

THESIS

PUBLIC PERCEPTIONS OF THE COLORADO STATE FOREST SERVICE

Submitted by

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ABSTRACT

PUBLIC PERCEPTIONS OF THE COLORADO STATE FOREST SERVICE

This Master's Thesis explored three main research questions pertaining to Colorado resident's perceptions of the Colorado State Forest Service (CSFS) and forest management practices. Data were obtained from a public perceptions of the CSFS survey ($n = 416$), which provided the first step to understanding Colorado residents' attitudes toward the agency and different forest management practices. Results from the public perceptions of the CSFS survey indicated that (a) Colorado residents' aesthetic evaluations of the nine forest management practices had a larger impact on their approval of those practices than their familiarity with them, except for creating wildfire defensible space, windbreaks, and fuelbreaks; (b) social trust is the largest predictor of overall satisfaction with the CSFS; and (c) level of education, household income, ethnicity, familiarity with the CSFS and forest management practices, and total knowledge of the CSFS were related to Colorado residents' awareness of their proximity to the wildland-urban interface (WUI). The results from the public perceptions of the CSFS survey will help the agency focus its outreach efforts to more effectively communicate with Colorado residents about the valuable services the agency provides. Only with effective outreach and education will the CSFS be able to change Colorado residents' attitudes about forest management practices and work to achieve the stewardship of Colorado's diverse forest ecosystems for the benefit of present and future generations.

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INTRODUCTION

There is expanding recognition by natural resource managers that management decisions must acknowledge both biophysical and social processes at a multitude of scales and timeframes, and yet, managers must be able to make snap decisions supported by credible science and research (McCool & Guthrie, 2001). Forces such as economic growth, population and demographic changes, technological change, political-economic institutions, and the attitudes and beliefs held by citizens influencing both biophysical and social processes make it a challenge for natural resource agencies to remain relevant and reputable. Natural resource agencies must address all of these issues while allowing public participation of diverse and local voices in the decision-making process; however, not all decisions will satisfy every stakeholder involved in an issue. The Colorado State Forest Service (CSFS) wanted to gauge Colorado residents' perceptions of the agency. Knowledge of these perceptions would allow the CSFS to better focus its outreach messages and determine how to increase awareness of the agency and foster acceptance of forest management decisions.

The Colorado State Forest Service

The Colorado State Forest Service (CSFS) is the lead state agency for forestry expertise in Colorado. The CSFS is a service and outreach agency of the Warner College of Natural Resources (WCNR) at Colorado State University (CSU) and staffs the Division of Forestry in the Colorado Department of Natural Resources. The mission of the CSFS is *to achieve stewardship of Colorado's diverse forest environments for the benefit of present and future generations* (Colorado State Forest Service, 2014a). The CSFS has four programmatic areas, forest management, wildland fire mitigation and education, urban and community forestry, and conservation education. The CSFS manages Colorado's state and private forests for the benefit

of the residents within the state; and, therefore, the input of those residents is important to the agency (Colorado State Forest Service, 2014a).

Problem Statement

In 2010, the CSFS strategic plan identified the need for a public perceptions survey of the agency. The purpose of the survey was to understand residents' perceptions of forest management practices and the CSFS in general. The goal was to create a survey that would benefit the CSFS by providing insight on the public's knowledge and attitudes about the CSFS' forest management and outreach efforts. This included information about Colorado residents' familiarity with the CSFS, their approval or disapproval of various forest management practices, whether their perceptions of the CSFS have changed over time, their evaluation of the CSFS as an agency, their interest in learning more about forestry-related topics, where they receive their information, and general demographics of the Colorado residents who took the public perceptions survey.

On July 1, 2012, wildfire command and control operations transferred from the CSFS to the Colorado Department of Public Safety. This transfer of responsibilities has created a need for the CSFS to revise its strategic plan and focus outreach and education programs to reach landowners and audiences that have been underrepresented in the past (*House Bill 1283*, 2012). Much of that education will focus on communicating the importance of different forest management practices, such as forest thinning or creating wildfire defensible spaces. These practices are not always widely accepted by the public and require education and outreach for people to understand the benefits they provide. The public perceptions survey of the CSFS provided the first step to understanding Colorado residents' attitudes toward different forest

management practices which will allow the agency to improve its outreach efforts and encourage Colorado residents to be more informed about forest management practices.

Research Questions

Following are the primary research questions for this Master's Thesis:

1. What are Colorado residents' attitudes of forest management practices and how are they influenced by familiarity and positive or negative evaluations of the aesthetic impacts of those forest management practices?
2. What is the largest predictor of Colorado residents' satisfaction with the CSFS?
3. Do Colorado residents' perceptions of whether they live in the wildland-urban interface (WUI) correlate with actual WUI latitude and longitude data? What demographic characteristics influence whether Colorado residents know if they live in the WUI?

Methods

Public Perceptions of the CSFS Survey

The public perceptions survey was mailed to a sample of 3,000 randomly selected Colorado residents throughout the state. The random sample was purchased from Survey Sampling International (SSI). Three mailings were used to administer the survey during the summer and fall of 2012. Residents first received a cover letter with a URL link and an access code with directions on how to take the survey online. A week later, a postcard was sent to residents reminding them to take the online version of the survey. Approximately a month after the postcard reminder, a paper questionnaire with a pre-paid postage return envelope was mailed to those who had not yet taken the survey (Dillman, Smith, & Christian, 2009).

To reduce respondent burden and increase the overall response rate, the survey was split into three separate versions so that each individual evaluated only three of the nine forest management practices. The only differences between the three versions of the survey were the

forest management practices; the rest of the survey remained the same. Each forest management practice was briefly defined on the survey (see Table 1). Version one of the survey included questions about forest restoration, windbreaks, and wildfire defensible space. Version two of the survey included questions about forest thinning, clearcuts, and patch cuts. Version three of the survey included questions about prescribed fire, fuelbreaks, and reducing surface fuels. Each survey version was sent to 1,000 of the randomly selected Colorado residents. A crosstabs analysis was used to compare the responses to the three survey versions to ensure that there were no statistical differences between respondents' answers.

A total of 416 completed surveys were returned with an overall response rate of 14% (39% took the survey online and 61% returned the paper questionnaire). A crosstabs analysis compared responses from the online survey to the paper questionnaire and there were no substantive differences. Each version of the survey was completed by approximately one-third of the 416 respondents. A non-response check was conducted of Colorado residents who did not respond to the survey. Selected key issues (familiarity with the CSFS; perceptions of the CSFS; familiarity, approval, and aesthetic impacts of forest management practices; and distance of residence to a forested area) were addressed in a telephone survey of non-respondents ($n = 42$). The non-response check showed no substantive differences between those who responded to the survey and those who did not.

According to the U.S. Census Bureau (2012), 21% of Colorado residents are Hispanic or Latino. Only 7% percent of the survey respondents stated that their ethnicity was Hispanic or Latino. Also, according to the U.S. Census Bureau (2012), 49.8% of Colorado residents are female. Only 36% of the survey respondents reported that they were female. The data were weighted to account for this under-sampling of Hispanics and females.

Variables

This Master's thesis is divided into three separate chapters, each focusing on one of the afore mentioned research questions. Each of the chapters focuses on a set of independent and dependent variables that were analyzed using statistical analyses in the Statistical Package for the Social Sciences (SPSS) software.

Chapter one methods.

Chapter one examines Colorado residents' approval of nine different forest management practices and how their familiarity with and aesthetic evaluation of those forest management practices impacts their approval. A regression analysis was used to assess the amount of variance in Colorado residents' approval of the nine forest management practices explained by their familiarity and aesthetic evaluation of those practices. Results indicated that Colorado residents' aesthetic evaluations of the nine forest management practices had a larger impact on their approval of those practices than their familiarity with them, except for creating wildfire defensible space, windbreaks, and fuelbreaks. These findings suggest that forestry agencies should focus their outreach messages on the aesthetic benefits of using different forest management practices in order to increase approval.

Chapter two methods.

Chapter two examines Colorado residents' familiarity, knowledge, salient value similarity, and social trust of the Colorado State Forest Service (CSFS) to explore which is the largest predictor of overall satisfaction with the agency. A series of ordinary least squares (OLS) regression analyses were run to assess the amount of variance in Colorado residents' overall satisfaction with the CSFS, explained by their familiarity, total knowledge, salient value similarity, and social trust in the agency.

Results indicated that the more familiar Colorado residents are with the CSFS, the more they know about the agency. Also, the more familiar with the CSFS and the more knowledge of the CSFS, the more salient value similarity Colorado residents have with the CSFS. The more knowledge and salient value similarity, the more social trust Colorado residents have in the CSFS. Finally, the more salient value similarity and social trust, the higher Colorado residents' overall satisfaction was with the CSFS. Social trust was the largest predictor of overall satisfaction with the CSFS. These findings suggest that the CSFS must work on increasing Colorado residents' trust in the agency through their outreach messages and one-on-one interactions with private landowners to increase Colorado residents' overall satisfaction with the agency.

Chapter three methods.

Chapter three examines Colorado residents' awareness of whether they live in the wildland-urban interface (WUI). Those perceptions were crosschecked with WUI boundaries in Colorado, defined by the Colorado Wildfire Risk Assessment Portal (CO-WRAP) in order to determine whether Colorado residents actually know the extent to which they are at risk from wildfire.

Results indicated that level of education, household income, ethnicity, familiarity with the CSFS, and total knowledge of the CSFS were related to Colorado residents' awareness of their proximity to the WUI. Colorado residents who had higher levels of familiarity with creating wildfire defensible space, forest thinning, and clearcuts also were more likely to know whether or not they live in the WUI. The findings from this study suggest that the CSFS must change how it educates Colorado residents about the WUI in order to reach out to diverse and underrepresented audiences, including Hispanic or Latino residents, residents with a high school

education or less, and residents with annual household incomes under \$75,000 a year. The CSFS should also work to increase familiarity with and total knowledge of the agency to help foster greater awareness among Colorado residents of their proximity to the WUI. Finally, the CSFS should continue to increase Colorado residents' familiarity with creating wildfire defensible space, forest thinning, and clearcuts to encourage acceptance of these beneficial forest management practices and increase Colorado residents' awareness of their wildfire risk.

Summary

Following are three chapters addressing the three main research questions of this Master's Thesis. They are in the format of publishable papers, beginning with an abstract and ending with a discussion of the implications of the research conducted and areas for future research. Each chapter has its own theoretical framework, as well as a methods section describing the types of statistical analyses used to analyze the variables stated above. The results from each chapter fueled the discussion of how the CSFS should focus its outreach efforts in the future.

Tables

Table 1.
Definitions of nine forest management practices as defined on the public perceptions of the Colorado State Forest Service survey

Forest Management Practice	Definition
Forest Restoration	<i>Forest restoration</i> is the process of returning forests to their natural state in order to ensure that healthy forests exist in the future. Forest restoration re-establishes original forest ecosystem processes and protects critical habitat and watersheds.
Planting trees as windbreaks	Trees can be planted in rows to serve as <i>windbreaks</i> . Windbreaks can protect structures, lower heating and maintenance costs, and provide visual screens and noise barriers. Windbreaks also provide wildlife habitat.
Wildfire defensible space	<i>Defensible space</i> is an area around a home where natural and manmade fuels, such as vegetation and wood piles, are treated, cleared or reduced to slow the spread of wildfire toward the home. Defensible space also reduces the chance of a structure fire spreading from the residence to the surrounding forest.
Forest thinning	<i>Forest thinning</i> is a forest management practice in which the number of standing trees in an area is reduced in order to improve tree growth and enhance forest health. Forest thinning can reduce wildfire hazards, improve wildlife habitat and support local economies by providing wood products.
Patch cut	A <i>patch cut</i> is a method where all of the trees in a block or patch, typically less than 2.5 acres, are removed from a forested area to encourage new growth.
Clearcut	Similar to a patch cut, a <i>clearcut</i> is a forest management option requiring essentially all of the trees to be removed from a forested area greater than 2.5 acres in size.
Prescribed fire	<i>Prescribed fire</i> is the controlled application of fire to an area to accomplish specific land management goals, such as reducing the build-up of natural fuels and enhancing wildlife habitat.
Fuelbreak	A <i>fuelbreak</i> is an easily accessible strip of land of varying width in which many of the trees and other large vegetation are removed to stop or slow the spread of a wildfire. Fuelbreaks help to protect subdivisions and communities.
Reducing surface fuels	<i>Surface fuels</i> are dead or downed trees, logs, branches, grasses or pine needles in the understory of forests. These fuels can be reduced to lower the risk of wildfire.

