2.2% lower than counties without national forest. States that have counties without national forest that have lower percent in poverty include Oregon, Minnesota, Wisconsin, Michigan, Illinois, Ohio, Missouri, Kentucky, and Texas ($p < 0.05$). Counties without national forest in these states had an average unemployment rate higher by 1.3-3.1%. The remaining states had no statistically significant differences ($p > 0.05$) in their counties' average unemployment rates (Figure 9).

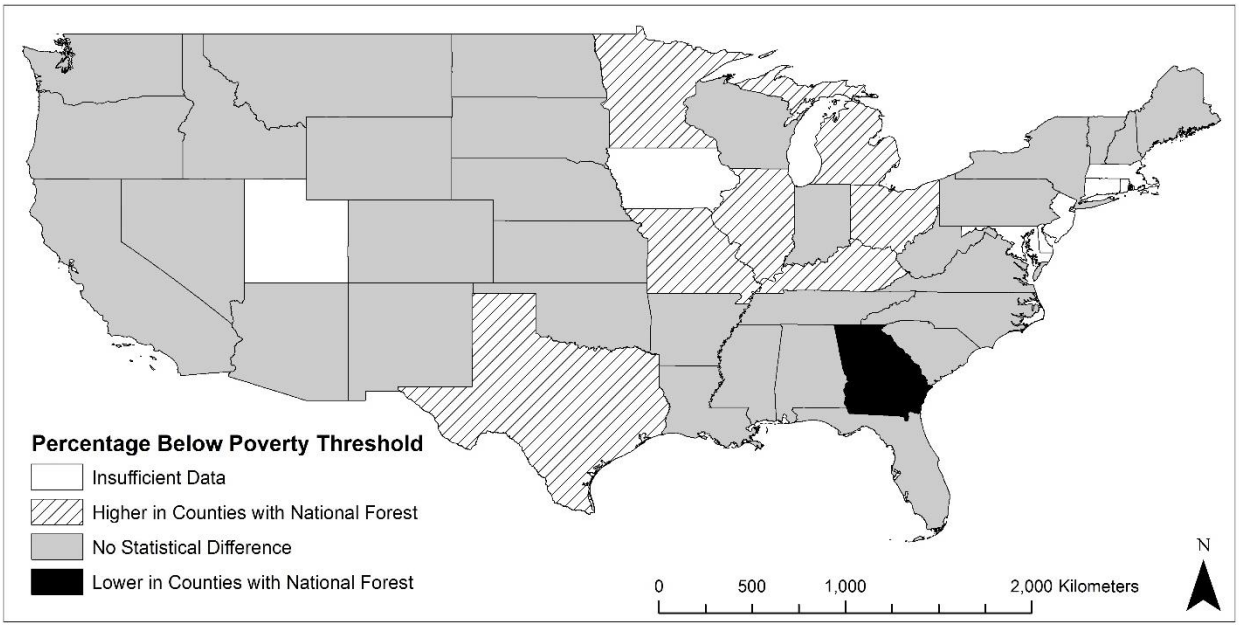

Figure 8. Percentage below poverty threshold of counties with national forests compared to those without in the contiguous United States.

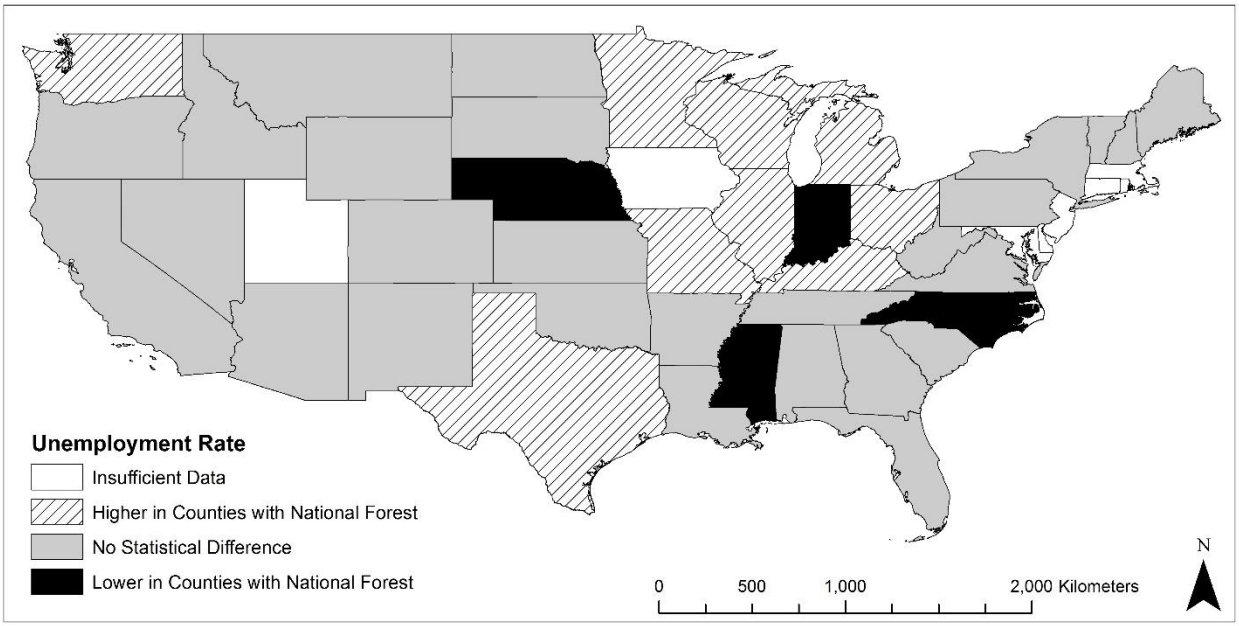

Figure 9. Unemployment rate of counties with national forests compared to those without in the contiguous United States.

