

**Examining the Relationship Between Prescribed Fire Management and Forest Aesthetics in
Longleaf Pine (*Pinus palustris* Mill.) Forests**

by

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Abstract

The majority of the coastal plain from Virginia to Texas was predominantly covered by longleaf pine (*Pinus palustris* Mill.) stands. These forests were described as 'park like' forests with a clean, aesthetic, and picturesque understory. However, European settlement dramatically degraded the longleaf pine ecosystem. The first exploitation of longleaf pine stands mostly occurred because of over harvesting along with tar, turpentine, and rosin production. Because of inadequate regeneration after harvesting, longleaf pine forests declined profoundly, and during 1950s, paper, pulp, and timber industries promoted the planting of faster growing, and fire intolerant loblolly pine (*Pinus taeda*) which further reduced longleaf pine stands. Today, suppression of fires has substantially reduced the pine reproduction, increased the woody understory vegetation, and has significantly decreased the stand maintenance and regeneration of longleaf pine stands. Environmental design concept is an important factor that impacts the view of longleaf pine forests. The main objective of environmental design is relevant with social behavior such as perception of aesthetics, and it applies the empirically derived principles of social behavior to the landscapes and public involvement. Yet, there is a gap in understanding the relationship between the scenic beauty, forests aesthetics and how prescribed fire treatments impact the public perception of longleaf pine forests. The study of forest aesthetics is a comprehensive framework that can provide a better understanding of how the public perceives prescribed fire and its influence on the perceived visual quality of longleaf pine ecosystems. This study aims to evaluate how different seasons and timing of prescribed fire treatments impact the

scenic beauty of longleaf pine forests on the Escambia Experimental Forest near Brewton, Alabama. The main objectives of this research are: 1) develop an annotated bibliography of literature relevant to scenic beauty, forest aesthetics and prescribed fire, 2) assess the scenic beauty of longleaf pine stands that have been managed with prescribed fire at different time intervals and seasons, and 3) examine the forest measurements associated with each of the prescribed fire treatments in an attempt determine additional factors that may contribute to the scenic beauty of a forest scene. The results of this study will develop a framework to help natural resource professionals and the public better understand not only how the results of the application of prescribed fire in longleaf pine ecosystems is perceived but also how crucial it is to maintaining and conserving the forested ecosystems. The 4th chapter of this dissertation was published at <http://www.jiarm.com/home.html> in July issue.

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List of Abbreviations

ACES	Alabama Cooperative Extension System
EQUIP	Environmental Quality Incentives Program
FRI	Fire Return Interval
SBE	Scenic Beauty Estimation
SMS	Sustainable Forest Management
USDA	United States Department of Agriculture

Chapter 1

Introduction

1.1 Introduction

Historic accounts state that longleaf pine (*Pinus palustris* Mill.) forests once dominated much of the southern forest landscape, including Alabama. It is estimated that longleaf pine could be found on just over 50 percent of southern uplands, or about 36 million hectares (Frost 1993). These forests were often described as “park-like”, maintained by fire every 2-4 years that was the result of both natural and human-ignition. In the early 1900s southern woods fires were part of the culture and the ecosystem. This is not so today.

Increasingly, the general public is insulated from nature, with fewer individuals living in rural environments. In the 1900 census, the United States Census Bureau estimated that over 60 percent of the U.S. population was considered “rural”. This is in sharp contrast to today where it is estimated that only about 19 percent live in rural areas (US Census 2010). For example, between the 2000 and 2010 census, almost half of Alabama’s counties showed population loss, with notable losses in the rural counties of the Black Belt. Almost half of the state’s population (49%) is now located in four major metropolitan areas. Has this shift in population dynamics caused a perceptible change in the way that the public relates to and perceives the natural environment and especially the use of prescribed fire in longleaf pine forests?

1.2 Longleaf Pine

The majority of the coastal plain from Virginia to Texas was predominantly covered by pine forests in the past (Frost 1993). Although longleaf pine once dominated approximately 36

million ha of coastal region in the southeastern United States, due to absence of frequent burning and manipulations through maintaining ecosystem integrity, the prevalence of the species has dramatically decreased to less than 3% cover (Noss 1989, Gilliam and Platt 1999). According to Van Lear, et al. (2005), the distribution of longleaf pine once extended into the Piedmont, Cumberland Plateau, Ridge and Valley, and Blue Ridge physiographic region. Today, longleaf pine forests are ranked as the third most endangered ecosystems in the U.S. (Noss et al. 1995) with almost 70% of those longleaf pine forests located on private mostly non-industrial lands in the US. One exception is Florida where most longleaf pine forests are publicly owned (Stainback and Alavalapati 2004).

The first exploitation of longleaf pine stands occurred because of tar, turpentine, and rosin production in the late 1800s and early 1900s (Frost 1993, Gilliam and Platt 1999). Later, from South Carolina to Georgia and Florida, across Alabama and Mississippi, Louisiana and Texas longleaf pine forests were cleared because timber harvestings (Outcalt 2000). Because of inadequate regeneration after harvesting, longleaf pine forests declined profoundly, and during the 1950s, paper, pulp, and timber industries initiated planting faster growing loblolly pine (*Pinus taeda*) which further reduced the longleaf pine stands (Alavalapati et al. 2002). Peet and Allard (1993) stated that suppression of fires has substantially reduced longleaf pine reproduction because of an increase in woody understory that would otherwise be controlled frequent fires.