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CHAPTER 1. COLORADO RESIDENTS' FAMILIARITY, AESTHETIC EVALUATIONS, AND APPROVAL OF FOREST MANAGEMENT PRACTICES

Introduction

Many people live in forested areas because they like how the forest looks. Residents have told wildfire incident commanders that “they would prefer losing their homes to fire to cutting down any of their trees, since it was the trees that drew them to the property in the first place” (Burton, 2013). Given these comments, the Colorado State Forest Service (CSFS) wanted to know Colorado residents’ approval of nine different forest management practices and whether their familiarity with, and their aesthetic evaluation of, those forest management practices impacted attitudes toward forest management. The nine forest management practices included in this study were: (a) forest restoration, (b) planting trees as windbreaks, (c) wildfire defensible space, (d) forest thinning, (e) clearcuts, (f) patch cuts, (g) prescribed fire, (h) fuelbreaks, and (i) reducing surface fuels.

The Colorado State Forest Service

The Colorado State Forest Service (CSFS) is the lead state agency for forestry expertise in Colorado. The CSFS is a service and outreach agency of the Warner College of Natural Resources (WCNR) at Colorado State University (CSU) and staffs the Division of Forestry in the Colorado Department of Natural Resources. The mission of the CSFS is *to achieve stewardship of Colorado's diverse forest environments for the benefit of present and future generations*. The CSFS has four main programmatic areas: (a) forest management, (b) wildland fire mitigation and education, (c) urban and community forestry, and (d) conservation education (Colorado State Forest Service, 2014a).

The CSFS manages Colorado's state and private forests for the benefit of the residents within the state, and therefore, public input is important to the agency. The CSFS was interested in understanding Colorado residents' perceptions of the agency, as well as their perceptions of forest management practices within the state. This was part of a public perceptions survey of the CSFS that was designated as part of the agency's 2010 strategic plan (Colorado State Forest Service, 2014a). Understanding Colorado residents' attitudes toward different forest management practices would allow the agency to improve their outreach efforts to foster Colorado residents' awareness and acceptance of forest management practices, and give Colorado residents the knowledge they need to protect the forests on their property from natural processes such as wildfires and insect and disease outbreaks.

Theoretical Framework

To determine Colorado residents' perceptions and levels of approval for different forest management practices, the public perceptions survey needed to measure Colorado residents' attitudes and beliefs of forest management practices. Theory suggests that an individual's view of their environment can be organized into a cognitive hierarchy. This hierarchy consists of values, value orientations, attitudes/norms, behavioral intentions, and behaviors, and suggests that an individual's thoughts regarding a specific topic tends to be consistent with one another (Ball-Rokeach, Rokeach, & Grube, 1984; Fulton, Manfredi, & Lipscomb, 1996; Homer & Kahle, 1988; Rokeach, 1973, 1979). Fulton et al. (1996) have used an inverted pyramid to represent the cognitive hierarchy, with values at the bottom of the inverted pyramid and behaviors at the top (Figure 1). Components at the bottom of the inverted pyramid are few in number, centrally held, hard to change, and transcend situations, whereas components at the top

are much more numerous, relatively easier to change, and specific to certain situations (Fulton et al., 1996).

Beliefs in the cognitive hierarchy “serve to strengthen and give meaning to fundamental values” (Vaske & Donnelly, 1999, p. 525). Patterns of beliefs create value orientations, which in turn are used to predict and influence an individual’s attitudes (Fulton et al., 1996; Homer & Kahle, 1988). Attitudes represent an individual’s tendency to respond favorably or unfavorably toward an object, which could include an issue, a behavior, another individual, or an entity such as an agency (Fishbein & Ajzen, 1975). Attitudes have also been defined as a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor (Eagly & Chaiken, 1993). In other words, attitudes are positive or negative evaluations of objects, people, or institutions.

Cognitions and prior experience in an area influence the perceived aesthetics of the natural environment (Ulrich, 1993). Scenic quality was traditionally viewed as an externality of well-managed forests (Ribe, 1989). However, demand for areas managed for values other than timber harvesting and other commercial activities is increasing (Panagopoulos, 2009). Kimmins (1999) found that ecologists’ ideas of beautiful and sustainable forests may seem ugly to the average citizen. Clearcuts, for example, are a tool used for forest regeneration where essentially all of the trees in a stand are removed. Average citizens may think clearcuts are ugly, but ecologists know that clearcuts will help the forest regenerate and become healthier in the future. Differences in ideas of beauty and aesthetics make it imperative to understand citizens’ aesthetic evaluations of natural resources and landscape management.

Yi (1999) examined explanations for the similarities and differences in individuals’ cognitive evaluations of landscapes, and found that landscape beauty, landscape meaning, tasks

in which individuals participate within the landscape, and schematic knowledge were important determinants of affective landscape experiences. Landscape beauty was the best predictor of affective experiences of landscape, regardless of socio-cultural identities, the tasks that people participated in, or the meanings they attributed to the landscape. Preferences for affective experiences varied, however, depending on socio-cultural identity, the task in which an individual participated within the landscape, and the meanings an individual attributed to the landscape (Yi, 1999).

Panagopoulos (2009) reviewed the methods of aesthetic assessment of forest landscapes with the goal of helping the implementation of visual-impact assessment in sustainable forestry. Panagopoulos defined beauty as “the quality that gives pleasure to senses and is studied as part of aesthetics” (2009, p. 2485). Beauty is a subjective interpretation of an entity and may lead to feelings of emotional well-being. Incorporating such definitions into forest management processes that are based on objective planning is challenging. Panagopoulos proposed that aesthetic evaluation methods should be used in combination with psychophysical preference modelling (a popular quantitative holistic technique of landscape evaluation) to create new standards for techniques of estimating public perceptions of aesthetic quality in forests.

Daniel (2004) argues that scenic beauty is one of the most sought after and appreciated benefits of natural landscapes. Natural resource managers and social scientists, therefore, must do the best they can to identify scenically beautiful landscapes and how management decisions and policies might affect them. Landscape features account for the greatest share of variance in scenic beauty assessments, making it a challenge to achieve valid representations of temporal and spatial variations in landscape patterns. American citizens’ perceptions and appreciation of

the scenic beauty of landscapes will become an important consideration in natural resource management decisions (Daniel, 2004).

Familiarity is also an important component of environmental preference, be it visual or otherwise. In fact, “familiarity gained through prior information and past experiences can be vital to how humans will react to an environmental scene” (Hammitt, 1979, p. 217). The way people perceive, take in, and process information are consequences of past experiences (Kaplan & Kaplan, 1978). People develop cognitive models of their environment through their past experiences, which in turn influence their perceptions of future environments. By exploring what visitors remember visually from an on-site recreational experience, Hammitt (1979) found that landscapes that were rated to be of high visitor preference were also rated most familiar by those visitors. In other words, preference and familiarity for natural landscapes are closely related.

Racevskis and Lupi (2006) examined urban and rural residents’ familiarity with the management of forest ecosystems in Michigan’s Central Upper Peninsula. They found that there were differences between rural (i.e. timber-dependent) and urban (i.e. non-timber-dependent) participants in their familiarity with forest management. These differences in familiarity resulted in timber-dependent residents being more concerned about the continued provision of both market and nonmarket forest outputs, whereas nontimber- dependent residents were more concerned about maintaining recreational opportunities within forests. Racevskis’ and Lupi’s findings suggest that varying levels of familiarity with forest management practices may influence what benefits residents want their forests to be managed for.

This study explored Colorado residents’ beliefs of their familiarity with nine forest management practices (i.e. (a) forest restoration, (b) planting trees as windbreaks, (c) wildfire defensible space, (d) forest thinning, (e) clearcuts, (f) patch cuts, (g) prescribed fire, (h)

fuelbreaks, and (i) reducing surface fuels), their positive or negative evaluations of aesthetic impacts from the forest management practices, and their approval or disapproval of the forest management practices. In particular, this article examined the combined influence of familiarity and aesthetics on Colorado residents' approval of the nine forest management practices. Familiarity was defined as a belief regarding residents' knowledge of forest management practices; aesthetics was defined as positive or negative evaluations of the visual impacts associated with forest management practices; and approval was defined as positive or negative evaluations of the nine forest management practices.

Hypotheses

H₁: Colorado residents' attitudes of approval of forest management practices increase as their familiarity with those management practices increases.

H₂: Colorado residents' attitudes of approval of forest management practices increases as their evaluations of aesthetic impacts become more positive.

H₃: Colorado residents' evaluations of the aesthetic impacts of forest management practices have more influence on their attitudes of approval than familiarity with those forest management practices.

Methods

Survey Administration

Data were obtained from a sample of 3,000 randomly selected Colorado residents throughout the state. The sample was purchased from Survey Sampling International (SSI). Three mailings were used to administer the survey during the summer and fall of 2012. Residents first received a cover letter with a URL link and an access code with directions on how to take the survey online. A week later, a follow-up postcard was sent reminding residents to take the

online version of the survey. One month after the postcard reminder, a paper questionnaire with a pre-paid postage return envelope was mailed to those who had not as yet completed the survey (Dillman, Smith, & Christian, 2009).

To reduce respondent burden and increase overall response rate, three versions of the survey were constructed; each version included only three of the nine forest management practices. The rest of the survey remained the same in all three versions. The forest management practices are defined in Table 1. Version one of the survey included questions about forest restoration, windbreaks, and creating wildfire defensible space. Version two included questions about forest thinning, clearcuts, and patch cuts, and version three included questions about prescribed fire, fuelbreaks, and reducing surface fuels. Each survey version was sent to 1,000 Colorado residents.

A total of 416 completed surveys were returned (response rate = 14%); 39% completed the survey online and 61% returned the paper questionnaire. Comparisons between the online and paper responses revealed no substantive differences. Each version of the survey was completed by approximately one-third of the 416 respondents.

A non-response telephone survey ($n = 42$) was conducted for those who did not respond to the survey. Selected key issues (familiarity with the CSFS; perceptions of the CSFS; familiarity, approval, and aesthetic impacts of forest management practices; and distance of residence to a forested area) were included in this evaluation. The non-response check showed no substantive differences between those who responded to the survey and those who did not.

Variables

For each of the nine forest management practices included in the survey, respondents indicated their perceived familiarity, their evaluations of the aesthetic impacts, and their approval of the management practices.

Independent variables. Perceived familiarity was measured on a 7-point scale, ranging from ‘1’ (not at all familiar) to ‘7’ (extremely familiar) with the forest management practice. Aesthetic evaluations were also measured on a 7-point scale where ‘1’ indicated the management practice makes the forest look substantially worse, and ‘7’ indicated substantially better.

Dependent variable. Approval of the nine forest management practices was also coded on a 7-point scale ranging from ‘1’ (strong disapproval) to ‘7’ (strong approval).

Analysis

According to the U.S. Census Bureau (2012), 21% of Colorado residents are Hispanic or Latino; only 7% of the respondents were Hispanic or Latino. In addition, Census data show that 49.8% of Colorado residents are female; only 36% of the respondents were female. The data were weighted to account for this under-sampling of Hispanics and females. Nine regression analyses were run in order to predict approval of the nine forest management practices based on Colorado residents’ perceived familiarity and aesthetic evaluations.

Results

As predicted, as familiarity with the nine forest management practices increased, approval of those practices also increased. Similarly, management practices that were perceived to have more positive aesthetic impacts were more likely to receive approval. In general, aesthetics evaluations of forest management practices had a larger influence on Colorado residents’ approval ratings than their familiarity with them. Aesthetics evaluations explained

87% of the variance in approval of clearcuts; familiarity with clearcuts was not a significant predictor of approval for this management practice. For forest thinning, 71% of the variance in residents' approval was explained by their aesthetic evaluations of forest thinning, with familiarity once again not a significant predictor of approval. Aesthetic evaluations and familiarity collectively explained 59% of the variance in approval of patch cuts; aesthetic evaluations was the strongest predictor of approval ($\beta = .68$; familiarity $\beta = .28$). This pattern was observed for reducing surface fuels ($R^2 = .43$; aesthetics $\beta = .55$; familiarity $\beta = .28$), prescribed fire ($R^2 = .29$; aesthetics $\beta = .48$; familiarity $\beta = .17$), and forest restoration ($R^2 = .17$; aesthetics $\beta = .32$; familiarity $\beta = .24$).