CHAPTER 4

DISCUSSION

Factors used to determine socioeconomic position were analyzed for counties containing national forest and those without using three measures, (1) median household income, (2) percentage below poverty threshold, and (3) unemployment rate. Higher socioeconomic position is implied by higher median household income, lower percentage below poverty threshold, and lower unemployment rate. The U.S. Forest Service Intermountain and Rocky Mountain Regions, Georgia, Indiana, Mississippi, Nebraska, and North Carolina had at least one socioeconomic factor that could be used to imply higher socioeconomic position in counties with national forest than those without.

4.1 Nationwide

All counties with national forest that were at least 90% rural in the lower 48 states had lower implied socioeconomic position than counties without national forest. The median household income was lower, the percent in poverty was higher, and the unemployment rate was higher in counties with national forests. Counties with 1-30% national forest had indications of lower socioeconomic position for all three factors as well. Counties containing 31-40%, 51-60%, and 81-100% national forest only had one factor that indicated counties with national forest have lower socioeconomic position. This trend could be because counties with small amounts of land area of national forests have other dominant industries that make national forest lands and jobs secondary to other, more abundant sources of income. Conversely, counties with a higher percent of national forest coverage could have too much national forest lands. These high percentages of

national forest may be impeding on a balance and diversity that could help the county grow. Too much public land and too few private businesses may result in a community having little economic growth.

Topography and geography may also be factors. The size of the spatial unit (counties) may be too large to accurately represent national forest communities. In many cases of eastern and western national forests, the national forests are located in the more rugged terrain. Counties with 1-30% national forest land are likely near the lower slopes of ridges or intermixed with agricultural areas on flatter slopes. Counties with 90% or more national forest land likely are situated in rugged land where other industry is lacking (except perhaps mining or recreation).

The shifting focus of the United States Forest Service could be a reason why national forest counties are struggling economically. The U.S. Forest Service has been driven by a combination of science and policy. In its inception, the focus of the Forest Service was to protect national forests from fire and abuse. During the Great Depression, the Forest Service helped create jobs and conservation work programs through opportunities on national forest lands. After World War II the Forest Service focused on timber production as well as dealt with many controversies involving clearclutting, environmental protection, and consideration for all uses of the forests, not just timber production. In the past few decades, the focus has been to embrace ecological management, national fire planning, partnerships, and collaborative stewardship (Williams 2004). Despite the growing global timber market, emphasizing conservation and sustainability as it relates to climate change are becoming the focus of the U.S. Forest Service (Blate et al. 2009). Climate change is a highly politicized science topic that may have an effect on the goals and priorities of the U.S. Forest Service. Jobs provided by public land timber harvest could be important in rural communities' economy. If there are fewer forest areas being

harvested to protect wildlife, watersheds, and endangered species, the U.S. Forest Service could have difficulty partnering with local mills, harvesters, and markets. Timber harvest provides many jobs to communities in close proximity to national forests, and some argue that it needs to continue to be a top priority for the U.S. Forest Service (Dombeck 2000).

In 1998 there were over 17,500 Forest Service staff dedicated to managing National Forest System lands. In 2015 there were just over 10,000 Forest Service staff dedicated to managing the lands. The shift in staff comes from the increased number of wildfires. In 1998 there were just over 5,000 Forest Service fire personnel. In 2015 that number has doubled and is close to 12,000 fire personnel. The wildfire responsibilities that the U.S. Forest Service has taken on in the last couple decades has overtaken the budget, activity, and services the Forest Service provides to the public (Vilsack 2015). The increase in fire personnel has provided additional employment with the Forest Service, but firefighting is limited in who can successfully perform the duties the position requires. Firefighting is a male-dominated industry and requires physical fitness, training, and certification, making it an employment opportunity that is limited (Haynes and Stein 2017).

4.2 U.S. Forest Service Regions

The large Northern, Eastern, Southern, and Pacific Northwest Regions' socioeconomic factors all showed that there could be less socioeconomic prosperity in areas with national forest. In Fiscal Year 15 the Northern and Southern Regions allocated the most amount of funds to state and private forestry compared to the other six regions (Table 4). The State and Private Forestry programs help states and private landowners maintain their forests. Since there are more private forests than public forests in the Northern, Eastern, and Southern Regions, the main benefactors from forests are the private landowners who own the forests. The private landowners can enjoy

Table 4. Fiscal Year 2015 budget for U.S. Forest Service Regions.

Region	State and Private Forestry	National Forest System	Wildland Fire Management	Capital Improvement and Maintenance	Other	Total All Funds
Northern	22,582	136,215	83,122	30,450	31,790	304,159
Rocky Mountain	10,993	117,029	64,843	34,175	26,331	253,371
Southwestern	7,049	119,655	96,610	25,879	16,559	265,752
Intermountain	9,102	122,579	84,783	30,167	33,887	280,518
Pacific Southwest	11,321	126,815	309,566	37,294	113,395	598,391
Pacific Northwest	15,686	167,911	125,809	42,300	72,169	423,875
Southern	40,233	134,074	101,636	38,885	68,592	383,420
Eastern	25	126,406	37,210	30,274	41,488	235,403

(dollars in thousands)

the benefits (such as hunting, aesthetics, and recreation) their own land gives them and may not necessarily need the benefits a national forest can provide. Counties with national forest in these regions could offer less socioeconomic benefits to their communities because of the dominant private forest industry. The North, Rocky Mountain, and Pacific Coast consume more wood than they produce, but the South Region produces more wood than it consumes (USDA Forest Service 2014). There is an excess of wood being produced in the South so public forests in the South may not be necessary to supplement timber production from private forests. The Southern and Eastern Region have the least amount of national forest by acres because these lands were mainly purchased rather than held back from the public domain. The Southern Region only has 13 million acres and the Eastern Region has about 12 million acres of national forest (Table 5). The small density of national forest spanning the large regions could be a reason why counties with national forest are less socioeconomically equitable to counties without national forest. There may not be enough national forest in the Southern and Eastern Region for them to be

Table 5. National forest land in U.S. Forest Service Regions (acres).