The longleaf pine ecosystem evolved with frequent fire which influenced its unique understory composition and forest reproduction process (Frost 1993; Outcalt 2000; Barlow et al. 2010). Understories of fire-maintained longleaf pine forests are often dominated by bluestem grass (*Andropogon spp.*) and wiregrass (*Aristida stricta*) (Brockway and Lewis 1997). Thus

promoting the open and “park like” identity of longleaf pine forests (Chapman 1932). According to Glitzenstein et al. (1995), fire regimes in the Southeastern United States can importantly affect the vegetative distribution and stand dynamics. They indicated fire frequency, fire intensity, and season of burning, can be important factors for sustainability of longleaf pine ecosystems.

Exclusion of fire in terms of longleaf pine ecosystem sustainability can result with various problems (Croker and Boyer 1975). Kush et al. (2000) reported that exclusion of fire causes replacement of longleaf pine with hardwood trees and shrubs in the understory. Boyer (1987) noted that understory vegetation, specifically hardwoods and woody shrubs can depress the growth of longleaf pine stands and clearing the understory woody plants can stimulate an increase in growth of longleaf pine forests.

Longleaf pine ecosystems provide a unique model in which to examine the sustainability of biodiversity due to fire dependency (Mitchell et al. 2006). More importantly, longleaf pine ecosystems benefit from prescribed fire at frequent intervals because it maintains the physiognomic character of stands, enhances seedbeds for the reproduction process, creates microsites for various herbaceous species in the understory, increases the soil nutrient levels, provides forage for grazing, improves wildlife habitat, minimizes diseases and insects, and alleviates wildfire hazards by reducing fuel accumulation (McKee 1982; Boyer 1987; Brockway and Outcalt 2000). But increasingly the use of fire in southern forest systems is limited by air quality issues, concerns over public safety and negative public opinion about prescribed fire (Brockway and Outcalt 2000). The general public often does not make the connection between forest health, forest beauty, and prescribed fire.

1.3 What is Beauty?

Beauty itself can be defined as "*... no quality in things themselves: It exists merely in the mind which contemplates them; and each mind perceives a different beauty. One person may even perceive deformity, where another is sensible of beauty; and every individual ought to acquiesce in his own sentiment, without pretending to regulate those of others*" (Stanford Encyclopedia of Philosophy 2012). There have been many studies which argued that beauty is subjective (Stanford Encyclopedia of Philosophy 2012). According to Kant (1790), the understanding of taste is not logical; thus beauty can be defined as subjective. Nieters (2015) described beauty as a conveyance of theme and a successful measuring tool between the artist and perceiver. In contrast, Guter (2010) defined beauty as a consideration of a feature which is pleasurable and thus has value.

The perception of beauty has been affected by philosophic assurances such as epistemological, metaphysical, and ethical commitments (McMahon 2012). Li et al. (2009) claimed that appreciating beauty is a characteristic of human beings since early history. They additionally argued that creation of different tools, designing the landscape, and successful implementation of design originally resulted as a human appreciation of beauty. Meredith (1952) stated that a judgement of beauty is valid universally. However, Cook (2009) indicated that endeavoring to make something beautiful results with perfection and the achievement of what is good and useful, thus, it is connected with desire, cultural values, and tastes. According to Panagopoulos (2009), beauty is pleasure combined with aesthetics which is a branch of philosophy that examines the interpretation of beauty.

1.4 Aesthetics as a Concept

Aesthetic theory has been defined as *"a logically vain attempt to define what cannot be defined, to state the necessary and sufficient properties of that which has no necessary and sufficient properties, to conceive the concept of art as closed when its very use reveals and demands its openness"* (Weitz 1956). Santayana (1904) described aesthetics as the expression of the various forms of appreciation, intuition, or imaginative analysis. According to Kant's (1790) aesthetics and judgements theory, aesthetic judgement is comprised of feelings such as pleasure and displeasure. It was also stated that there are three different types of aesthetic judgement; the agreeable, the beautiful, and the sublime (Stanford Encyclopedia of Philosophy 2013).

Furthermore, others such as Allison (2001) disagreed with the judgement theory of Kant which defends beauty is the exhibition of the aesthetic thought, instead arguing that formalistic and expressionistic views in the theory were separate from each other. Weitz (1956) pointed out the initial task of aesthetics is to improve the concept of art and defined themes within it.

According to Guter (2010), aesthetic values are dependent on the fundamental aspects of art, such as beauty and expressiveness and aestheticism is relevant to formalism. Santayana (1904) stated that whatever the purpose, the term *"aesthetics"* defines the spirit of beauty and thus, aesthetic quality cannot be measured by a specific and single origin of perspective.

Consequently, to provide more appropriate definition to the aesthetics and its judgement theory in nature, the relationship between evolution and landscape art must be examined.