Conversely, regression analyses for planting trees as windbreaks, fuelbreaks, and creating wildfire defensible space found familiarity to be the stronger predictor of Colorado residents' approval. Aesthetic evaluations and familiarity collectively explained 26% of the variance in approval for planting trees as windbreaks; however, familiarity was the stronger predictor with a β of .42. Aesthetic evaluations and familiarity collectively explained 25% of the variance in approval for fuelbreaks, but once again, familiarity was the stronger predictor ($\beta = .41$). Finally, aesthetic evaluations and familiarity collectively explained 19% of the variance in approval of wildfire defensible space, but familiarity was the strongest predictor of that approval ($\beta = .36$).

Discussion

Colorado residents' approval of nine forest management practices (i.e. forest restoration, planting trees as windbreaks, wildfire defensible space, forest thinning, clearcuts, patch cuts, prescribed fire, fuelbreaks, and reducing surface fuels) increased as their familiarity with those management practices increased, and as their evaluations of aesthetic impacts became more positive. This demonstrates that the more familiar Colorado residents are with a forest

management practice and the more aesthetically pleasing they think the management action will make the forest, the more likely they are to approve of that management practice.

Also, for six of the nine forest management practices Colorado residents' aesthetic evaluations had a larger influence on their approval than their familiarity with the management practices themselves. This means that forest managers should communicate the aesthetic benefits of forest management through their outreach messages to Colorado residents. This can be done by showing images of forests before and after the management practices have been implemented, as well as on-site visits or field trips to areas that have been managed by forestry agencies. Even if Colorado residents have little knowledge about forest management practices, if they believe that the management practice will increase the beauty of the forest (or their property), they are more likely to approve of the use of that management practice. This means that forest management agencies must begin to convey that the forest management practices Colorado residents think make the forest look worse (i.e. clearcuts and patch cuts) do increase the natural beauty of Colorado's forests over time. In these instances, Colorado residents may not see personal aesthetic benefits to themselves if it takes decades for the forests to regrow, so the CSFS must communicate the aesthetic benefits of forest management practices to future generations.

It is important to keep in mind, however, that beauty is an individual's personal evaluation (Eagly & Chaiken, 1993). It is essential to provide Colorado residents with personal experiences to demonstrate how management practices can enhance the beauty of forested environments. It may be impossible to effectively communicate aesthetic benefits of forest management practices if the CSFS cannot change Colorado residents' personal evaluations.

For management practices such as planting trees as windbreaks, creating wildfire defensible space, and fuelbreaks, familiarity was found to be the stronger predictor of Colorado residents' approval than their aesthetic evaluations. This may be due to the fact that wildfires have been in the news more frequently over the last few years and Colorado residents have become familiar with the terms fuelbreaks and wildfire defensible space. Creating and maintaining a wildfire defensible space is promoted as a landowner's first defense against a wildfire, not only by the CSFS, but also by national and local organizations, such as Firewise Communities USA[®] and local fire protection districts. Fuelbreaks are also promoted to protect subdivisions and communities, and aid firefighters in slowing the spread of wildfires (under normal burning conditions). Colorado residents may also know about windbreaks and their uses (i.e. reducing soil erosion, protecting homes and livestock, lowering heating and cooling costs, and enhancing wildlife habitat), especially in southeastern Colorado where the wind blows often and hard. The fact that Colorado residents are more knowledgeable about these forest management practices may have played a role in causing their familiarity to be the stronger predictor of their approval than their aesthetic evaluations of planting trees as windbreaks, and creating fuelbreaks and wildfire defensible space.

Future Research

This article explored Colorado residents' familiarity with, aesthetic evaluations of, and approval of nine forest management practices as identified in a public perceptions survey of the CSFS. Research has shown that experts (i.e. scientists, agencies), constituent/interest groups, and the public can vary in their perceptions, particularly when judging risk (Vaske, Absher, & Bright, 2007; Sjoberg, 1999; Taylor, Carpenter, Cortner, & Cleaves, 1988). With increasing concern about forest health, these perceptions of risk may factor into Colorado residents' approval or

disapproval of forest management practices. More research must be done on Colorado residents' perceptions of risk to the forests on their private property, or the state forests that they recreate in and enjoy, and how it influences their approval or disapproval of the use of different forest management practices. Other research could also examine how forest experts, interest groups, and the public vary in their perceptions of forest management practices in general.

Research must also be done to explore more effective methods for the CSFS to communicate the aesthetic benefits of forest management practices to Colorado residents. Are there specific mediums to communicate this information through? Will visual representations of forest management practices properly communicate forest management benefits? Access to this information will allow the CSFS to gain both rural and urban Colorado residents' approval of forest management practices. The management of Colorado's state and private forests impacts all Colorado residents. If private landowners do not properly manage their forests for wildfire mitigation, the increased threat of wildfires to their property not only affects that landowner, but also urban residents downstream who depend on that forest for its watershed benefits. The more approving Colorado residents are of forest management practices, the more likely they are to vote for bills that provide funding for proper forest management, creating benefits such as clean air, clean water, and increased biodiversity for both rural and urban residents.

Many Colorado residents live in forested areas because they enjoy the natural beauty of forest environments (Burton, 2013). However, to continue to enjoy the beautiful scenery and other benefits Colorado's forests provide, the most effective forest management practices need to take place, including silvicultural practices, such as clearcuts and patch cuts. Communicating the aesthetic benefits of such practices will help increase Colorado residents' approval, allowing the

CSFS and other agencies “to achieve stewardship of Colorado’s diverse forest environments for the benefit of present and future generations” (Colorado State Forest Service, 2013).

Tables and Figures

Table 2.
Predicting approval for nine forest management practices in Colorado

Dependent Variable Approval of:	Familiarity ¹	Aesthetics ¹	<i>R</i> ²
Clearcuts	.08	.87**	.75
Patch cuts	.28**	.68**	.59
Forest Thinning	.08	.71**	.56
Reducing Surface Fuels	.28**	.55**	.43
Prescribed Fire	.17*	.48**	.29
Windbreaks	.42**	.27**	.26
Fuelbreaks	.41*	.31*	.25
Defensible Space	.36**	.19**	.19
Forest Restoration	.24*	.32**	.17

¹Values are standardized β regression coefficients

**Values significant at $p = < .001$

* Values significant at $p = < .05$

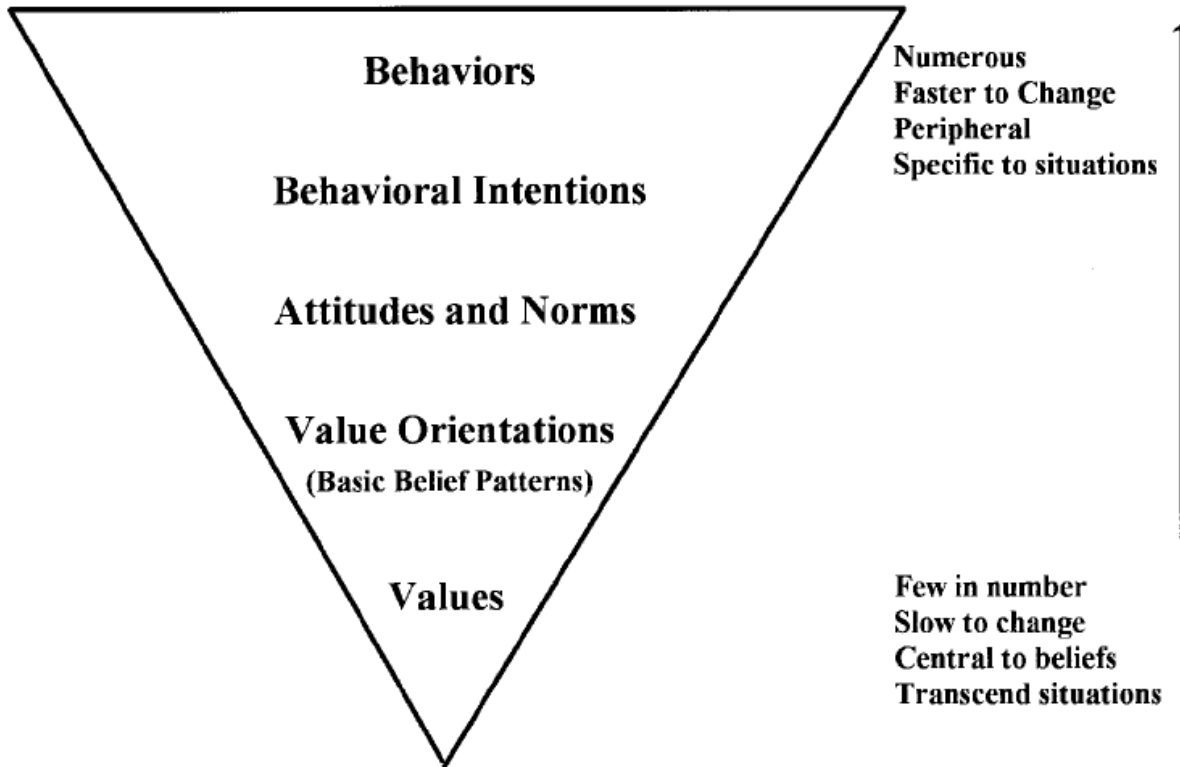


Figure 1.
The cognitive hierarchy model of human behavior adapted from Fulton et al. (1996)

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CHAPTER 2. PREDICTORS OF COLORADO RESIDENTS' SATISFACTION WITH THE COLORADO STATE FOREST SERVICE

Introduction

There is expanding recognition that natural resource management decisions must identify both biophysical and social processes at a multitude of scales and time frames, and yet, managers must be able to make quick decisions supported by credible science and research (McCool & Guthrie, 2001). Forces such as economic growth, population and demographic changes, technological change, political-economic institutions, and changes in the attitudes and beliefs held by citizens all influence biophysical and social processes. This makes it difficult for natural resource agencies to remain relevant and reputable, while also maintaining the satisfaction of the constituents they serve. Natural resource agencies must address all of these issues while including the public in the decision-making process; not all decisions, however, will satisfy every stakeholder involved in an issue. This creates a challenge for natural resource agencies to maintain the trust and satisfaction of the people they serve.

This article examined the influence of Colorado residents' familiarity, knowledge, salient value similarity, and social trust of the Colorado State Forest Service (CSFS) on overall satisfaction with the agency. Knowing what influences Colorado residents' satisfaction will help the CSFS focus its outreach messages in order to increase favorable public perceptions of the agency, as well as acceptance of Colorado forest management practices.

Theoretical Framework

Satisfaction

Quality of natural resources is one underlying goal of all natural resource management agencies (Jacobson, 2001). A primary measure of quality for natural resource management

agencies has been public satisfaction (Manning, 1986; Vaske, Donnelly, & Williamson, 1991; Jacobson, 2001). The majority of the public satisfaction studies performed have focused on recreation visitors (Jacobson, 2001). Visitor satisfaction is the degree of consistency between a visitor's expectations and perceptions of the existence of given attributes in the recreational environment (i.e. performance) (Mackay & Crompton, 1990).

Feedback on public satisfaction can provide information to improve management decision-making, as well as “strategic planning processes to develop action plans and goals; track and manage customer problems; and link employee training, development, and incentives to customer satisfaction through better service” (Jacobson, 2001). Knowing what influences satisfaction will allow the CSFS to focus its outreach efforts on those variables and adjust decision-making processes on forest management in order to increase overall satisfaction with the agency.

Social Trust

The concept of trust is a recurring theme throughout a multitude of professions and disciplines. Trust exists at multiple levels (i.e., individual, group, firm, or institutional), occurs within or between organizations, and has multiple roles (i.e., cause, outcome, mediator, moderator) (Rousseau et al., 1998). Economists, for example, view trust as calculative (Williamson, 1993) or institutional (North, 1990), whereas psychologists focus on the attributes of trustors and trustees, both of whom have internal cognitions (Rotter, 1967; Tyler, 1990). Sociologists, on the other hand, believe trust is socially rooted in relationships between people (Granovetter, 1985) or institutions (Zucker, 1986). Such disciplinary differences explain why scholars operationalize trust differently (Rousseau et al., 1998).

Rousseau et al. (1998) defined four different forms of trust: deterrence-based, calculus-based, relational, and institution-based trust. First, deterrence-based trust “emphasizes utilitarian considerations that enable one party to believe that another will be trustworthy, because the costly sanctions in place or breach of trust exceeds any potential benefits from opportunistic behavior” (Rousseau et al., 1998, p. 398). This form of trust represents the idea that trust is low, and there are high costs or sanctions for violating that trust. For natural resource management, this would require the command-and-control form of management, where there are penalties for not complying with natural resource management policies.