Region	National Forest	Grassland	Total
Northern	24,341,989	1,260,074	25,602,063
Rocky Mountain	20,011,055	2,097,941	22,108,996
Southwestern	20,346,222	262,701	20,608,923
Intermountain	31,862,351	47,790	31,910,141
Pacific Southwest	20,187,302	18,425	20,205,727
Pacific Northwest	24,641,010	112,357	24,753,367
Southern	12,928,974	38,182	12,967,156
Eastern	11,964,370	-	11,964,370

(USDA Forest Service 2011)

visible as a tourist destination and economic contributor. Much of the national forest land is located in mountainous areas that are not integrated into large cities. In the Pacific Northwest, there has been a decrease in land management contracting, which could contribute to unemployment and worker displacement for loggers and at mills (Moseley 2006).

Regionally, only the Mountain Regions had indications of higher socioeconomic position based on their higher median household income. The Intermountain region has four major geographic provinces: the Great Basin, Colorado Plateau, Middle Rocky Mountains, and the Northern Rocky Mountains. The scenic landscape in this region could be one of the reasons there are households with higher socioeconomic position. The aesthetic and recreational appeal could be a reason people are drawn to the area (USDA Forest Service 2017c). Whether people live there year-round or come to visit, both types of national forest visitors may contribute to the need for jobs in the area. The Rocky Mountain Region has similar unique recreational and scenic appeal. This region also highlights four areas where they focus their strategic long-term efforts: forest and grassland health, recreation, water, and public service (USDA Forest Service 2017b). These long-term efforts, specifically recreation and public service, could contribute to positive

socioeconomic impacts the national forests in this mountainous region provide to local communities.

The Pacific Southwest and Southwestern Regions showed no significant difference in any of the socioeconomic factors, so it can be inferred that the socioeconomic position of people living in close proximity to national forest is similar to people who do not live near national forest. This may be interpreted as neither a good nor a bad outcome. Theoretically, it could be that national forests are not taking away from any opportunity another industry might offer the community. Counties with national forest could be just as prosperous as counties without.

4.3 States

Georgia, Indiana, Mississippi, Nebraska, and North Carolina had results that indicated higher socioeconomic position for counties containing national forest compared to counties without. These results are similar to the study of Costa Rica's and Thailand's protected areas (Andam et al. 2010). Georgia had higher median household income and a lower percent in poverty in counties with national forest. Indiana, Mississippi, Nebraska, and North Carolina had lower unemployment rates in counties with national forest. These states are of interest, as are Illinois, Kentucky, Michigan, Minnesota, Missouri, Ohio, Texas, Virginia, Washington, and Wisconsin because they refute the hypotheses and show that counties without national forest may have higher socioeconomic position than those with national forest. Comparable results were found in Brazil by Sálvio et al. (2016). The remaining states did not have any statistically significant differences for counties with and without national forest. Hanauer and Canavire-Bacarreza's (2015) study of Bolivia showed no differences in poverty between communities with and without protected areas, which is also demonstrated in these results from states with no statistical differences.

Georgia

Georgia has the second most counties in the United States behind Texas. There are 159 counties in Georgia and 124 of those counties are at least 90% rural. Georgia is the only state that had two socioeconomic factors statistically support my hypotheses. Georgia (Table 6) has 866,468 acres of national forest (USDA Forest Service 2011). In lieu of taxes, Georgia received $2.5 million from the Department of Interior (U.S. Department of Interior 2017). There were over 35,000 people with natural resource, mining, manufacturing, and leisure and hospitality jobs in Georgia in 2015 (the same number of people the U.S. Forest Service employs nationwide). Some of these jobs are directly and indirectly related to the services that the national forest provides. Leisure and hospitality jobs could include businesses related to the recreational opportunities national forests provide. Relative to the national average, Georgia has a high amount of forestry and conservation science professors (U.S. Department of Labor: Bureau of Labor Statistics 2016). These are a few reasons why counties with national forest lands could be used as an example of how to integrate national forest into a community to increase the socioeconomic position of local citizens.

Indiana

Indiana has only 202,814 acres of national forest (USDA Forest Service 2011). In 2015 Indiana received $564,001 from the Department of Interior (U.S. Department of Interior 2017). The unemployment rate in counties with national forest is 1.4% lower than in counties without national forest. This could be due to the high location quotient of furniture jobs in Indiana compared to the national average of furniture jobs in the whole United States (U.S. Department of Labor: Bureau of Labor Statistics 2016). Woodworking jobs are indirectly related to the forest industry.

Table 6. National forest land in states (acres).