1.5 Evolution Versus Landscape Art: Influence on Public Perception

According to Falk and Balling (2010), it is believed that human landscape preference has risen from human genomics which reveals landscape preferences of our ancestors. They also noted that evolutionary influence on human preference is important and human preferences for

parklands and savannah-like biodiversity is highly associated with human's evolution in savannah-like biomes. Savannah-like biodiversity is a mixed woodland and grassland ecosystem which has an open canopy cover (Summit and Sommer 1999). Additionally, the fossils found in eastern and western Africa indicated that human biology and behavior was influenced by savannah-like ecosystems and human adaptations to these environment (Falk and Balling 2010). According to Leakey et al. (1995), human evolution not only influenced open space and clustered tree preference, it also drew a preference through mosaics of environments like grasslands and open and closed forest cohorts. Studies have shown that in general there is an expressed visual preference for tree groups consisted of acacia-type tree forms like African savanna, in contrast to other species such as oak (*Quercus* sp.), palm (*Arecaceae*), and eucalyptus (*Eucalyptus* sp.) (Summit and Sommer 1999).

In addition to evolutionary influence, art plays a major role on human landscape preferences, and when considering the perception of nature by the public, comparing scenic beauty perceptions and landscape art has become one of the most important components of human preference in modern psychology (Shepard 2003, Ellison 2014). The term "landscape" was first used to describe pictorial representations of ecosystems in the sixteenth century (Shepard 2003). In mid-19th century, Europe and North America, where the term "picturesque" originated, there was an increased emphasis on creating environments with different landscape forms and arrangements (Ellison 2014). Nash (1967) supported the idea that human landscape preference was not particularly relevant to innate preferences such as savannah-like ecosystems but instead aesthetic preferences primarily originated from 19th century artists and writers who conveyed the combinations of the sublime and picturesque.

Modern artists from 20th century promoted contemporary arts and design in landscape aesthetics and as a result many US National Parks, ecology preserves, and ecosystems around the world have been influenced by the picturesque design features (Carr 2007). As a result, over the last 40 years there have been numerous studies such as those by Kaplan and Kaplan (1989) and Williams and Stewart (1998) that report that people-landscape interaction is influenced primarily by aesthetics causing an increased interest in visual resource management. According to Smardon (1986), the USDA Forest Service's Visual Management System, a national forest landscape management program initiated to growing agency and public concerns for the visual resources, was created to improve the understanding of public perception of landscape aesthetics, people's emotions ties to landscapes, and retaining aesthetic quality of landscapes for the future.

1.6 Sense of Place and Perceptions of Scenic Beauty

There are several concepts attempting to determine the association between people and spatial settings, and “sense of place” is one of the most popular concepts among ecological management studies providing insight into understanding human attitudes toward natural places (Jorgensen and Stedman 2001). “Sense of place” refers to more than just a physical location. It is defined as the feelings and meanings that individuals or groups associate with a given location (Tuan 1979, Williams and Stewart 1998). Davenport and Anderson (2005) additionally reported that a sense of place has been considered as a cognitive approach by psychologists who claimed that humans create information about their environment which consequently influences their attitudes and behaviors. Williams and Stewart (1998) argued the sense of place is an elucidative concept encompassing the social and contextual quality of an idea which questions the sense of place.

According to Stedman (2003), sense of place is a beneficial concept contributing to forest management and ecosystem functions, and especially the objectives related to landscape management strategies. Williams and Stewart (1998) reported that sense of place can play a role in urban planning including zoning ordinances, regional tourism, and regulations on architectural styles. From an ecosystem management point of view, sense of place may contribute to sustainable use of natural resources where landscape ecosystems, ecosystem structure, and function are a focus (Yaffee 1999). Williams and Stewart (1998) asserted that both places and ecosystems are dynamic, so social processes construct the meanings of places in relation to bioecological concepts. Similarly, Thomas (1995) argued that “Scenery Management”, a context of ecosystem management to inventory and analyze scenery on national forest lands, can be properly applied using natural and cultural management resources.

1.7 Environmental Design

Involvement of environment to design and planning is a significant contribution that enables professionals develop more sustainable communities and forested landscapes (Steiner et al. 2013). Environmental design can be defined by Krasner (2013:3) as *"the planning of a coherent program and set of procedures to effect the total human and nonhuman environment in ways that increase the probability that certain goals of needs will be achieved."* The main objective of environmental design is also relevant with social behavior such as perception of aesthetics, and it applies the empirically derived principles of social behavior to the landscapes and public involvement. Moreover, the human concept is one of the most important components of environmental design and it consists of explicit assumptions about the nature of humanity (Zube et al. 1982). Visual appearance of the landscape is also another important factor that influences the environmental design because the majority of the public judge environment based

on what they observe and what is seen in the landscape (Twiss 1969). Therefore, understanding the interactions between public, nature, and the design plays a significant role to implement environmental design concept.