Second, calculus-based trust is based on rational choice, or the different characteristics of interactions present in economic exchange. Calculus-based trust “emerges when the trustor perceives that the trustee intends to perform an action that is beneficial” (Rousseau et al., 1998, p. 399). Calculus-based trust is more likely to occur if one party has credible information regarding the intentions of another.

Third, relational trust is created over time through multiple interactions between different parties. The relationship itself will give one party information about the other, creating trust and establishing a connection between the two parties.

Finally, institution-based trust occurs when “institutional factors can act as broad supports for the critical mass of trust that sustains further risk taking and trust behavior” by each party involved (Rousseau et al., 1998, p. 400). Institution-based trust can occur at the organizational level where the organization works as a team, or at the societal level through legal systems and regulations that protect individual rights (Rousseau et al., 1998).

Impact of trust in governmental institutions.

Political trust focuses more at the institutional level, where those who produce policies

either receive trust from those who support those policies or lose trust from those who are dissatisfied. In other words, “we tend to trust and like those who agree with us” (Citrin, 2001, p. 973). Early research on political trust found that an individual’s trust was linked to his/her social background or personality; however, more recent research has found this to not be the case and that it is, instead, that people trust the people they agree with (Citrin, 2001; Aberbach & Walker, 1970).

Salient value similarity.

This notion that individuals tend to trust the people they agree with has also been proposed through a concept called salient value similarity (SVS). Theoretically, people who perceive that they share similar views as those of a managing agency tend to trust that agency more than those who do not (Siegrist et al., 2000). Similar goals, thoughts, values, and opinions that an individual perceives to share with a management agency are all part of SVS. The concept influences social trust, or “the willingness to rely on those who have the responsibility for making decisions and taking actions related to the management of technology, the environment, medicine, or other realms of public health and safety” (Siegrist et al., 2000, p. 354). In this definition, “social” represents those who have formal responsibilities within organizations and may not be known to the person making the decision to trust. In the case of the CSFS, Colorado residents who share salient value similarity with the agency may be more likely to trust the management practices performed by the agency than those who do not.

Cognitions and trust.

Positive or negative attitudes toward an agency can influence an individual’s willingness to trust that agency. Attitudes represent an individual’s tendency to respond favorably or unfavorably toward an object, which could include an issue, behavior, another individual, or an

entity such as an agency (Fishbein & Ajzen, 1975). Attitudes have also been defined as a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor (Eagly & Chaiken, 1993). In other words, attitudes are our positive or negative evaluations of objects, people, or institutions. Research on procedural justice has found that when people have positive attitudes or evaluations of decision-making processes, they display a higher level of voluntary cooperation, trust, and commitment to the process than those who do not (Kim & Mauborgne, 1998).

Research in the psychology realm has also found an influence of behavior on trust. In relationships, for example, individuals will tend to trust their partner when they perceive that their partner has “enacted pro-relationship behavior departing from their direct self-interest for the good of the relationship” (Wieselquist, Rusbult, Foster, & Agnew, 1999, p. 943). In their research, Wieselquist et al. (1999) have found that pro-relationship behaviors mediate the commitment between partners and their trust in each other.

Trust research in natural resources.

Trust research has also emerged as an important area of study in natural resource management. This is based in part on the recognition that the trust the public has in different natural resource agencies can influence the success of management decisions and affect public outreach and educational efforts. Following are three different case studies that have explored the impacts of trust in natural resource management decisions and programs.

First, Vaske, Absher, and Bright (2007) conducted research on social trust in the USDA Forest Service. They found that individuals who share the same values (salient value similarity) as the USDA Forest Service managers trusted the agency to effectively use prescribed burning and mechanical thinning for forest management. They also found that as salient value similarity

between individuals and the agency increased, social trust in the agency also increased, as well as the approval of these forest management practices. The study found social trust to be important in gaining public support for forest management.

Another study conducted by Teel, Dayer, Manfredo, and Bright (2005) explored the relationship between wildlife value orientations and trust. The researchers surveyed residents in 19 western states and found that approximately one-half of the respondents trusted state wildlife agencies to make decisions without their input. However, they also found that less than half of the individuals surveyed felt that their opinions were heard or taken into account by the management agencies, or that, if they provided input, it would even make a difference in agency decision-making. The study concluded that the federal government held the least amount of trust by the respondents, followed by state government, and state fish and wildlife agencies, which were trusted the most out of all three levels of government.

A third study by Davenport, Leahy, Anderson, and Jakes (2006) explored the perceptions of trust between community members and USDA Forest Service personnel at the Midewin National Tallgrass Prairie in northeastern Illinois, as well as the constraints to building that trust. The researchers found three dimensions of trust: (a) institutional trust in management processes, (b) institutional trust in management outcomes, and (c) interpersonal trust in agency personnel. Institutional trust in management processes was represented by the amount of public input and cooperation between USDA Forest Service personnel and other agencies in decision-making processes. Institutional trust in management outcomes reflected participants' perceptions of the knowledge and values in making decisions and taking action by USDA Forest Service personnel. Finally, interpersonal trust in the agency itself was measured by developed relationships between community members and USDA Forest Service personnel.

Davenport et al. (2006) concluded that trust was perceived by both community members and USDA Forest Service personnel as being important in the effective management of the Midewin National Tallgrass Prairie. They also found that community members were more willing to trust the agency if there were opportunities for communication, collaboration, and cooperation between community members and USDA Forest Service personnel throughout the decision-making process.

Davenport et al. (2006) identified a wide variety of constraints to building trust: unclear communication between community members and personnel, limited opportunities for community engagement, a feeling of limited community power, historical resentment of the agency among community members, slow progress in restoration and public access to Midewin, a lack of community awareness of the USDA Forest Service, a break in relationships due to staff turnover, and limited opportunities for agency members to build relationships with the community. All of these barriers have one main theme: knowing your audience is imperative in building trust (Davenport et al., 2006).

Information Processing

Natural resource agencies, however, also need their audience to know about them to properly promote the management work they do. Without this knowledge, one mistake by a natural resource agency may ruin their public image, or bring that agency to the public's radar in a negative way, thereby decreasing trust and satisfaction with the agency. "It has been argued that news about negative events has a much stronger effect on decreasing social trust than does news on positive events on increasing it" (Cvetkovich et al., 2002, p. 359). There is asymmetry between the difficulty of creating trust and the ease of destroying it (Slovic, 1993). Positive and negative information are not evaluated in the same way; negative information triggers a stronger

reaction than positive information (Taylor, 1991). The media devotes more space to risk because people find news about risk more valid than information indicating an absence of risk (Siegrist & Cvetkovich, 2001). Negative events covered by the media have a large influence on reducing the amount of social trust in natural resource agencies (Cvetkovich et al., 2002). Because of the immense coverage of negative events, Colorado residents that have more knowledge of the CSFS may be more likely to trust the agency than those who know little to nothing about the agency.

Fewer studies have been conducted looking at the relationship between familiarity and trust. Gefen (2000) explored the role of familiarity and trust in E-commerce (purchasing products on the internet) and found that both familiarity with an Internet vendor and trust in the vendor influenced customers' intentions to inquire about and purchase books on the internet. Gefen also found that familiarity does build trust; however, it is customers' disposition to trust that affected their trust in the Internet book vendors. Based on the results of Gefen's research, this study will look at whether familiarity with the CSFS will influence trust in the agency, or if knowledge of the CSFS and salient value similarity have larger impacts on trust.

The Colorado State Forest Service

The Colorado State Forest Service (CSFS) is the lead state agency for forestry expertise in Colorado. The CSFS is a service and outreach agency of the Warner College of Natural Resources (WCNR) at Colorado State University (CSU) and staffs the division of forestry in the Colorado Department of Natural Resources. The mission of the CSFS is *to achieve stewardship of Colorado's diverse forest environments for the benefit of present and future generations*. The CSFS has four main programmatic areas: (a) forest management, (b) wildland fire mitigation and education, (c) urban and community forestry, and (d) conservation education (Colorado State Forest Service, 2014a).

The CSFS manages Colorado's state and private forests for the benefit of the residents within the state, and therefore, the input of those residents is important to the agency. The CSFS was interested in learning about Colorado residents' perceptions of the agency, as well as their perceptions of forest management practices within the state. This was part of a public perceptions survey of the CSFS that was identified in the agency's 2010 strategic plan (Colorado State Forest Service, 2014a).

On Monday, March 19, 2012, the CSFS initiated a 50-acre prescribed burn as part of a service agreement on Denver Water Board property in Jefferson County, Colorado, to reduce hazardous fuels in the Lower North Fork Area (Colorado State Forest Service, 2012). Crews completed a containment line around the fire area that day and the actual prescribed fire was carried out and completed on Thursday, March 22, with mop-up operations beginning on Friday, March 23. The fourth day after the burn, Monday, March 26, a patrol crew reported a significant increase in wind, which blew embers over the containment line into unburned fuels, causing the patrol crew to immediately request additional resources and begin aggressively fighting the fire that later came to be known as the Lower North Fork Fire (Bass et al., 2012; Colorado State Forest Service, 2012). The Lower North Fork Fire burned for a week, resulted in the deaths of three people and the loss of 24 structures, and burned 4,140 acres in a populated area near Conifer. At the peak of the fire, more than 900 homes in the area were evacuated (Colorado State Forest Service, 2014e).

An investigation of the prescribed burn on the Denver Water Board property found that four factors contributed to the escape of the prescribed burn and the conversion to a wildfire. The largest factor was a rapidly escalating wind event. A weather watch for strong winds was issued on Saturday, March 24, 2012 and upgraded to a red flag warning for Monday, March 26. The

patrol crew was on scene Monday, March 26, but was unable to keep the prescribed burn contained. Three other factors that “potentially contributed to the prescribed burn escape [included] unburned fuel and residual heat present in the burn area at the time of the wind event, operational actions drawn from experience and common practice” (i.e. 200 foot buffer for mop-up and anticipation of need to respond to other wildfires), and “weather and fire projections that did not/could not predict the complete set of circumstances that occurred” (Bass et al., 2012, p. 1, 55).

“One of the primary roles of the Colorado State Forest Service is to help keep forests healthy and reduce the threat of catastrophic wildfires through fuel reduction. Prescribed fires are a well established tool in this effort, with many measures in place to make this tool as safe as possible” (Colorado State Forest Service, 2012, p. 1). As a result of the Lower North Fork Fire, wildfire command and control operations transferred from the CSFS to the Colorado Department of Public Safety on July 1, 2012 (*House Bill 1283*, 2012). This transfer of responsibilities may represent a decrease in the amount of trust Colorado residents had in the CSFS. The public perceptions survey of the CSFS attempted to learn if Colorado residents’ still had social trust in the agency, and whether their perceptions of the CSFS had changed between 2012 and 2013, after the prescribed burn. If social trust is the largest predictor of satisfaction, it is important for the CSFS to know the level of Colorado residents’ social trust and determine how to increase the trust with the agency in order to increase Colorado residents’ overall satisfaction. This led to several hypotheses.

Hypotheses

H₁: The more familiar Colorado residents are with the CSFS, the higher their total knowledge of the agency will be.

H₂: The more familiar Colorado residents are with the CSFS, the higher their salient value similarity with the agency.

H₃: The higher Colorado residents' knowledge of the CSFS is, the higher their salient value similarity with the agency.

H₄: The more familiar Colorado residents are with the CSFS, the more social trust they will have in the agency.

H₅: The higher Colorado residents' knowledge of the CSFS is, the more social trust they will have in the agency.

H₆: The more salient value similarity Colorado residents share with the CSFS, the more social trust they will have in the agency.

H₇: The more salient value similarity Colorado residents share with the CSFS, the higher their overall satisfaction will be with the agency.

H₈: The more social trust Colorado residents have in the CSFS, the higher their overall satisfaction will be with the agency.

H₉: Salient value similarity and social trust will mediate the relationships between familiarity, knowledge, and overall satisfaction with the CSFS.

H₁₀: Social trust will be the largest predictor of Colorado residents' overall satisfaction with the CSFS.

Methods

Survey Administration

The survey was mailed to a sample of 3,000 randomly selected Colorado residents throughout the state. The sample was purchased from Survey Sampling International (SSI).

Three mailings were used to administer the survey during the summer and fall of 2012. Residents

first received a cover letter with a URL link and an access code with directions on how to take the survey online. A week later, a follow-up postcard was sent reminding residents to take the online version of the survey. Approximately a month after the postcard reminder, a paper questionnaire with a pre-paid postage return envelope was mailed to Colorado residents who had not yet taken the survey (Dillman, Smith, & Christian, 2009).