State	National Forest	National Grassland	Total
Alabama	370,865	-	370,865
Arizona	11,264,619	-	11,264,619
Arkansas	2,598,826	-	2,598,826
California	20,790,923	18,425	20,809,348
Colorado	13,884,722	636,141	14,520,863
Florida	1,111,214	-	1,111,214
Georgia	866,468	-	866,468
Idaho	20,416,960	47,790	20,464,750
Illinois	266,026	-	266,026
Indiana	202,814	-	202,814
Kansas	-	108,176	108,176
Kentucky	561,802	-	561,802
Louisiana	603,360	-	603,360
Maine	42,364	-	42,364
Michigan	2,866,752	-	2,866,752
Minnesota	2,762,565	-	2,762,565
Mississippi	1,172,531	-	1,172,531
Missouri	1,491,840	-	1,491,840
Montana	17,086,117	-	17,086,117
Nebraska	257,943	94,520	352,463
Nevada	5,765,915	-	5,765,915
New Hampshire	708,488	-	708,488
New Mexico	9,081,603	136,977	9,218,580
New York	16,259	-	16,259
North Carolina	1,254,885	-	1,254,885
North Dakota	-	1,105,291	1,105,291
Ohio	240,101	-	240,101
Oklahoma	354,642	46,286	400,928
Oregon	15,555,804	112,357	15,668,161
Pennsylvania	513,175	-	513,175
South Carolina	629,765	-	629,765
South Dakota	1,151,047	866,388	2,017,435
Tennessee	655,271	-	655,271
Texas	637,745	117,620	755,365
Vermont	399,151	-	399,151
Virginia	1,664,310	-	1,664,310
Washington	9,287,525	-	9,287,525
West Virginia	1,044,779	-	1,044,779
Wisconsin	1,533,685	-	1,533,685
Wyoming	8,694,111	547,999	9,242,110

Mississippi

Mississippi has over one million acres of national forest land (USDA Forest Service 2011) and received over $1.8 million from the Department of Interior in 2015 (U.S. Department of Interior 2017). The state has the highest concentration of fallers and the second highest logging equipment operators compared to the national average concentration. It also has a high concentration of log graders and scalers. Other occupations that are highly concentrated in Mississippi compared with the rest of the United States are forest fire inspectors and prevention specialists (U.S. Department of Labor: Bureau of Labor Statistics 2016). These employment opportunities are evidence of the forest industry's presence in Mississippi and are most likely the reason for the lower unemployment rate in counties with national forests.

Nebraska

Nebraska has 352,463 acres of national forest and grassland (USDA Forest Service 2011). They received just over $1 million from the Department of Interior in 2015 (U.S. Department of Interior 2017). There are over 10,000 natural resource, mining, manufacturing, and leisure and hospitality jobs in Nebraska. Farming is a large industry that dominates in Nebraska (U.S. Department of Labor: Bureau of Labor Statistics 2016). Farms in close proximity to national forest could benefit from the environmental and ecosystem services the forests provide. The counties with national forest have a lower unemployment rate than counties without national forest, but the unemployment rate is still low for both county groups at 1.4% and 3.4%, respectively.

North Carolina

There are 1,254,885 acres of national forest in North Carolina (USDA Forest Service 2011). In 2015, they received $4.2 million from the Department of Interior, which is more than

any of the other states that supported my hypotheses (U.S. Department of Interior 2017). Textile jobs are a large part of North Carolina's rural occupations, but the state also has a relatively high concentration of fallers compared to the national average concentration (U.S. Department of Labor: Bureau of Labor Statistics 2016). Although forestry is not the dominant industry in North Carolina, my results show that the unemployment rate in counties with national forest is lower than in counties without. The socioeconomic position of individuals living in close proximity to national forests could be considered higher in North Carolina.

Illinois

Illinois only contains 266,026 acres of national forest (USDA Forest Service 2011). Only the southernmost counties of Illinois have national forest. This small amount of national forest could be the reason why counties containing national forest had lower socioeconomic position indicated by all three factors failing to reject the null hypotheses.

Kentucky

Although Kentucky has a relatively high concentration of fallers compared to the national average concentration (U.S. Department of Labor: Bureau of Labor Statistics 2016), the socioeconomic position of national forest counties seems to be lower than counties without national forest. With over a half a million acres in national forest (USDA Forest Service 2011) and over $2 million from the Department of Interior (U.S. Department of Interior 2017), Kentucky has over a $10,000 median household income gap between national forest counties and counties without national forest. In terms of employment, forestry may take a backseat to mining which is a large industry in Kentucky. Competing industries such as mining may not be as economically beneficial as forestry or be as employable to a diverse workforce in populations within rural communities.

Michigan

Michigan has over 2.8 million acres of national forest (USDA Forest Service 2011). The Department of Interior gave Michigan $4.6 million in 2015 (U.S. Department of Interior 2017). Michigan has a relatively high concentration of logging workers compared to the national average concentration. Manufacturing is a dominant industry in Michigan as well as leisure and hospitality (U.S. Department of Labor: Bureau of Labor Statistics 2016). Socioeconomic position could be lower in counties with national forest despite a large industry for leisure and hospitality.

Minnesota

Part of the $2.2 million from the Department of Interior (U.S. Department of Interior 2017) is given to Minnesota in lieu of taxes on their 2.7 million acres of national forest land (USDA Forest Service 2011). Counties without national forest could have implied higher socioeconomic position than counties with national forest. Minnesota's counties with national forest lie in the northeast corner of the state. Seasonality might play a small role in employment opportunities related to or with the national forests. Heavy snowfall, cold winters, and short summers may contribute to decreased utilization of forest service lands and less necessity for employment.

Missouri

Missouri has close to 1.5 million acres of national forest (USDA Forest Service 2011). In 2015 the Department of Interior contributed almost $3.7 million in lieu of taxes for federal lands in Missouri (U.S. Department of Interior 2017). Primary production of wood is not as popular as secondary wood production, such as woodworking, which is a popular occupation in Missouri and could be indirectly related to forestry (U.S. Department of Labor: Bureau of Labor Statistics 2016). Forestry may not be a dominant industry in Missouri and counties with national forest

could have lower socioeconomic position based on these income, poverty, and unemployment results.