Environmental design can provide more accurate location to landscape planning and homeowners (Twiss 1969). Location of the landscape affects the human perception of environment and design by using the observers' position, landscape form, spatial definition, light, and sequence (Burton 1968). Another important factor effecting the perception of a landscape is the distance of observers to the scene of a landscape (Burton 1968). In designing a sustainable landscape, distance to the landscape is divided into three zones, foreground, middleground, and background zones which establish an optimum proportion between the scale of the landscape and distance from the view point of observers (Burton 1968). Moreover, there are three main methods of designing an aesthetic forest scene, such as integrating forest management practices with other resources and products, justification for land use decisions, and improving the relationship between landowners and forest managers (Daniel and Boster 1976). Thus, understanding the factors effecting the perception of landscape can positively impact the contribution of design and planning in an aesthetical environment.

1.8 Aesthetic Assessment and Ecosystem Management

The Scenery Management System (SMS) is a way in which the inventory, assessment, and valuation of the visual components of forest plans can be completed using expert and perception-based assessment methods (Daniel 2001). According to Thomas (1995), SMS provides a more anthropogenic approach to a sense of place. Thomas also denoted that SMS combines biological and physical elements to develop a landscape level forest descriptions. Galliano and Loeffler (2000) reported that scenic beauty assessments may be influenced by the

four primary attributes of landscape characters: land forms, vegetation, cultural forms, and bodies of water. These major constituents additionally affect the perception of scenic beauty by contributing to the sense of place (Galliano and Loeffler 2000).

In order to create a judgement criterion component for landscape aesthetics assessment, the Scenic Beauty Estimation (SBE) model was first applied by Daniel and Boster (1976) who involved the observers' perception rankings on scenic beauty of vistas. The scenic beauty values of landscapes can be derived from different landscape scenes by participation of various observers and results of visual preference surveys can be analyzed using the RMRATE rating data software (Daniel and Boster 1976). The SBE method has long been accepted as a way to accurately depict observers' perceptions of changes in a landscape and how they impact the scenic beauty (Ray 1994). Therefore, using software such as RMRATE can help assess the public's perception of the level of scenic beauty on a given landscape.

The judgements made by a number of observers provide the scenic beauty values for different landscape scenes. The criterion component of the SBE method is also applied by set of values to test the perceived scenic beauty dimension. These criterion values are also used during the judgement situation of the scenic beauty of landscapes. During the evaluation process of forested scenes, each observer expresses his own judgement of landscape beauty by a numerical rating such as 1 (extremely low scenic beauty) to 10 (extremely high scenic beauty) (Daniel and Boster 1976).

In SBE method, each stimulus is ranked based on condition of interest, then each category is converted to a Z score (as a reference to standard normal distribution). In order to eliminate biases of SBE analysis, the baseline-adjusted Z-Score procedure is also applied on the survey data. In this analysis, the procedure computes standard scores as:

$$SBE_i = (MZ_i - BMMZ)100$$

Where SBE_i is SBE of stimulus i , MZ_i is the mean Z of stimulus i , and $BMMZ$ is the mean Z s of the baseline stimuli. For each survey group, each 4th stimulus can be used as a baseline during the SBE calculation process. Then, stimuli are calculated based on these baseline categories for each survey group (Daniel and Boster 1976; Ray 1994).

1.9 Assessing the Impact of Prescribed Fire in Longleaf Pine Forests on Forest Aesthetics

Based on the information provided regarding forest aesthetics and scenic beauty estimation, the primary goal of the current study was to expand upon the work of others in the area of forest aesthetics through the evaluation of perceived scenic beauty of longleaf pine stands in Escambia Experimental Forest in Brewton, Alabama with a focus on how varying prescribed fire management regimes are perceived by public. While there have been many other studies (Kauffman 2004; Loomis et al. 2001; Ostergen et al. 2008) which focused on public perceptions of ecological restoration, specifically fire management in the north, west, and southeastern U.S. no studies have included longleaf pine systems, for which fire is a critical part of its management. Therefore, more information is needed about the influence prescribed fire management has on the aesthetics of longleaf pine forests including how various timing of prescribed fire and frequency between fires might impact the visual quality of a given forest stand.

1.10 Goals of Current Research

This dissertation includes the examination of three separate but related aspects of forest aesthetics assessments in longleaf pine forests: an annotated bibliography of literature relevant to scenic beauty and forest aesthetics, an assessment of the impact of prescribed fire on scenic beauty and diversification in visual appearance of longleaf pine stands through a visual

assessment survey, and use measurements of the forest overstory on each of the treatments to create a relationship between forest measurements with seven different fire treatment groups and scenic beauty assessments in longleaf pine ecosystem. The organization of this study is as follows:

1. The annotated bibliography (Chapter 2) is the platform on which the remaining components of the study were based. The information collected through tasks associated with this objective were used to frame follow-up surveys and analyses. This involved a comprehensive review of literature related to scenic beauty, scenic quality, forest aesthetics, and public perception of longleaf pine ecosystems. Findings associated with the annotated bibliography were used as a basis for a literature review of scenic beauty, forest aesthetics, and public perception of forest aesthetics in relation to longleaf pine forests.
2. The second portion of this study (Chapter 3) examines the potential relationship between scenic beauty and prescribed fire treatments on longleaf pine forests using a survey of Auburn University students. Photographs derived from the study site on the Escambia Experimental Forest near Brewton, Alabama were used to evaluate the levels of scenic beauty of longleaf pine stands managed with various prescribed fire treatments.
3. The final chapter uses tree measurement from the study plots, and information from the second chapter outlined above, to determine if a relationship exists between forest measurements derived from five different treatment groups and scenic beauty estimation for longleaf pine cover.