A total of 416 completed surveys were returned, with an overall response rate of 14% (39% took the survey online and 61% returned the paper questionnaire). Crosstabulations comparing the online survey and the paper questionnaire responses found no substantive differences. A non-response check was conducted of Colorado residents who did not respond to the survey. Selected key issues (familiarity with the CSFS; perceptions of the CSFS; familiarity, approval, and aesthetic impacts of forest management practices; and distance of residence to a forested area) were addressed in a telephone survey of non-respondents ($n = 42$). The non-response check showed no substantive differences between those who responded to the survey and those who did not. The non-response check also suggested no substantive differences between rural and urban respondents.

Variables

Independent Variables – Familiarity and Knowledge with the CSFS. Familiarity with the CSFS was measured using responses to the survey statement “please indicate how familiar you are with the Colorado State Forest Service (CSFS) in general” (measured on a 7-point scale ranging from ‘not at all familiar’ [1] to ‘extremely familiar’ [7]).

The second independent variable, total knowledge of the CSFS, was computed from a series of 12 true/false statements regarding the agency. Respondents were asked to indicate whether they believed each of the following statements related to the Colorado State Forest

Service (CSFS) is true or false: (a) the CSFS is part of the U.S. Forest Service; (b) the CSFS owns large areas of public land; (c) the CSFS helps landowners manage the forests on their property; (d) the CSFS is the lead state agency for forestry expertise in Colorado; (e) the CSFS is a part of Colorado State University; (f) the CSFS works with land managers to plan forestry projects; (g) the CSFS works with land managers to implement forestry projects; (h) the CSFS provides forestry expertise to lawmakers; (i) the CSFS assists communities with planning urban forestry tree care efforts; (j) the CSFS manages a seedling tree nursery that provides trees to private landowners; (k) the CSFS has responsibility for enforcing laws; and (l) the CSFS is part of the Colorado Department of Natural Resources.

Mediator Variables – Salient value similarity and social trust were hypothesized to serve as mediators between familiarity and knowledge with the CSFS, and overall satisfaction with the agency. Following the format of Siegrist et al. (2000), salient value similarity was measured using five questions. Respondents were asked to indicate the extent to which they agreed or disagreed with the following statements: I believe the CSFS (a) shares similar values as me; (b) shares similar opinions as me; (c) thinks in a similar way as me; (d) takes similar actions as I would; and (e) shares similar goals as me. Responses were given on a 7-point scale ranging from ‘strongly disagree’ (1) to ‘strongly agree’ (7).

Social trust was measured using four questions regarding trust in the CSFS. Respondents were asked to indicate the extent to which they agreed or disagreed with the following statements regarding their trust in the CSFS: I trust the CSFS to (a) provide credible information on forest management issues; (b) provide the best information so I can decide what actions I should take regarding forest management; (c) provide truthful information about forest management; and (d)

provide timely information regarding forest management issues. Responses were given on a 7-point scale ranging from ‘strongly disagree’ (1) to ‘strongly agree’ (7).

Dependent Variable – Overall Satisfaction. Overall satisfaction with the CSFS was computed from a series of eight questions regarding respondents’ ratings on forest management and outreach activities performed by the CSFS on a 5-point scale ranging from “poor” (1) to “excellent” (5). The questions included: “How would you rate the CSFS on” (a) providing information about our forests, (b) providing forestry-related education, (c) providing wildfire mitigation education, (d) managing state forests, (e) managing private forests, (f) assisting with urban tree planting, (g) creating opportunities for community involvement in forestry, and (h) offering online resources.

The internal consistency of salient value similarity, social trust, and overall satisfaction were examined using Cronbach’s alpha. Ordinary least square (OLS) regression analyses were used to assess the relationships between familiarity, knowledge, salient value similarity, social trust, and overall satisfaction.

Results

Scale Reliabilities

The majority of respondents (60%) reported being somewhere between slightly familiar to extremely familiar with the CSFS. A little under half of the respondents (45%) were able to answer half (i.e. 6) to all 12 of the true/false statements correctly. Thirteen percent of the respondents did not answer any of the true/false statements correctly, and 42% of the respondents answered only one to six of the true/false statements correctly.

With respect to salient value similarity, respondents believed that they slightly share the same values ($M = .62, SD = 1.29$), opinions ($M = .50, SD = 1.21$), thoughts ($M = .46, SD = 1.24$),

goals ($M = .61$, $SD = 1.27$), and take similar actions ($M = .50$, $SD = 1.22$) as the CSFS. The reliability coefficient (i.e. Cronbach's alpha) for these five items was .97, indicating that, when combined to create a single index, the index had high internal consistency. Deleting any of the items would not improve the overall reliability of the scale.

Respondents also slightly trust the CSFS to provide credible information ($M = .84$, $SD = 1.54$), provide the best information ($M = .71$, $SD = 1.51$), provide truthful information ($M = .86$, $SD = 1.59$), and provide timely information ($M = .63$, $SD = 1.53$) regarding forest management issues in Colorado. The reliability coefficient for these four items was .96, indicating a high internal consistency for the index. Once again, deleting any of the items would not increase the overall reliability of the scale.

On average, respondents rated the CSFS as doing a "good" job on its forest management and outreach activities ($M = 3.04$, $SD = 1.18$), indicating moderate satisfaction with the agency in general. The internal consistency of the index was high with a reliability coefficient of .98 for the eight items in the scale. Deleting any of the items would not increase the overall reliability of the scale.

Ordinary Least Squares Regressions

After demonstrating the reliability of the constructs, a series of ordinary least squares (OLS) regression analyses were run. Seven of the eight proposed hypotheses were supported. The more familiar Colorado residents were with the CSFS, the higher their total knowledge of the agency ($\beta = .34$), with familiarity explaining 11% of the variance in Colorado residents' total knowledge of the CSFS. The more familiar Colorado residents were with the CSFS ($\beta = .17$) and the higher Colorado residents' total knowledge of the CSFS ($\beta = .25$), the higher their salient

value similarity was with the agency. Colorado residents' familiarity and knowledge of the CSFS explained 12% of the variance in salient value similarity.

Hypothesis four (the more familiar Colorado residents are with the CSFS, the more social trust they will have in the agency), was not supported. Familiarity did not influence social trust. Instead, Colorado residents' total knowledge ($\beta = .13$) and their salient value similarity ($\beta = .60$) with the CSFS combined explained 45% of the variance in social trust, acting as mediators between Colorado residents' familiarity with and social trust in the CSFS. This did support hypotheses five and six because as knowledge and salient value similarity increased, so did Colorado residents' social trust of the CSFS.

As predicted by hypothesis seven, as salient value similarity increased, Colorado residents' overall satisfaction also increased. Similarly, as social trust increased, Colorado residents' overall satisfaction with the CSFS also increased. Salient value similarity and social trust together explained 32% of the variance in Colorado residents' overall satisfaction with the CSFS. This also supported hypothesis nine, because salient value similarity and social trust mediated the relationships between familiarity and knowledge with the CSFS, and overall satisfaction with the agency. Finally, hypothesis ten was supported by the data because social trust was the strongest predictor of Colorado residents' overall satisfaction with the CSFS ($\beta = .45$).

Discussion

Based on the results of the OLS regressions, the model that familiarity influences knowledge, which influences salient value similarity, which influences social trust, which ultimately influences overall satisfaction with the CSFS was proposed (see figure 1). This model suggests that the CSFS should begin to focus on increasing Colorado residents' familiarity,

knowledge, salient value similarity, and social trust in the agency in order to increase overall satisfaction. The CSFS should place particular emphasis on increasing Colorado residents' trust. This could be accomplished through assisting with and hosting community events to help build a sense of community between the CSFS and Colorado residents. This would also help increase Colorado residents' familiarity with CSFS staff, as well as the agency in general. The CSFS could also focus its education and outreach efforts on communicating the wide array of community benefits provided by forest management practices performed by the agency. Also, since negative media coverage is more prevalent than positive media coverage and it lowers levels of trust in natural resource management agencies, the CSFS must begin to find ways to promote their positive messages and success stories using a wider array of media forums, such as social media (Siegrist & Cvetkovich, 2001).

It is important to keep in mind that values are centrally held and very difficult to change (Fulton, Manfredo, & Lipscomb, 1996). The CSFS has a list of guiding value principles. The CSFS values (a) the people it serves, (b) CSFS employees who are trusted and supported to do their best, and (c) biological, social, and cultural diversity in Colorado (Colorado State Forest Service, 2009). The CSFS can work on communicating to Colorado residents these values and demonstrate that CSFS employees are Colorado residents too. Since social trust was the largest predictor of overall satisfaction with the CSFS, however, the agency should focus its outreach efforts on increasing trust in the agency instead of trying to convince Colorado residents that they share the same core values.

To create trust in the CSFS, the agency must work on increasing its knowledge of the audiences it serves. When it comes to creating trust between natural resource agencies and local communities, one of the main barriers continues to be knowledge of the audience. This may be

due to a lack of human, physical, and financial resources needed by agency managers and staff members to build trust in the first place (Davenport et al., 2006). Changing demographics in the United States are requiring natural resource agencies to reach out to their audiences in new ways. The outdoorsy white male who loves to hunt and fish is no longer the primary target for natural resource managers. Agencies must instead begin to focus on creating trust with whole communities with different ethnicities, ages, cultural backgrounds, and natural resource-related interests. This cannot be accomplished without getting to know the audience of Colorado residents who depend on and live within Colorado's forest ecosystems.

Another barrier to trust between natural resource agencies and local communities may be a lack of capacity and supportive policies required to encourage collaboration to continue to maintain trust once it has been established (Schusler, Decker, & Pfeffer, 2003). Once trust is created, personnel are needed in the field and in the community, interacting with people and maintaining trust, which can be difficult if capacity does not exist within the agency to achieve this. Also, trust may be created through an agreement about how an area may be managed in the future, but without proper policies in place, the management actions may not be taken.

Although perceptions and different dimensions of trust have been explored in natural resource management, clarity on the meaning of trust and how it is developed and maintained in collaborative relationships is lacking (Schusler et al., 2003). Natural resource agencies must work on creating a definition of trust that incorporates a plan on how to develop and maintain good relationships with partners and local communities over time. As the CSFS develops and maintains trust with the audiences it serves, satisfaction with the CSFS will increase among those audiences.

Multiple barriers to creating and maintaining trust requires additional research to fully understand the factors that influence Colorado residents' trust and satisfaction with the CSFS. Other components that influence trust, such as distrust in government agencies or a lack of trust in the agency's technical competency, may also impact trust, and in turn, satisfaction with the CSFS. However, to create trust, to even develop trust in the first place, the CSFS must know their audiences and their attitudes regarding forest management.

Using findings from the public perceptions survey of the CSFS completed by Colorado residents hopefully will help the agency identify its audiences so it can begin to develop trust and increase satisfaction with the audience members it has not been able to reach in the past, and increase the satisfaction of audiences that are already familiar with the CSFS. The results of this study will allow the agency to properly address how it is going to communicate with its audiences when the new CSFS strategic plan is developed, and change the delivery mechanisms the agency uses to educate them about forest management in Colorado.

Satisfying all Colorado residents, both rural and urban, should be a priority of the CSFS, because all Colorado residents are impacted by the management of Colorado's state and private forests. If private landowners do not properly manage their forests for wildfire mitigation, the increased threat of wildfires to their property not only affects that landowner, but also urban residents downstream who depend on that forest for its watershed benefits. The more knowledge Colorado residents have of the CSFS and the more they trust the agency to utilize best forest management practices, the more likely they are to vote for bills that provide funding for proper forest management.

“With increasing public demands and diverse stakeholder desires, effective monitoring of public satisfaction will be a key element in support of ecosystem management in the future”

(Jacobson, 2001, p. 96). The CSFS must continue to learn more about Colorado residents' satisfaction with the agency, and how to increase their trust in order to gain support for the important forest management practices and outreach and education programs the agency provides.