Ohio

Ohio only has 240,101 acres of national forest (USDA Forest Service 2011). The few counties in southeast Ohio that contain national forest may have lower socioeconomic position than counties without national forest. This could be due to the small size of national forest counties or the dominant manufacturing industry in Ohio (U.S. Department of Labor: Bureau of Labor Statistics 2016).

Texas

Only east Texas is forested with a total of 755,365 acres of national forest lands (USDA Forest Service 2011). They receive over $5 million from the Department of Interior, but only a fraction of that is for the Forest Service lands (U.S. Department of Interior 2017). Natural resource, mining, manufacturing, leisure and hospitality jobs amount to over 100,000 jobs in Texas. These job categories include jobs the Forest Service could directly and indirectly provide to local communities, but farming and the oil and gas industry are the dominant occupations in Texas (U.S. Department of Labor: Bureau of Labor Statistics 2016). These dominant industries most likely outcompete interest in forestry and natural resource jobs because they are highly profitable industries.

Virginia

Virginia counties containing national forest had lower median household incomes than counties without national forest. There is over 1.6 million acres of national forest in Virginia (USDA Forest Service 2011). They get supplemented $3.7 million from the Department of Interior for all their federal lands including the national forest land (U.S. Department of Interior

2017). Natural resource and forestry jobs are not as common in Virginia as leisure and hospitality jobs that may be related to national forest recreation. Virginia has a relatively high concentration of fallers compared to the national average concentration. The variety of competing, higher paying occupations in Virginia including architects, engineers, and political scientists could contribute to the lower median household incomes in counties with national forest (U.S. Department of Labor: Bureau of Labor Statistics 2016). National forests in Virginia are mostly located in the mountains, which make them difficult to access and live within close proximity to any benefits they may offer to surrounding communities.

Washington

Washington has the most national forest land of all the states that showed statistical differences. There are nearly 9.3 million acres of national forest land in Washington (USDA Forest Service 2011). The Department of Interior gave Washington $19.5 million in 2015 in lieu of federal taxes on all federal lands (U.S. Department of Interior 2017). Washington has a relatively high concentration of forest and "conservation workers", fallers, and log graders and scalers compared with the national average concentration (U.S. Department of Labor: Bureau of Labor Statistics 2016). It is unclear why unemployment is higher in counties with national forest when there is a high concentration of forestry jobs in Washington. It could be that logging jobs are limited to people in better physical condition or other specific duties required of loggers.

Wisconsin

Wisconsin received $3.4 million in 2015, of which some was used for the 1.5 million acres of national forest land (U.S. Department of Interior 2017; USDA Forest Service 2011). There are a few counties in the north and northeast of Wisconsin that contain national forest lands. These counties could have implied lower socioeconomic position than counties without

national forest. Paper goods occupations are popular in Wisconsin, but there is a wide variety of other industries that could compete with (U.S. Department of Labor: Bureau of Labor Statistics 2016).

CHAPTER 5

CONCLUSION

Conservation is complex when considering the impacts or tradeoffs with social or economic benefits. The Forest Service has been managing national forest lands for over a century, and boast numerous ecological and economic benefits. Evaluating the socioeconomic position of communities in close proximity to the national forest lands can be helpful in determining the local economic benefits the Forest Service provides. The goal of this research was to broadly examine communities with national forest to get a better idea of community socioeconomic position. I predicted that communities containing national forest would have an implied higher socioeconomic position than counties without because of the many jobs, opportunities, outreach, and services provided by the U.S. Forest Service. I used higher median household income, lower percentage below poverty threshold, and lower unemployment rate as indicators of implied higher socioeconomic position. When examining the entire country, counties with national forest had indications of lower socioeconomic position than counties without national forest. In the U.S. Forest Service mountain regions, the national forest counties had implied higher socioeconomic position than those without. Comparing counties within state boundaries yielded the most statistically significant results that both supported and did not support my hypotheses. Only a few states including Georgia, Indiana, Mississippi, Nebraska, and North Carolina had indications of higher socioeconomic position in their counties with national forest than the counties without. Other states that had no statistical differences show that the national forests could likely not be “poverty traps” and could be synonymous socioeconomically

to other rural industries. There are several possible reasons why states did not support my hypotheses. Other dominant industries, location of national forest, and size of national forest could be reasons why counties with national forest in the Eastern and Southern Regions had lower socioeconomic income. Further research is needed to continue to track socioeconomic trends and incorporate other factors and variables, such as environmental services, politics, and market research. Being able to identify human well-being (socioeconomic position) and conservation efforts can further illustrate the trade-offs between having national forest within or outside of a community (McShane et al. 2011). Future research weighing quantifiable ecosystem benefits of the national forest on individual communities at the scales examined here might help identify mutually beneficial situations for both communities and ecosystems. Using socioeconomic factors and environmental outcomes as covariates can help conservation planning to target certain conservation, management, or development efforts (Ferraro et al. 2010). The U.S. Forest Service should continue to use a wholistic approach for serving our forests and the people who are affected by their economic, political, social, or ecological agendas.

REFERENCES

Andam KS, Ferraro PJ, Sims KRE, Healy A, Holland MB. 2010. Protected areas reduced poverty in Costa Rica and Thailand. Proceedings of the National Academies of Sciences. 107 (22): 9996-10001.

Bedimo-Rung AL, Mowen AJ, Cohen DA. 2005. The significance of parks to physical activity and public health: A conceptual model. Am J Prev Med. 28(2, Supplement 2):159-168.