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Chapter 2

Scenic Beauty And Prescribed Fire Management On Forested Landscapes:

An Annotated Bibliography

Landscape perception research has been ongoing for over fifty years. Some of these earliest works examined the public's perception of the level of visual quality, or scenic beauty, of a landscape. Visual quality is more than just the beauty of a landscape. It is a measure of the visual significance given to a scene by a viewer. It can be influenced by both the viewer's cultural values and the physical properties of the scene being observed.

Perception of scenic beauty is of particular interest in fire managed or fire maintained forest systems. While prescribed fire is an important tool in southern forest management, its use can be misunderstood by the general public. Individuals may believe fires are detrimental to forest landscapes, or may find post-burn forests not particularly aesthetically pleasing. However some studies have shown that light to moderate fires can enhance the scenic beauty of a forest just a few months post burn.

Land managers and landowners can benefit from understanding how the use of fire can increase ecological and visual forest benefits. This annotated bibliography is a summary of selected research publications from scientific journals, conference proceedings, technical reports, and books published that examines prescribed fire management and the quantification and qualification of scenic beauty of forest landscapes.

To aid readers in the use of this document, summaries of each publication are included. The use of an * designates the original paper abstract, while an ** designates a modified version

of the original abstract. Keywords are listed at the end of each summary. In the front of the publication is a keyword index to help readers locate a specific topic. Publications in this index are listed by author last name, year published, and unique reference number.

While this is not an exhaustive list of every article related to scenic beauty and prescribed fire on forested landscapes, it is a sample of a wide array of publications on the topic. Please forward suggestions for future publications to add to this bibliography to: Dr. Becky Barlow, Alabama Cooperative Extension System, Auburn, Alabama. phone: 334.844.1019.
email: rjb0003@aces.edu

2.1 Keyword Index

Aesthetics

(Atiyeh and Hayek, 2008 #5; Carlson, 1977 #9; Daniel and Boster, 1976 #14; Gundersen and Frivold, 2008 #26; Hull et al. 2000 #28; Tyrvaainen et al. 2003 #57; Ulrich, 1986 #59)

Aesthetical view

(Leopold, 1949 #36; McCaffrey, 2006 #40)

Amenity values

(Tahvanainen et al. 2001 #55)

***Aristida beyrichiana* Trin. and Rupr.**

(Brockway and Outcalt 2000 #8)

Arizona

(Ostergren et al. 2008 #42)

Attitude

(Toman et al. 2004 #56)

Beauty

(Atiyeh and Hayek, 2008 #5)

Biodiversity

(Alavalapati et al. 2002 #2; Gobster, 1996 #24; Stainback and Alavalapati, 2004 #53)

Bluestem

(Outcalt, 2000 #44)

Botanical view

(Garren, 1943 #22)

Burning frequency

(Glitzenstein et al. 1995 #23)

Burning season

(Glitzenstein et al. 1995 #23)

Canopy basal area

(Addington et al. 2015 #1)

Carbon sequestration

(Alavalapati et al. 2002 #2; Stainback and Alavalapati, 2004 #53)

Catastrophic wildfires

(Kauffman, 2004 #32)

Chronology

(Lorimer, 1984 #38)

Clearcutting

(Palmer, 2008 #45)

Coarse woody debris

(Hauru et al. 2014 #27)

Communication

(Loomis et al. 2001 #37)

Community

(Bell and Oliveras 2006 #6)

Community pressure

(Steelman and McCaffrey 2011 #54)

Competition

(Glitzenstein et al. 1995 #23)

Conflict resolution

(Wagner et al. 1998 #61)

Conservation aesthetics

(Davis and Stamps 2004 #17; Leopold, 1949 #36)

Conservation biology

(Mitchell et al. 2006 #41)

Criteria and indicators

(Sheppard and Meitner, 2005 #50)

Cross-cultural

(Falk and Balling, 2010 #19)

Cross-cultural comparison

(Lim et al, 2015 #35)

Culture

(Edwards et al. 2012 #18)

Cultural difference

(Ueda et al. 2012 #58)

Dead wood

(Hauru et al. 2014 #27)

Decision-support systems

(Sheppard and Meitner, 2005 #50)

Delphi

(Edwards et al. 2012 #18)

Distribution history

(Lorimer, 1984 #38)

Ecological

(Jorgensen, 2011 #30)

Ecological aesthetic

(Gobster, 1996 #24)

Ecological policies

(Hull et al. 2000 #28)

Ecological values

(Yang et al. 2014 #63)

Ecology

(Leopold, 1949 #36; Tyrvaïnen et al, 2003 #57)

Ecology and evolution

(Davis and Stamps, 2004 #17)

Ecosystems

(Rideout et al. 2003 #49)

Ecosystem management

(Daniel, 2001 #13; Gobster, 1996 #24; Ribe et al. 2002 #47)

Ecosystem services

(Ribeiro and Lovett, 2011 #48)

Education

(Loomis et al. 2001 #37)

Environmental aesthetics

(Hauru et al. 2014 #27)