Tables and Figures

Table 3.
Reliability analysis of Salient Value Similarities, Social Trust, and Satisfaction

Variable	Mean	Standard Deviation	Cronbach Alpha If Item Deleted	Cronbach's Alpha
Salient Value Similarities				.97
I believe that the CSFS shares similar values as me ¹	.62	1.29	.964	
I believe that the CSFS shares similar opinions as me ¹	.50	1.21	.958	
I believe that the CSFS thinks in a similar way as me ¹	.46	1.24	.960	
I believe that the CSFS takes similar actions as I would ¹	.50	1.22	.963	
I believe that the CSFS shares similar goals as me ¹	.61	1.27	.961	
Social Trust				.96
I trust the CSFS to provide credible information on forest management issues ¹	.84	1.54	.938	
I trust the CSFS to provide the best information so I can decide what actions I should take regarding forest management ¹	.71	1.51	.947	
I trust the CSFS to provide truthful information about forest management ¹	.86	1.59	.957	
I trust the CSFS to provide timely information regarding forest management issues ¹	.63	1.53	.948	
Satisfaction				.98
How would you rate the CSFS on providing information about forests? ²	2.93	1.27	.980	
How would you rate the CSFS on providing forestry-related education? ²	3.01	1.33	.979	
How would you rate the CSFS on providing wildfire mitigation education? ²	3.11	1.30	.978	
How would you rate the CSFS on managing state forests? ²	3.14	1.33	.980	
How would you rate the CSFS on managing private forests? ²	3.11	1.46	.980	
How would you rate the CSFS with assisting with urban tree planting? ²	3.22	1.38	.979	
How would you rate the CSFS on creating opportunities for community involvement in forestry? ²	3.15	1.43	.979	
How would you rate the CSFS on offering online resources? ²	3.28	1.41	.979	

¹Responses given on a 7-point scale: '-3' strongly disagree, '-2' moderately disagree, '-1' slightly disagree, '0' neutral, '1' slightly agree, '2' moderately agree, '3' strongly agree

²Responses given on a 5-point scale: '1' poor, '2' fair, '3' good, '4' very good, '5' excellent

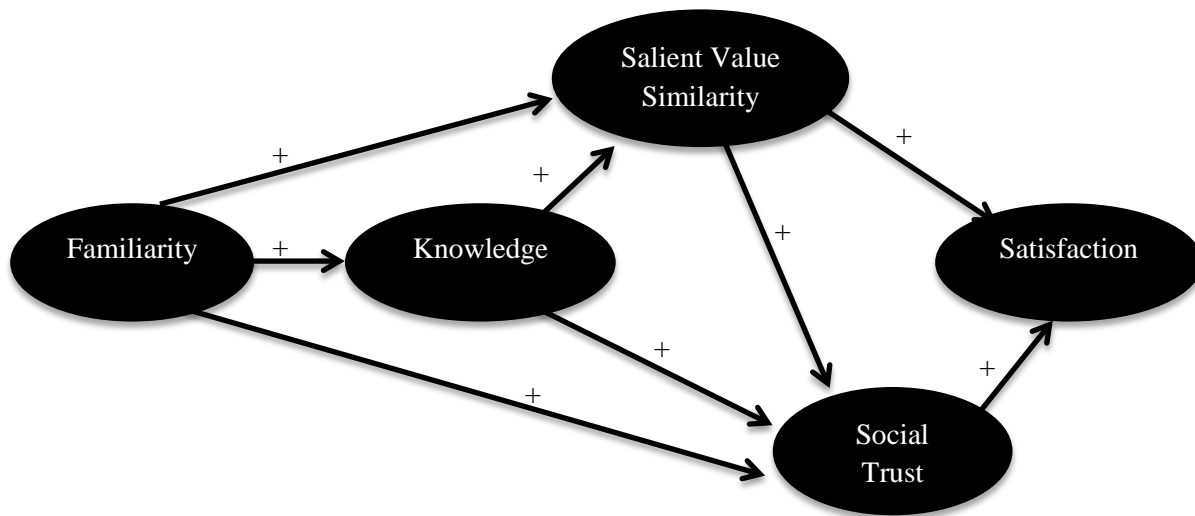


Figure 2.
Hypotheses predicting Colorado residents' satisfaction with the Colorado State Forest Service

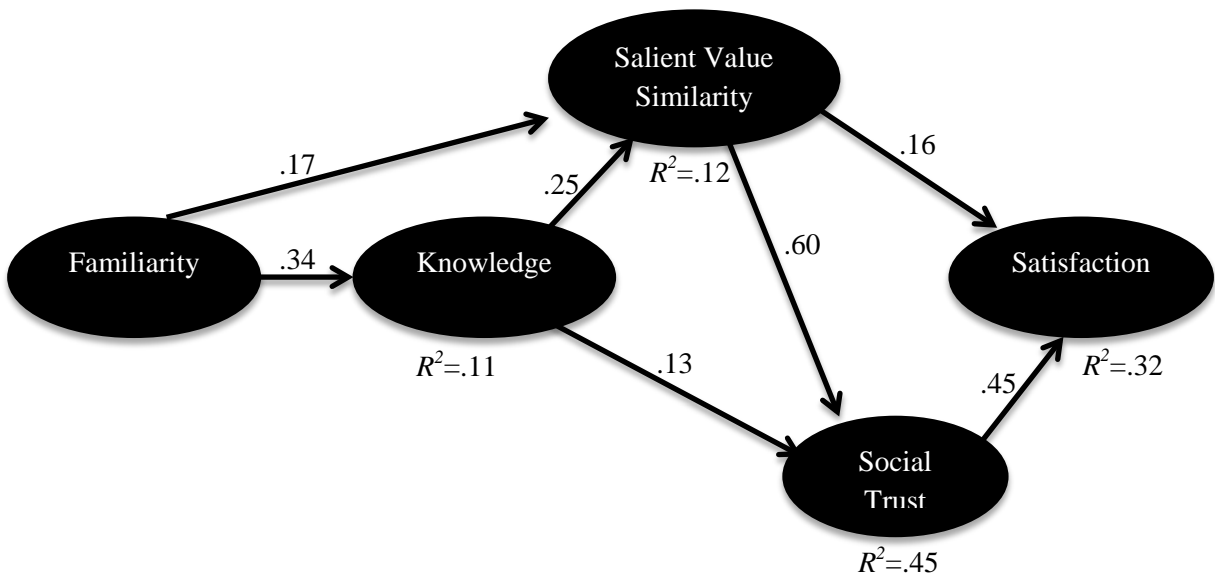


Figure 3.
 Predicting Colorado residents' satisfaction with the Colorado State Forest Service

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CHAPTER 3. THE WILDLAND-URBAN INTERFACE IN COLORADO:
ARE COLORADO RESIDENTS AWARE OF THEIR WILDFIRE RISK?

Introduction

The number of residents living within Colorado's wildland-urban interface (WUI) is increasing. Given the growing prevalence of wildfires in Colorado, educating residents about wildfire mitigation and forest management is essential. Lack of communication between natural resource agencies and the public is a key contributor to conflicts and misunderstandings between forest managers, property owners, and public interest groups (Vining & Merrick, 2008). Forest managers need to understand the perceptions of citizens to effectively communicate the importance of forest management practices.

The wildland-urban interface (WUI) is defined as "any area where man-made improvements are built close to, or within, natural terrain and flammable vegetation, and where high potential for wildland fire exists" (Colorado State Forest Service, 2014a). Colorado populations in the WUI have increased over the last few decades and are projected to continue increasing as homes, businesses, and subdivisions continue to be built on forested lands that have historically experienced regular wildfires (or that need wildfires in order to remain healthy).

This article examined Colorado residents' awareness of whether they live in the wildland-urban interface (WUI). Residents' awareness was crosschecked with WUI boundaries in Colorado, as defined by the Colorado Wildfire Risk Assessment Portal (CO-WRAP). The goal was to determine whether residents understand their degree of risk from wildfire. Demographic variables were also compared with the WUI index to identify who was knowledgeable about the location of their residence (i.e., inside or outside the WUI). Finally, familiarity with nine forest management practices was related to awareness of living in the WUI.

Theoretical Framework

“Although fire itself is a biophysical process, fire management is essentially a social one” (McCaffrey, Toman, Stidham, & Shindler, 2013, p. 20). Residents’ approval and perceived benefits of pre-fire mitigation and wildfire management strategies whether citizens engage in fire mitigation behaviors. Understanding citizens’ perceptions of wildfire risk and wildfire management actions before, during, and after a wildfire event is key to ensuring that future wildfire management can help improve the safety of communities, while simultaneously fostering ecological benefits (McCaffrey et al., 2013).

Theobald and Romme (2007) projected Colorado’s WUI to increase by 300%, from 715,500 acres in 2000 to 2,161,400 acres in 2030. In 2007, approximately 89% of the WUI was privately owned land. About 65% of the WUI in 2007 contained areas of high severity (i.e. forest types where stand-replacing fires dominate fire regimes, such as lodgepole pine forests) and areas that recently burned at high intensity fire regimes but were historically low. Historically low wildfires would burn at relatively low intensity through surface fuels without spreading into tree crowns and relatively easy to contain or suppress (Theobald & Romme, 2007).

Researchers have assumed that people living in or near forested land have “different and perhaps stronger perceptions, emotions, and opinions about various forest management practices than the public at large” (Vining & Merrick, 2008, p. 155). Several studies, however, have found that this assumption may not be correct. Vining and Merrick (2008), for example, found that proximity to forested areas did not influence residents’ self-rated emotions of forest management, their preferred types of wildfire management techniques, or the reasons for their preferred management techniques.

Also, there were few differences in perceptions and attitudes of Illinois' Shawnee National Forest management activities between residents living in counties adjacent to the forest, residents living in the remaining Illinois counties, and residents living in counties in Kentucky, Missouri, and Tennessee that are adjacent to the border of southern Illinois (Vining 2003). These results highlight the need to solicit feedback from a diversity of audiences instead of focusing on special interest groups and communities that border forested areas.

Research has also explored the impact of communication and education on citizens' perceptions of wildfire and the WUI. Monroe and Nelson (2004), for example, examined residents living in forested areas in Florida and Minnesota who were at risk of wildland fire. Results indicated that most residents already knew about their wildfire risk and suggested that educational materials should emphasize the secondary benefits of wildfire mitigation (e.g., wildlife habitat, recreation opportunities) and the social norms that motivate residents to adopt defensible space strategies.

A review of 64 articles dealing with the public acceptance of fire and fuels management identified some key social science lessons (McCaffrey, Toman, Stidham, & Shindler, 2013). In general, high levels of public support exist for forest thinning and prescribed fire on public lands that are at high risk. These high levels of acceptance were related to familiarity in the management technique, trust in the management agency implementing the technique, beliefs about treatment outcomes, consideration of local values, perceptions of wildfire risk, and citizen involvement in the decision-making process. The influence of demographic characteristics (i.e. age, education, income, and forest proximity), however, on fuels management preferences was mixed and inconclusive (McCaffrey et al., 2013).

A review of 30 articles about public perceptions of wildfire risk and 41 articles on homeowner preparedness and mitigation by McCaffret et al. (2013) revealed that most people living in the WUI perceive a high wildfire risk and have taken some type of action to protect their property. Perceptions of risk, however, were influenced by “individual probability calculations; the timeframe and spatial area that are being considered; perceived vulnerability to potential negative outcomes; and type of negative consequences considered” (McCaffrey et al., 2013, p. 17). Homeowners saw themselves as responsible for mitigating the fire risk on their property, and viewed government agencies as responsible for educating residents about hazards and managing public lands.

Community-agency interactions and well-designed communication programs are also important factors in citizens’ acceptance of fuel treatments, homeowner preparedness, behavior during a fire event, and post-fire recovery efforts. Formal collaborative efforts and interactions that facilitate information exchange help increase trust and understanding, which also increase acceptance of forest management practices. Explanations about the importance of fuels mitigation techniques that discuss what to do and why it needs to be done, particularly through interactive approaches (i.e. workshops, meetings, field trips, etc.), were the most effective at influencing fire-safe attitudes and behaviors (McCaffrey et al., 2013).

When creating policies and planning for wildfire mitigation and management practices, research suggests that efforts should be focused on fully implementing current policies. The appropriate scale and conditions of planning efforts that involve local citizens in the planning process should also be considered (McCaffrey et al., 2013). Finally, a review of 12 articles on organizational effectiveness found that “risk perceptions and attitudes of agency personnel can significantly limit the willingness of managers to actively engage in the full range of pre-fire

mitigation activities, from working with communities to selecting more risky practices (e.g. wildland fire use)” (McCaffrey et al., 2013, p. 19).

The Colorado State Forest Service

The Colorado State Forest Service (CSFS) is the primary state agency for forestry expertise in Colorado. The CSFS is a service and outreach agency of the Warner College of Natural Resources (WCNR) at Colorado State University (CSU) and staffs the division of forestry in the Colorado Department of Natural Resources. The mission of the CSFS is *to achieve stewardship of Colorado's diverse forest environments for the benefit of present and future generations*. The CSFS has four main programmatic areas: (a) forest management, (b) wildland fire mitigation and education, (c) urban and community forestry, and (d) conservation education (Colorado State Forest Service, 2014a).