Blate GM, Joyce LA, Little JS, McNulty SG, Millar CI, Moser SC, Neilson RP, O'Halloran K, Peterson DL. 2009. Adapting to climate change in United States national forests. Unasylva 231/232. 60(1-2): 57-62.

Briant A, Combe PP, Lafourcade M. 2008. Dots to boxes: do the size and shape of spatial units jeopardize economic geography estimations? J Urban Economics. 67(3): 287-302.

Darden J, Rahbar M, Jezierski L, Li M, Ellen V. 2010. The measurement of neighborhood socioeconomic characteristics and black and white residential segregation in metropolitan Detroit: Implications for the study of social disparities in health. Ann of the Assoc of Am Geo. 100(1):137-158.

de Groot RS, Brander L, van der Ploeg S, Costanza R, Bernard F, Braat L, Christie M, Crossman N, Ghermandi A. 2012. Global estimates of the value of ecosystems and their services in monetary units. Ecosystem Services. 1(1):50–61.

Dombeck M. 2000. The changing role of timber harvest in our national forests. American Forest and Paper Association, Washington, D.C. Available from http://lobby.la.psu.edu/068_Roads_in_National_Forests/Agency_Activities/FS/FS_Changing_Role_Timber_Harvest.htm [cited 2017 May 6].

Fagerland MW, Sandvik L. 2009. Performance of five two-sample location tests for skewed distributions with unequal variances. Contemporary Clinical Trials. 30(5): 490-496.

Ferraro PJ, Hanauer MM, Sims KRE. 2010. Conditions associated with protected area success in conservation and poverty reduction. Proceedings of the National Academies of Sciences. 108(34): 13913-13918.

Fortmann L, Kusel J. 1990. New voices, old beliefs: Forest environmentalism among new and long-standing rural residents. Rural Sociology. 55(2):214-232.

Hanauer MM, Canavire-Bacarreza G. 2015. Implications of heterogenous impacts of protected areas on deforestation and poverty. Phil Trans of the Royal Society B. 370(1681).

Haynes HJG, Stein GP. 2017. U.S. Fire Department Profile – 2015. National Fire Protection Association, Quincy, MA. NFPA No. USS07-REV. 39 p.

Jackson E. 2017. A brief history of Georgia counties. Digital Library of Georgia, University System of Georgia, Atlanta, Georgia. Available from http://georgiainfo.galileo.usg.edu/topics/history/article/progressive-era-world-war-ii-1901-1945/a-brief-history-of-georgia-counties [cited 2017 Jun 06].

Johnson KM, Stewart SI. 2007. Demographic trends in national forest, recreational, retirement, and amenity areas. *In* Proceedings: National Workshop on Recreation Research Management. Linda Kruger, Rhonda Mazza and Kelly Lawrence (eds.). PNW-GTR-698. Portland, OR: USDA Forest Service Research, Pacific Northwest Research Station. pp. 187-199.

Jones RE, Fly JM, Talley J, Cordell HK. 2003. Green migration into rural America: The new frontier of environmentalism? Soc & Nat Res. 16(3):221-238.

Krieger N, Chen JT, Waterman PD, Rehkopf DH, Subramanian SV. 2003. Race/ethnicity, gender, and monitoring socioeconomic gradients in health: A comparison of area-based socioeconomic measures – The public health disparities geocoding project. Am J of Pub Health. 93(10):1655-1671.

Krieger N, Williams DR, Moss NE. 1997. Measuring social class in US public health research: Concepts, methodologies, and guidelines. Annu Rev Publ Health. 18(1):341-378.

McShane TO, Hirsch PD, Trung TC, Songorwa AN, Kinzig A, Monteferri B, Mutekanga D, Thang HV, Dammert JL, Pulgar-Vidal M, Welch-Devine M, Brosius JP, Coppolilo P, O'Connor SO. 2011. Hard choices: Making trade-offs between biodiversity conservation and human well-being. Biological Conservation. 144(3): 966-972.

Moseley C. 2006. Procurement contracting in the affected counties of the Northwest Forest Plan: 12 years of change. Gen. Tech. Rep. PNW-GTR-661. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 36 p.

Ruxton, GD. 2006. The unequal variance *t*-test is an underused alternative to Student's *t*-test and the Mann-Whitney *U* test. Behavioral Ecology. 17(4):688-690.

Sálvio GMM, Fontes MAL, Junior WJS, Silva HA. 2016. Conservation areas, poverty, and social inequality: an evaluation using socioeconomic indicators in Minas Gerais, Brazil. Cerne, 22(2): 145-150.

Tervonen HE, Morrel S, Aranda S, Roder D, You H, Niyonsenga T, Walton R, Baker D, Currow D. 2016. The impact of geographic unit of analysis on socioeconomic inequalities in cancer survival and distant summary stage – a population-based study. Aust NZ J Public Health. 41: 130-6.

USDA Foreign Agricultural Service. 2015. Money does grow on Trees as U.S. forest product exports set record. Washington, DC. Available from https://www.fas.usda.gov/data/money-does-grow-trees-us-forest-product-exports-set-record [cited 2017 Jun 06].

USDA Forest Service. 2017a. About the agency. Washington, DC. Available from https://www.fs.fed.us/about-agency [cited 2017 Feb 06].

USDA Forest Service. 2017b. About the region. Golden, CO. Available from https://www.fs.usda.gov/main/r2/about-region [cited 2017 Jun 07].

USDA Forest Service, 2017c. About the region. Ogden, UT. Available from https://www.fs.usda.gov/main/r4/about-region [cited 2017 Jun 07].

USDA Forest Service. 2017d. Fiscal year 2017 budget overview. Washington, DC. Available from https://www.fs.fed.us/about-agency/budget-performance [cited 2017 Feb 07].