Environmental management

(Sheppard et al. 2004 #51)

Environmental perception

(Daniel and Meitner, 2001 #15; Panagopoulos, 2009 #46)

Environmental values

(Wagner et al. 1998 #61)

Environmental value orientations

(Howley, 2011 #29)

Europe

(Edwards et al. 2012 #18)

Evolutionary psychology

(Falk and Balling, 2010 #19)

Fire

(Ostergren et al. 2008 #42; Outcalt, 2000 #44)

Fire ecology

(Frost, 1993 #20)

Fire ecosystem

(Garren, 1943 #22)

Fire frequency

(Addington et al. 2015 #1)

Fire hazard reduction strategies

(Blanchard and Ryan, 2007 #7)

Fire management

(Cortner et al. 1984 #11; Gonzalez-Benecke et al. 2015 #25, Steelman and McCaffrey, 2011 #54; Winter and Fried, 2000 #62)

Fire prevention

(Winter and Fried, 2000 #62)

Fire regimes

(Glitzenstein et al. 1995 #23)

Fire suppression

(Stelman and McCaffrey, 2011 #54)

Flatwoods

(Glitzenstein et al. 1995 #23)

Foliar cover

(Brockway and Outcalt, 2000 #8)

Forest

(Sheppard et al. 2004 #51)

Forest aesthetics

(Kohsaka and Flitner, 2004 #34; Palmer, 2008 #45; Panagopoulos, 2009 #46)

Forest aesthetic indicator

(Lim et al. 2015 #35)

Forest attractiveness

(Ribeiro and Lovett, 2011 #48)

Forest disturbance history

(Lorimer, 1984 #38)

Forest fires

(Valente et al. 2015 #60)

Forest management

(Gundersen and Frivold, 2008 #26; Palmer, 2008 #45; Ribeiro and Lovett, 2011 #48; Sheppard et al. 2004 #51; Valente et al. 2015 #60)

Forest management plans

(Sheppard and Meitner, 2005 #50)

Forest management preferences

(Wagner et al. 1998 #61)

Forest owners

(Valente et al. 2015 #60)

Forest planning

(Orland, 1994 #43)

Forest recreation

(Tahvanainen et al. 2001 #55)

Forest resources

(Sheppard et al. 2004 #51)

Forest restoration
(Kauffman, 2004 #32)

Forest structure
(Edwards et al. 2012 #18)

Forest stake-holders
(Valente et al. 2015 #60)

Forest thinning
(Kauffman, 2004 #32)

Forestry
(Hull et al. 2000 #28; Sheppard et al. 2004 #51)

Forestry research
(Sheppard et al. 2004 #51)

Forestry science
(Sheppard et al. 2004 #51)

Frequent burning
(Mitchell et al. 2006 #41)

Fuel-hazard reduction
(Kauffman, 2004 #32)

Fuel-reduction burning
(Bell and Oliveras, 2006 #6)

Germany
(Kohsaka and Flitner, 2004 #34)

GIS
(Orland, 1994 #43)

Ground cover
(Gonzalez-Benecke et al. 2015 #25;)

Group interview
(Kohsaka and Flitner, 2004 #34)

Habitat
(Glitzenstein et al. 1995 #23)

Habitat preference

(Davis and Stamps, 2004 #17, Falk and Balling, 2010 #19)

Habitat restoration

(Alavalapati et al. 2002 #2; Stainback and Alavalapati, 2004 #53)

Hardwood control

(Addington et al. 2015 #1)

Harmonic profile

(Atiyeh and Hayek, 2008 #5)

Herbicide

(Brockway and Oultcalt, 2000 #8)

Herbicide alternatives

(Wagner, 1998 #61)

Heritage

(Antrop, 2006 #3)

Homeowner perceptions

(Blanchard and Ryan, 2007 #7)

Human perception

(Ulrich, 1986 #59)

Human evolution

(Falk and Balling, 2010 #19)

Human-landscape interaction

(Gobster, 1996 #24)

Ideal proportions

(Atiyeh and Hayek, 2008 #5)

Japan

(Kohsaka and Flitner, 2004 #34; Ueda et al. 2012 #58)

Kant

(Lothian, 1999 #39)

Land ethic

(Leopold, 1949 #36)

Landscape aesthetics

(Daniel and Boster, 1976 #14; Daniel, 2001 #13; Gobster, 1996 #24)

Landscape assessment

(Clay and Daniel, 2000 #10; Panagopoulos, 2009 #46)

Landscape change

(Antrop, 2006 #3)

Landscape character

(Galliano and Loeffler, 2000 #21)

Landscape image

(Ueda et al. 2012. #58)

Landscape image sketching technique

(Ueda et al. 2012. #58)

Land management

(Bell and Oliveras, 2006 #6)

Landscape management

(Antrop, 2006 #3; Zube et al. 1982 #64)

Landscape perception

(Palmer, 2008; Zube et al. 1982 #64)

Landscape perception paradigms

(Lothian, 1999 #39)

Landscape planning

(Arthur et al. 1977 #4; Carlson, 1977 #9; Tahvanien et al. 2001 #55)