The CSFS manages Colorado’s state and private forests for the benefit of the residents within the state, and therefore, the input of those residents is important to the agency. For this research, the CSFS was interested in learning about Colorado residents’ perceptions of the agency and forest management practices within the state. This was part of a public perceptions survey of the CSFS that was identified in the agency’s 2010 strategic plan (Colorado State Forest Service, 2014a). Understanding Colorado residents’ attitudes toward different forest management practices would allow the agency to improve their outreach efforts to encourage Colorado residents to be more involved in forest management decisions, and give Colorado residents the knowledge they need to protect the forests on their property from natural processes such as wildfires and insect and disease outbreaks.

Colorado Wildfire Risk Assessment Portal (CO-WRAP)

The Colorado Wildfire Risk Assessment Portal (CO-WRAP) is a web-mapping tool that provides access to statewide wildfire risk assessment information in Colorado. CO-WRAP is the primary tool for the CSFS to “deploy risk information and create awareness about wildfire issues across the state,” (Colorado State Forest Service, 2014c, p. 6). The goal of CO-WRAP is to “provide a consistent, comparable set of scientific results to be used as a foundation for wildfire mitigation and prevention planning in Colorado” (Colorado State Forest Service, 2014b).

The information provided by CO-WRAP builds on the West Wide Wildfire Risk Assessment (WWA) results compiled in the Fall of 2012, and the Colorado Wildfire Risk Assessment Project: Summary Statistics Report (Colorado WRA project), which was last updated in February 2014. The WWA provides baseline risk assessment results for the 17 western states and Pacific Islands. The Colorado Wildfire Risk Assessment project is based on WWA project data, tailoring its results to reflect Colorado conditions to help meet Colorado planning requirements (Colorado State Forest Service, 2014c). CO-WRAP is an interactive web-mapping application tool based on the data provided by the Colorado Wildfire Risk Assessment project, which is available to wildfire mitigation and prevention planners, government officials, and interested citizens.

Data from the Colorado Wildfire Risk Assessment project revealed that in 2012, 2,010,025 people lived in the WUI, encompassing 6,606,348 acres. The difference in these numbers from past assessments is due to enhanced data collection and mapping abilities, the increasing number of people moving into the WUI, and the inclusion of a quarter-mile area inside of urban boundaries that have been found to be at risk of wildfire (Colorado State Forest Service, 2014d).

The Colorado Wildfire Risk Assessment project measures Colorado’s wildfire risk, the possibility of loss or harm occurring from a wildfire, and provides information for the data used in this study (Colorado State Forest Service, 2014d). This is different from wildfire threat, the likelihood of an acre burning (Colorado State Forest Service, 2014d). “Wildfire risk combines the likelihood of a fire occurring (threat), with those areas of most concern that are adversely impacted by fire (fire effects), to derive a single measure of wildfire risk” (Colorado State Forest Service, 2014d, p. 18). Fire effects focus on the values impacted by the occurrence of a wildfire, such as forest assets, riparian assets, and drinking water; each contains its own layer in CO-WRAP (Colorado State Forest Service, 2014c).

The Colorado Wildfire Risk Assessment project developed a WUI Risk Index, which is “a measure of the potential impact on people and their homes from wildfire” (Colorado State Forest Service, 2014d, p. 22). These data include information on housing density from the Federal Register National standards to help provide information on the location of people living in the WUI. The WUI Risk Index itself is derived from a response function modeling approach, which assigns a net change in the value of a resource or asset based on its susceptibility to wildfire at different flame lengths. The WUI Risk Index was calculated by combining Colorado housing density data with flame length data, making it possible to determine where the “greatest potential impact to homes and people is likely to occur” (Colorado State Forest Service, 2014d, p. 22).

This article focused on Colorado residents’ awareness of whether they live in the WUI. Using the WUI Risk Index data from CO-WRAP and respondents’ answers to a public perceptions survey of the Colorado State Forest Service (CSFS), a new index was created to determine whether respondents were correct or incorrect about living in the WUI. Demographic

factors (i.e. education, sex, ethnicity, etc.) were analyzed to determine whether a relationship exists between these variables and Colorado residents' knowledge of their proximity to the WUI, and are therefore at risk from wildfire. Colorado residents' levels of familiarity and knowledge with nine forest management practices and the CSFS itself were also compared with residents' knowledge of their proximity to the WUI. This led to the formulation of several hypotheses.

Hypotheses

H₁: Older Colorado residents are more likely to know that they live in the WUI than younger residents.

H₂: Colorado residents with at least a college degree are more likely to know if they live in the WUI than individuals with a high school degree or less.

H₃: Males and females will not differ in their ability to identify if they live in the WUI in Colorado.

H₄: Colorado residents with higher annual household incomes will be more likely to know if they live in the WUI than residents with lower household incomes.

H₅: The ability of Colorado residents to correctly identify whether they live in the WUI will not be influenced by ethnicity.

H₆: The ability of Colorado residents to correctly identify whether they live in the WUI will not be influenced by their race.

H₇: Colorado residents in natural resource-related occupations will be more likely to know if they live in the WUI than Colorado residents who are not in natural resource-related occupations.

H₈: Colorado residents who are more familiar with the CSFS will be more likely to know that they live in the WUI.

H₉: The more total knowledge of the CSFS Colorado residents have, the more likely they are to know if they live in the WUI.

H₁₀: Colorado residents who are more familiar with forest management practices in Colorado will be more likely to know if they live in the WUI.

Methods

Survey Administration

The survey was mailed to a sample of 3,000 randomly selected Colorado residents throughout the state. The random sample of Colorado residents was purchased from Survey Sampling International (SSI). Three mailings were used to administer the survey during the summer and fall of 2012. Residents first received a cover letter with a URL link and an access code with directions on how to take the survey online. One week later, a follow-up postcard was sent reminding residents to take the online survey. Approximately a month after the postcard reminder, a paper questionnaire with a pre-paid postage return envelope was mailed to Colorado residents who had not yet taken the online survey (Dillman, Smith, & Christian, 2009).

To compare familiarity with forest management practices in Colorado with residents' awareness of living in the WUI, respondents were asked about nine different forest management practices. To reduce respondent burden and increase response rate, the survey was split into three separate versions so that each individual evaluated only three of the nine forest management practices. The only differences between the three versions of the survey were the forest management practices; the rest of the survey remained the same. Each forest management practice was briefly defined on the survey. Version one of the survey included questions about forest restoration, windbreaks, and wildfire defensible space. Version two of the survey included questions about forest thinning, clearcuts, and patch cuts. Version three of the survey included

questions about prescribed fire, fuelbreaks, and reducing surface fuels. Each version was sent to 1,000 of the randomly selected Colorado residents. A crosstabs analysis was used to compare the responses to the three survey versions to ensure that there were no statistical differences between respondents' answers.

A total of 416 surveys were returned, with an overall response rate of 14% (39% took the survey online and 61% returned the paper questionnaire). A crosstabs analysis compared responses from the online survey to the paper questionnaire and there were no substantive differences. Each version of the survey was completed by approximately one-third of the 416 respondents. A non-response check was conducted of Colorado residents who did not respond to the survey. Selected key issues (familiarity with the CSFS; perceptions of the CSFS; familiarity, approval, and aesthetic impacts of forest management practices; and distance of residence to a forested area) were addressed in a telephone survey of non-respondents ($n = 42$). The non-response check showed no substantive differences between those who responded to the survey and those who did not.

Variables

Dependent variable. A new variable was created to determine whether Colorado residents could correctly identify their proximity to the WUI, using the Colorado WRA WUI Risk Index and the response to the question “do you live in the Wildland-Urban Interface?” The WUI Risk Index ranged in values from ‘-1’ to ‘-9,’ where a value of ‘-1’ represents the least negative impact from a wildfire and a value of ‘-9’ represents the greatest possible negative impact. An area with a WUI Risk Index of ‘-9’ would have high housing density and high flame lengths, whereas an area with a WUI Risk Index of ‘-1’ would have low housing density and low flame lengths (Colorado State Forest Service, 2014d). This GIS data layer in CO-WRAP was overlaid

with the latitudinal and longitudinal data for the public perceptions of the CSFS survey respondents to determine the WUI Risk Index for all respondents.

On the survey, respondents were asked if they lived in the WUI and could respond with ‘yes,’ ‘no,’ ‘do not know,’ or ‘have never heard of the wildland-urban interface.’ A series of if statements combining these answers and the WUI Risk Index values (which had been imported into SPSS) were used to create the new variable “WUI_Correct,” representing respondents’ ability to correctly identify whether they live within the WUI in Colorado. A value of ‘0’ meant respondents did not correctly identify that they live in the WUI, and a value of ‘1’ meant respondents did correctly identify that they live in the WUI.

Independent variables. A series of demographic variables (i.e. age, education, sex, annual household income, ethnicity, race, and occupation) were analyzed to determine which variables impacted respondents’ ability to correctly identify whether they live in the WUI. Respondents’ familiarity and total knowledge of the CSFS were also used to predict whether Colorado residents know that they live in the WUI. Familiarity with the CSFS was measured on a four-point scale, where a value of ‘1’ represented not at all familiar and a value of ‘4’ represented extremely familiar.

Total knowledge of the CSFS was computed from a series of 12 true/false statements regarding the agency. These statements were generated with the help of CSFS employees to accurately create statements that measure knowledge of the CSFS. The 12 true/false statements were preceded with: “Please indicate whether you believe each of the following statements related to the Colorado State Forest Service (CSFS) is true or false.” The statements included: (a) the CSFS is part of the U.S. Forest Service; (b) the CSFS owns large areas of public land; (c) the CSFS helps landowners manage the forests on their property; (d) the CSFS is the lead state

agency for forestry expertise in Colorado; (e) the CSFS is a part of Colorado State University; (f) the CSFS works with land managers to plan forestry projects; (g) the CSFS works with land managers to implement forestry projects; (h) the CSFS provides forestry expertise to lawmakers; (i) the CSFS assists communities with planning urban forestry tree care efforts; (j) the CSFS manages a seedling tree nursery that provides trees to private landowners; (k) the CSFS has responsibility for enforcing laws; and (l) the CSFS is part of the Colorado Department of Natural Resources. A value of '0' for total knowledge of the CSFS index meant the respondent did not answer any of these true/false statements correctly, and a value of '12' meant the respondent answered all 12 true/false statements correctly.

Finally, levels of familiarity with nine forest management practices were analyzed to determine whether there is a relationship between these variables and Colorado residents' awareness of whether or not they live in the WUI. The nine forest management practices included: (a) forest restoration; (b) planting trees as windbreaks; (c) wildfire defensible space; (d) forest thinning; (e) clearcuts; (f) patch cuts; (g) prescribed fire; (h) fuelbreaks; and (i) reducing surface fuels. Respondents' familiarity with these nine forest management practices was measured on a 7-point scale, where '1' represented not at all familiar with the forest management practice; and '7' represented extremely familiar with the forest management practice.

Analyses

According to the U.S. Census Bureau (2012), 21% of Colorado residents are Hispanic or Latino. Only seven percent of the public perceptions of the CSFS survey respondents stated that their ethnicity was Hispanic or Latino. Also, according to the U.S. Census Bureau (2012), 50% of Colorado residents are female. Only 36% of the public perceptions of the CSFS survey

respondents reported that they were female. The data were weighted to more accurately represent the sex and ethnicity of Colorado residents. Nine regression analyses were run in order to predict approval of the nine forest management practices, based on Colorado residents' perceived familiarity and aesthetic evaluations. A series of t-tests and crosstabs analyses were run to determine if the demographic variables, familiarity, and total knowledge of the CSFS, and familiarity with the nine forest management practices, would influence Colorado residents' awareness of whether they live in the WUI.