USDA Forest Service. 2014. Indicator 6.32: Exports and imports of wood products as a share of production and consumption. Washington, DC. Available from https://www.fs.fed.us/research/sustain/criteria-indicators/indicators/indicator-632.php [cited 2017 Jun 06].

USDA Forest Service. 2011. Land areas of the national forest system. Washington, DC. Available from https://www.fs.fed.us/land/staff/lar/LAR2011/LAR2011_Book_A5.pdf [cited 2017 Jun 07].

United States Census Bureau. 2017a. Employment. Available from http://www.census.gov/topics/employment/about.html [cited 2017 Feb 12].

United States Census Bureau. 2017b. Geographic areas reference manual. Available from https://www.census.gov/geo/reference/garm.html [cited 2017 Jun 06].

United States Census Bureau. 2017c. How the Census Bureau measures poverty. Available from http://www.census.gov/topics/income-poverty/poverty/guidance/poverty-measures.html [cited 2017 Feb 12].

United States Census Bureau. 2017d. Income. Available from http://www.census.gov/topics/income-poverty/income/about.html [cited 2017 Feb 12].

U.S. Department of Labor: Bureau of Labor Statistics. 2016. Occupational employment statistics. Available from https://www.bls.gov/oes/current/area_lq_chart/area_lq_chart.htm# [cited 2017 Jun 07].

U.S. Department of the Interior. 2017. Payment in lieu of taxes. Available from https://www.nbc.gov/pilt/states-payments.cfm?fiscal_yr=2015&Search.x=33&Search.y=7 [cited 2017 Jun 04].

Vilsack T. 2015. The cost of fighting wildfires is sapping Forest Service budget. U.S. Department of Agriculture, Forest Service, Washington, D.C. Available from https://www.fs.fed.us/blogs/cost-fighting-wildfires-sapping-forest-service-budget [cited 2017 June 12].

Welch BL. 1938. The significance of the difference between two means when the population variances are unequal. Biometrika. 29(3/4):350-362.

Williams GW. 2004. The USDA Forest Service – The first century. Washington, DC: USDA Forest Service Office of Communication. Available from https://www.fs.fed.us/learn/our-history [cited 2017 Feb 06].

APPENDIX A

(A1) Results of Tests on All Counties and Different Percent National Forest Counties

	Median Household Income ($)			Percentage Below Poverty Threshold (%)			Unemployment Rate (%)		
Percent NF*	NF	No NF	p-value	NF	No NF	p-value	NF	No NF	p-value
1-10	42,907	44,987	0.010	19.3	16.8	0.000	8.7	7.5	0.001
11-20	42,080	44,987	0.004	18.8	16.8	0.002	8.7	7.5	0.000
21-30	43,390	44,987	0.049	18.1	16.8	0.026	9.0	7.5	0.000
31-40	44,233	44,987	0.497	17.3	16.8	0.408	8.2	7.5	0.047
41-50	44,193	44,987	0.593	17.5	16.8	0.329	8.3	7.5	0.032
51-60	44,565	44,987	0.830	17.3	16.8	0.554	8.3	7.5	0.053
61-70	44,734	44,987	0.892	17.0	16.8	0.852	8.5	7.5	0.102
71-80	42,047	44,987	0.153	16.5	16.8	0.788	8.6	7.5	0.149
81-90	42,258	44,987	0.241	17.0	16.8	0.801	9.6	7.5	0.019
91-100	38,969	44,987	0.030	19.8	16.8	0.136	9.4	7.5	0.072
All Counties	43,186	44,987	0.000	18.2	16.8	0.000	8.6	7.5	0.000

(A2) Results of Tests on Regions

	Median Household Income ($)			Percentage Below Poverty Threshold (%)			Unemployment Rate (%)		
Region	NF	No NF	p-value	NF	No NF	p-value	NF	No NF	p-value
Eastern	41,351	48,015	0.000	17.5	14.1	0.000	8.6	6.9	0.000
Intermountain	51,481	45,921	0.048	14.2	16.1	0.234	7.0	8.3	0.179
Northern	45,051	51,966	0.000	16.1	12.5	0.004	6.4	3.2	0.000
Pacific Northwest	44,961	47,527	0.197	17.4	17.6	0.840	10.0	8.4	0.005
Pacific Southwest	49,055	54,872	0.190	17.7	18.2	0.829	11.2	12.4	0.345
Rocky Mountain	50,665	47,517	0.023	14.0	13.5	0.536	6.1	4.5	0.001
Southern	37,834	41,277	0.000	21.4	20.1	0.005	9.6	9.0	0.007
Southwestern	41,695	37,937	0.276	21.4	21.2	0.910	9.8	9.0	0.533

(A3) Results of Tests on States with at Least One Significant Socioeconomic Factor