Landscape preference

(Falk and Balling, 2010 #19; Hauru et al. 2014 #27; Howley, 2011 #29; Tyryainen et al. 2003 #57)

Landscape protection

(Antrop, 2006 #3)

Landscape quality assessment

(Daniel, 2001 #13)

Landscape sustainability

(Yang et al. 2014 #63)

Landscape themes

(Galliano and Loeffler, 2000 #21)

Landscape theory

(Lothian, 1999 #39)

Landscape urbanism

(Jorgensen, 2011 #30)

Land use policy

(Howley, 2011 #29)

Landscape visualization

(Daniel and Meitner, 2001 #15)

Longleaf pine

(Alavalapati et al. 2002 #2; Frost, 1993 #20; Garren, 1943 #22; Gonzalez-Benecke et al. 2015 #25; Rideout et al. 2003 #49; Stainback and Alavalapati, 2004 #53)

Longleaf pine restoration

(Addington et al. 2015 #1)

Measurement models

(Jorgensen and Stedman, 2001 #31)

Modeling

(Gonzalez-Benecke et al. 2015 #25)

Multi-criteria analysis

(Sheppard and Meitner, 2005 #50)

Natural resources

(Sheppard et al. 2004 #51)

Natural resource management

(Davenport and Anderson, 2005 #17; Sheppard et al. 2004 #51)

North Florida

(Glitzenstein et al. 1995 #23)

Northeast United States

(Blanchard and Ryan, 2007 #7)

Numeric expression

(Atiyeh and Hayek, 2008 #5)

Participatory decision support
(Sheppard and Meitner, 2005 #50)

Participatory planning
(Tyrvaainen et al. 2003 #57)

Perception
(Valente et al. 2015 #60)

Perception and aesthetics
(Smardon, 1988 #52)

Philosophy of aesthetics
(Lothian, 1999 #39)

Photo contest
(Kohsaka and Flitner, 2004 #34)

***Pinus palustris* Mill**
(Brockway and Outcalt, 2000 #8; Glitzenstein et al. 1995 #23)

Place attachment
(Davenport and Anderson, 2005 #17)

Planned fire
(Bell and Oliveras, 2006 #6)

Plant species diversity
(Brockway and Outcalt, 2000 #8)

Political pressure
(Steelman and McCaffrey, 2011 #54)

Ponderosa pine (*Pinus ponderosa*)
(Ostergren et al. 2008 #42)

Portugal
(Ribeiro and Lovett, 2011 #48)

Preference
(Jorgensen, 2011 #30)

Prescribed fire
(Kauffman, 2004 #32; Knapp et al. 2006 #33; Loomis et al. 2001 #37; McCaffrey, 2006 #40; Mitchell et al. 2006 #41; Toman et al. 2004 #56; Winter and Fried, 2000 #62)

Prescribed fire management

(Daniel, 1988 #12)

Prescribed fire restoration

(Rideout et al. 2003 #49)

Public awareness

(Lim et al. 2015 #35)

Public communication

(Wagner et al. 1998 #61)

Public involvement

(Sheppard and Meitner, 2005 #50)

Public opinion

(Ostergren et al. 2008 #42)

Public perception

(Carlson, 1977 #9; Cortner et al. 1984 #11; McCaffrey, 2006 #40; Sheppard et al. 2004 #51; Toman et al. 2004 #56; Yang et al. 2014 #63)

Public preference

(Edwards et al. 2012 #18)

Public relations

(Kohsaka and Flitner, 2004 #34; Loomis et al. 2001 #37)

Public support

(Cortner et al. 1984 #11; Daniel, 1988 #12)

Quercus incana

(Glitzenstein et al. 1995 #23)

***Quercus laevis* Walt.**

(Brockway and Outcalt, 2000 #8; Glitzenstein et al. 1995 #23)

Recreation(Edwards et al. 2012 #18; Gundersen and Frivold, 2008 #26)

Red-cockaded woodpecker

(Alavalapati et al. 2002 #2; Stainback and Alavalapati, 2004 #53)

Restoration

(Ostergren et al. 2008 #42; Outcalt, 2000 #44)

Restoration ecology

(Gonzalez-Benecke et al. 2015 #25)

Risk Perceptions

(Wagner et al. 1998 #61)

Russia

(Ueda et al. 2012 #58)

Sandhill

(Brockway and Outcalt, 2000 #8; Glitzenstein et al. 1995 #23)

Savanna

(Falk and Balling, 2010 #19)

Scenery Assessment

(Galliano and Loeffler, 2000 #21)

Scenic

(Jorgensen, 2011 #30)

Scenic beauty

(Arthur et al. 1977 #4; Carlson, 1977 #9; Clay and Daniel, 2000 #10; Daniel and Boster, 1976 #14; Daniel and Meitner, 2001 #15; Galliano and Loeffler, 2000 #21; Gobster, 1996 #24; Gundersen and Frivold, 2008 #26; Leopold, 1949 #36; Tahvanainen et al. 2001 #55)

Scenic integrity

(Galliano and Loeffler, 2000 #21)

Scenic vista

(Ribe et al. 2002 #47)

Sense of place

(Davenport and Anderson, 2005 #17; Jorgensen and Stedman, 2001 #31)