Results

The series of *t*-tests and crosstab analyses indicated that a few demographic variables, familiarity with the CSFS, total knowledge of the CSFS, and familiarity with creating wildfire defensible space, forest thinning, and clearcuts have an influence on Colorado residents' ability to correctly identify whether they live in the WUI. The demographic variables that did have a significant relationship with Colorado residents' awareness of living in the WUI were education ($t = 1.99, p = .047$), annual household income ($\chi^2 = 4.20, p = .040$), and ethnicity ($\chi^2 = 14.03, p = < .001$). As hypothesized, Colorado residents with a college degree or higher and Colorado residents with higher annual household incomes were more likely to know if they lived in the WUI. The hypothesis that males and females would not differ in their ability to correctly identify whether they live in the WUI was also supported by the data ($\chi^2 = .019, p = .889$). The hypothesis that the ability of Colorado residents to correctly identify whether they live in the WUI will not be influenced by ethnicity was rejected. Results from the crosstabs analysis showed that non-Hispanic or non-Latino residents were almost twice as likely as Hispanic or Latino residents to know whether they lived in the WUI. Results from the analyses revealed that

age, race, or a natural resources-related occupation did not influence Colorado residents' knowledge of living in the WUI.

Colorado residents who were more familiar with the CSFS were more likely to know that they lived in the WUI ($\chi^2 = 8.13, p = .043$). Similarly, Colorado residents with more total knowledge of the CSFS were also more likely to know that they lived in the WUI ($t = 2.20, p = .028$). Finally, hypothesis ten was partially supported because residents who are more familiar with creating wildfire defensible space ($t = 3.33, p = .001$), forest thinning ($t = 3.05, p = .003$), and clearcuts ($t = 3.28, p = .002$) were more likely to know if they lived in the WUI than residents who were less familiar with these forest management practices. All of these relationships had typical effect sizes. However, familiarity with forest restoration, planting trees as windbreaks, patch cuts, prescribed fire, fuelbreaks, and reducing surface fuels did not have a significant impact on Colorado residents' awareness of living in the WUI.

Discussion and Future Research

The findings from this article suggest that the CSFS must change how it informs and educates Colorado residents about the WUI in order to reach out to diverse and underrepresented audiences, including Hispanic or Latino residents, residents with a high school education or less, and residents with annual household incomes under \$75,000 a year. Colorado has a rapidly increasing Hispanic and Latino population, many of whom may be moving into the WUI within the next few years (U.S. Census Bureau, 2012). The CSFS must work on increasing its outreach to Hispanic and Latino populations, as well as other underrepresented groups, in order to increase awareness about wildfire risk in Colorado and help these audiences administer the proper forest management techniques that can reduce their wildfire risk.

The CSFS could begin to use several different delivery mechanisms to increase the number of Colorado residents' who are aware of whether they live in the WUI and, thus, their wildfire risk. The CSFS, for example, could begin to use commercials to communicate about the correlation between living in the WUI and residents' wildfire risk during wildfire season that are aired on public broadcasting television channels. The CSFS could also set up booths at community centers during local events and continue to provide free resources for interested residents. Another option could be to take children from both rural and urban areas on fieldtrips to the WUI and teach about fire ecology in Colorado. The next step would be to determine the effectiveness of these outreach efforts at communicating information about the CSFS and the WUI to underrepresented populations.

The CSFS should also work on increasing Colorado residents' familiarity and total knowledge about the agency to help raise Colorado residents' awareness of wildfire risk to properties in the WUI. The more knowledge Colorado residents' have of the CSFS, the more likely they may be to work with the CSFS to manage the forests on their properties and reduce the chance of losing them during a wildfire. More research needs to be done on this topic.

Forest management agencies should also try to increase Colorado residents' familiarity with creating wildfire defensible space, forest thinning, and clearcuts to help increase awareness of their proximity to the WUI. Familiarity with these management practices may lead to approval and, ultimately, implementation on residents' private property, thereby helping to reduce the chance that a wildfire could spread to homes from surrounding forests or vice versa.

It is interesting that familiarity with forest thinning and clearcuts had significant relationships with Colorado residents' awareness of living in the WUI, whereas such forest management practices as prescribed fire, fuelbreaks, and reducing surface fuels did not. More

research needs to be done to determine why there was not a significant relationship between these three forest management practices, which have a direct impact on reducing wildfire risk and Colorado residents' awareness of living in the WUI.

Finally, it is important to remember that the Colorado Wildfire Risk Assessment project WUI Risk Index defines risk based on housing density and fire behavior. This means that some communities may have less intense fire behavior, but are in a highly dense housing community, which increases their risk according to the WUI Risk Index. Forest managers should keep this in mind when they are working with communities to take measures to reduce the risk of losing their properties during a wildfire, because it may influence where fire mitigation efforts are focused in that community.

Now that the CSFS knows which audiences are less aware of their wildfire risk, more research needs to be done to determine the best way to reach out to these audiences to increase their awareness of the WUI. The question now becomes: how does the CSFS begin to communicate with underrepresented populations about their wildfire risk and teach them about mitigation efforts to make their properties more defensible from future wildfires? What are the best mediums of communicating to the different demographic groups throughout Colorado?

Informing all Colorado residents, both rural and urban, about wildfire risk in the WUI should be a priority of the CSFS, because all Colorado residents are impacted by wildfires in Colorado's state and private forests. If a wildfire occurs in a private landowner's forested ecosystem, not only will that landowner be affected by the wildfire, but also urban residents who live downstream and depend on that forest for its watershed benefits. The more knowledge Colorado residents have of the WUI, and the more familiar they are with the CSFS and its management efforts, the more likely residents are to be aware of their proximity to the WUI and

their wildfire risk. This awareness may encourage Colorado residents to take actions to reduce their wildfire risk, even if it is simply voting to increase funding for wildfire mitigation efforts in Colorado.

Social data about the knowledge and demographics of Colorado residents will help provide the foundation for developing outreach and education programs that help increase Colorado residents' awareness of the WUI and wildfire risk. Colorado residents and forest management agencies must work together to reduce wildfire risk to homes while maintaining healthy forest ecosystems for present and future generations to enjoy, beginning with more dialogue between Colorado residents and forest management agencies about forest management policies and decision-making processes.

Tables and Figures

Table 4.
Colorado residents' awareness of living in the wildland-urban interface (WUI)

Independent Variables	Correctly Identified Living in WUI		χ^2	<i>t</i> -value	<i>p</i> -value	Effect size
	No	Yes				
Age (%) ^a	55	59		1.91	.057	.095
Education (<i>M</i>) ^b	9.30	9.94		1.99	.047	.101
Sex (%)			.019		.889	.007
Male	68	32				
Female	67	33				
Household income (%)			4.20		.040	.110
\$74,999 or less	72	28				
\$75,000 or more	61	39				
Ethnicity (%)			14.03		< .001	.178
Hispanic or Latino	83	17				
Non-Hispanic or Non-Latino	63	37				
Race (%)			.85		.357	.049
White	64	36				
Other	71	29				
Natural resource occupation (%)			.28		.598	.027
Yes	63	37				
No	67	33				
Familiarity with the CSFS (%)			8.13		.043	.143
Not at all familiar	74	26				
Slightly familiar	63	37				
Moderately familiar	62	38				
Extremely familiar	33	67				
Knowledge of the CSFS (<i>M</i>) ^c	5.20	6.00		2.20	.028	.109

^a Responses given on a continuous scale ranging from 20 to 99 years old.

^b Responses given on a continuous scale ranging from 1 '< 7 years of education' to 16 '22 years of education'

^c Index created from a total of 12 true/false questions about the CSFS where a score of '0' represents answering no answers correctly and a score of '12' represents answering all questions correctly

Table 5.

Familiarity with forest management practices and Colorado residents' awareness of living in the wildland-urban interface (WUI)

Forest Management Practice ¹	Correctly Identified Living in WUI		<i>t</i> -value	<i>p</i> -value	<i>Eta</i>
	No	Yes			
Forest Restoration	2.88	3.28	1.45	.148	.126
Planting Trees as Windbreaks	3.73	4.23	1.49	.138	.130
Creating Wildfire Defensible Space	3.72	4.74	3.33	.001	.257
Forest Thinning	3.13	4.09	3.05	.003	.277
Patch Cuts	2.08	2.54	1.55	.124	.134
Clearcuts	2.52	3.75	3.28	.002	.306
Prescribed Fire	4.26	4.34	.27	.785	.025
Fuelbreaks	3.59	3.98	1.14	.257	.102
Reducing Surface Fuels	4.09	4.18	.24	.813	.021

¹ Responses given on a continuous scale ranging from 1 'not at all familiar' to 7 'extremely familiar'

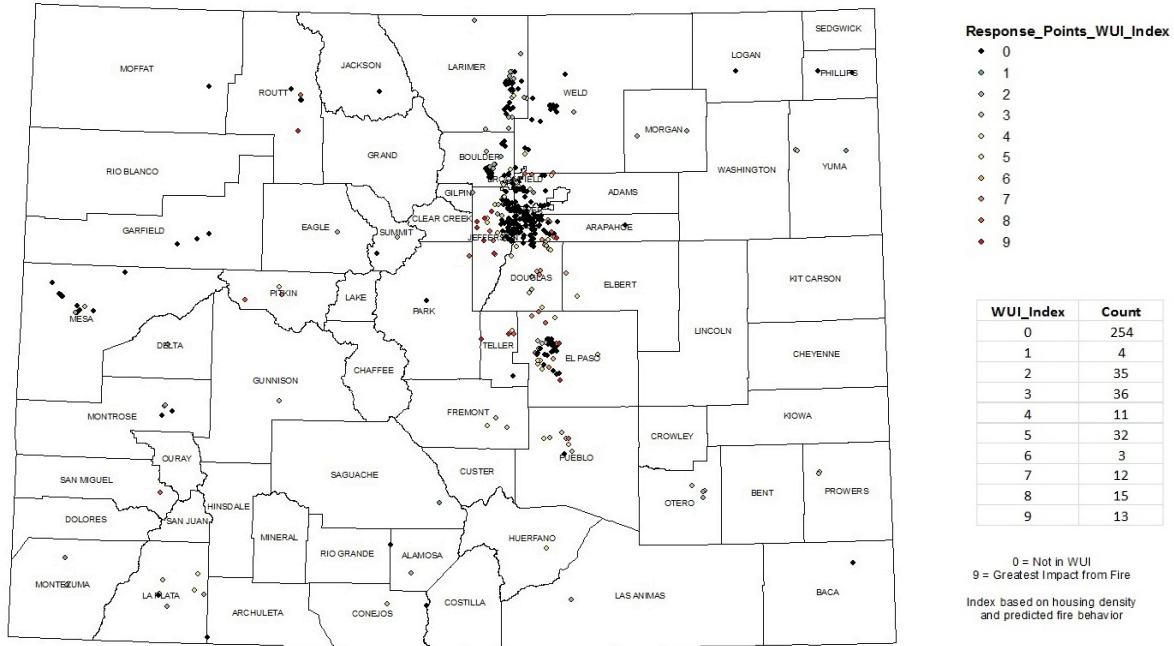


Figure 4.
 Map of survey respondents' wildfire risk index based on CO-WRAP data
 Image credit: Pete Barry, CSFS

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CONCLUSION

If the CSFS wants to remain relevant and reputable as the lead state agency for forestry expertise in Colorado, then it must address both the biophysical and social processes that are influencing management of Colorado's forests, including demographic changes, increasing development in the WUI, political-economic institutions, and changing attitudes and beliefs about forest management practices. The CSFS must begin to include a wider array of diverse stakeholders in the forest management decision-making process, particularly those stakeholders who have been underrepresented in the past. The public perceptions survey of the CSFS provides a foundation for examining Colorado residents' perceptions of the CSFS and forest management practices. The CSFS must now decide how to use the information from the survey in their strategic planning process, and how to focus its outreach messages to more effectively communicate with Colorado residents about the valuable services the CSFS provides. Only with effective outreach and education will the CSFS be able to change Colorado residents' attitudes about forest management practices and work to achieve the stewardship of Colorado's diverse forest ecosystems for the benefit of present and future generations.

DELIVERABLES

My ultimate goal is to complete three publishable manuscripts, one for the three chapters within my thesis itself, each focusing on one of the following research questions:

1. What are Colorado residents' attitudes of forest management practices and how are they influenced by familiarity and positive or negative evaluations of the aesthetic impacts of those forest management practices?
2. Does social trust mediate the relationship between salient value similarities and attitudes of forest management practices in Colorado?
3. Do Colorado residents' perceptions of whether or not they live in the wildland-urban interface (WUI) correlate with actual WUI latitude and longitude data?

Other deliverables will include:

- The three versions of the public perceptions of the CSFS survey mailed to the randomly selected 3,000 Colorado residents
- The cover letters and postcard reminders mailed to randomly selected Colorado residents
- A webinar presentation to the CSFS on the initial findings of the public perceptions survey, accompanied by an executive summary of the presentation
- The PowerPoint presentation utilized for the Master's Thesis Defense on May 9, 2014