	Median Household Income ($)			Percentage Below Poverty Threshold (%)			Unemployment Rate (%)		
State	NF	No NF	p-value	NF	No NF	p-value	NF	No NF	p-value
Georgia	41,888	36,602	0.000	19.0	24.3	0.000	9.2	10.2	0.093
Illinois	38,741	49,398	0.000	20.4	13.6	0.013	10.6	7.5	0.023
Indiana	46,446	48,055	0.470	14.3	13.4	0.499	6.0	7.4	0.015
Kentucky	29,969	40,062	0.000	29.0	20.5	0.000	11.6	8.9	0.000
Michigan	38,876	44,937	0.000	18.5	16.0	0.009	11.0	9.6	0.012
Minnesota	47,288	52,526	0.002	14.9	11.7	0.012	6.9	4.8	0.035
Missouri	37,834	41,835	0.005	20.4	17.6	0.002	9.1	7.1	0.000
Mississippi	34,767	33,331	0.342	25.0	27.5	0.141	11.1	13.1	0.037
Nebraska	46,176	48,426	0.355	13.8	11.9	0.399	1.4	3.4	0.015
N. Carolina	38,635	39,920	0.380	20.0	20.4	0.711	9.2	11.4	0.000
Ohio	39,842	48,054	0.000	20.7	14.6	0.002	9.1	7.8	0.040
Texas	39,378	45,931	0.008	20.7	17.0	0.016	9.1	6.6	0.017
Virginia	45,112	52,687	0.005	14.6	13.8	0.534	6.8	7.3	0.379
Washington	46,165	48,750	0.287	17.1	17.9	0.628	9.7	7.8	0.013
Wisconsin	44,333	50,270	0.001	13.3	12.6	0.464	7.3	5.9	0.033

(A4) Results of Tests on States with No Significant Socioeconomic Factors

	Median Household Income ($)			Percentage Below Poverty Threshold (%)			Unemployment Rate (%)		
State	NF	No NF	p-value	NF	No NF	p-value	NF	No NF	p-value
Alabama	35,271	36,825	0.406	22.7	22.2	0.809	11.1	11.9	0.479
Arkansas	36,441	36,110	0.811	20.9	22.2	0.241	8.5	9.4	0.206
Arizona	43,714	37,899	0.063	22.1	19.9	0.305	12.2	12.5	0.827
California	49,055	54,872	0.190	17.7	18.2	0.829	11.2	12.4	0.345
Colorado	50,409	44,274	0.117	14.4	16.4	0.312	7.5	8.2	0.664
Florida	41,481	41,012	0.863	19.8	20.6	0.703	11.0	10.6	0.657
Idaho	43,463	42,802	0.772	15.9	17.5	0.368	7.1	7.0	0.925
Kansas	50,731	46,971	0.570	14.5	12.8	0.720	4.4	4.5	0.935
Louisiana	36,449	40,300	0.171	23.0	22.6	0.892	9.3	9.6	0.777
Maine	49,275	44,590	0.684	13.7	15.6	0.703	7.6	7.6	0.990
Montana	44,110	45,095	0.626	16.0	15.4	0.737	6.0	4.8	0.265
North Dakota	55,486	55,588	0.985	14.3	11.0	0.408	4.4	2.4	0.493
New Hampshire	50,460	60,489	0.118	11.7	10.3	0.395	5.9	5.6	0.651
New Mexico	40,730	37,950	0.559	21.0	21.6	0.820	8.7	7.8	0.566
Nevada	55,226	50,586	0.465	14.0	13.5	0.854	10.3	10.9	0.598
New York	48,486	49,736	0.324	13.6	15.1	0.316	6.0	8.0	0.076
Oklahoma	41,558	43,937	0.622	20.1	17.3	0.326	5.2	6.4	0.606
Oregon	44,101	45,080	0.773	17.6	17.1	0.856	10.2	9.4	0.339
Pennsylvania	42,547	46,941	0.166	13.1	13.8	0.738	6.4	7.1	0.517
South Carolina	39,319	35,882	0.117	20.8	23.7	0.060	11.5	12.6	0.205
South Dakota	45,990	47,661	0.511	17.5	16.6	0.805	7.1	5.3	0.481
Tennessee	35,371	38,319	0.063	21.8	20.0	0.112	10.4	9.8	0.412
Vermont	53,572	50,053	0.391	11.5	12.1	0.663	5.8	6.2	0.634
West Virginia	37,595	38,347	0.655	17.7	19.7	0.152	7.7	9.3	0.071
Wyoming	57,585	53,422	0.544	11.5	12.9	0.648	4.4	5.6	0.160

* NF = National Forest

APPENDIX B

(B1) Number of Counties in Differing Percent National Forest

	# of Counties	
Percent NF*	NF	No NF
1-10	164	1961
11-20	108	1961
21-30	103	1961
31-40	83	1961
41-50	66	1961
51-60	52	1961
61-70	28	1961
71-80	21	1961
81-90	17	1961
91-100	20	1961
All Counties	662	1961

(B2) Number of Counties in Regions

	# of Counties	
Region	NF	No NF
Nationwide	662	1961
Eastern	130	696
Intermountain	66	12
Northern	53	69
Pacific Northwest	48	18
Pacific Southwest	35	9
Rocky Mountain	73	256
Southern	223	889
Southwestern	34	12

(B3) Number of Counties in States with Statistical Significance

	# of Counties	
State	NF	No NF
Georgia	23	101
Illinois	10	78
Indiana	8	65
Kentucky	25	86
Michigan	24	46
Minnesota	7	73
Missouri	29	78
Mississippi	31	45
Nebraska	5	85
North Carolina	19	56
Ohio	12	53
Texas	13	218
Virginia	29	54
Washington	20	12
Wisconsin	11	52

(B4) Number of Counties in States with No Statistical Significance

	# of Counties	
State	NF	No NF
Alabama	16	42
Arkansas	26	47
Arizona	11	3
California	35	9
Colorado	41	15
Florida	7	32
Idaho	33	9
Kansas	2	99
Louisiana	7	47
Maine	2	13
Montana	34	22
North Dakota	7	46
New Hampshire	3	4
New Mexico	23	9
Nevada	12	4
New York	2	40
Oklahoma	4	70
Oregon	28	6
Pennsylvania	4	41
South Carolina	14	22
South Dakota	12	54
Tennessee	9	69
Vermont	6	7
West Virginia	12	35
Wyoming	20	3

* NF = National Forest