Silviculture

(Gundersen and Frivold, 2008 #26)

Site visit

(Toman et al. 2004 #56)

Social Acceptability

(Wagner et al. 1998 #61)

Social impacts

(Frost, 1993 #20)

Social obstacles

(Daniel, 1988 #12)

Social forest value

(Lim et al. 2015 #35)

Social sustainability

(Panagopoulos, 2009 #46)

Society of American Foresters

(Hull et al. 2000 #28)

Soil texture

(Addington et al. 2015 #1)

Species change

(Glitzenstein et al. 1995 #23)

Sustainable forest management

(Lim et al. 2015 #35; Sheppard and Meitner, 2005 #50)

Sustainability

(Antrop, 2006 #3)

Sweetgum

(Addington et al. 2015 #1)

Theory

(Jorgensen, 2011 #30)

Third-party certification

(Sheppard et al. 2004 #51)

Trust

(Wagner et al. 1998 #61)

Understory vegetation

(Knapp et al. 2006 #33)

Urban forestry

(Gundersen and Frivold, 2008 #26; Tyrvaainen et al. 2003 #57)

Urban planning

(Smardon, 1988 #52)

Urban woodland

(Hauru et al. 2014 #27)

User preferences

(Ribeiro and Lovett, 2011 #48)

Vegetative evaluation

(Ulrich, 1986 #59)

Visual assessments

(Jorgensen and Stedman, 2001 #31; Smardon, 1988 #52; Ulrich, 1986 #59)

Visualisation (Visualization)

(Orland, 1994 #43; Ribe et al. 2002 #47; Sheppard and Meitner, 2005 #50; Tahvanainen et al. 2001 #55; Tyrvaainen et al. 2003 #57)

Visual management practices

(Gobster, 1996 #24)

Visual prompts

(Ribeiro and Lovett, 2011 #48)

Visual quality

(Clay and Daniel, 2000 #10; Zube et al. 1982 #64)

Visual resource management

(Clay and Daniel, 2000 #10; Panagopoulos, 2009 #46)

Wildfire

(Bell and Oliveras, 2006 #6; Kauffman, 2004 #32)

Wildfire costs

(Steelman and McCaffrey, 2011 #54)

Wildfire policy

(Steelman and McCaffrey, 2011 #54)

Wildland fire

(Kauffman, 2004 #32; Knapp et al. 2006 #33)

Wildland fire risk

(Blanchard and Ryan, 2007 #7)

Wildland–urban interface
(Blanchard and Ryan, 2007 #7)

Wiregrass
(Outcalt, 2000 #44)

Wombat State Forest
(Bell and Oliveras, 2006 #6)

1. Addington, R. N., Knapp, B. O., Sorrell, G. G., Elmore, M. L., Wang, G. G., and Walker, J. L. 2015. Factors affecting broadleaf woody vegetation in upland pine forests managed for longleaf pine restoration. *Forest Ecology and Management*, 354: 130-138.

* Controlling broadleaf woody plant abundance is one of the greatest challenges in longleaf pine (*Pinus palustris* Mill.) ecosystem restoration. Numerous factors have been associated with broadleaf woody plant abundance in longleaf pine ecosystems, including site quality, stand structure, and fire frequency and intensity, yet the way in which these factors vary and interact across a landscape is poorly understood. The goal of this study was to quantify the importance of environmental and management factors and their interactions on the abundance of hardwood tree and shrub species in upland pine forests managed for longleaf pine restoration in Fort Benning, GA. We measured understory, midstory, and overstory vegetation in 189 fixed-area plots, and we assembled descriptive plot data about soil texture classes, slope and aspect, and fire management history. We used classification and regression trees to model broadleaf woody species abundance. Regression trees identified fire return interval, soil texture, and slope as the most important factors affecting understory woody plant cover, with high mean cover occurring in areas with longer fire return intervals (i.e. less frequent fire), on fine-textured soils (sandy clay loams and sandy loams), and on slopes less than 6%. An interaction between soil texture and fire return interval was present and suggested that frequent fire was especially important in controlling understory broadleaf woody plants on fine-textured soils. A significant interaction emerged between soil texture and pine basal area as well, suggesting that the potential to release woody competitors with canopy removal was higher on fine-textured soils than on coarse-textured soils. The presence of hardwood stems in the midstory was most dependent upon time since burn. Other factors, such as the number of burns conducted during the growing season and

topographic aspect, did not contribute significantly to variation in woody plant cover or density. Of the woody species encountered, sweetgum (*Liquidambar styraciflua* L.) was the most abundant, especially on plots with fire return intervals P2.6 years, on fine-textured soils, and at low pine basal areas (<9.4 m²/ha). Other species such as persimmon (*Diospyros virginiana* L.), winged sumac (*Rhus copallinum* L.), and southern red oak (*Quercus falcata* Michx.) were commonly encountered but at low densities. Our results demonstrate the general complexity of woody species control, but more importantly indicate site differences that could be used to prioritize prescribed fire application at the landscape scale.

KEYWORDS: Canopy basal area, Fire frequency, Hardwood control, Longleaf pine restoration, Soil texture, Sweetgum

2. Alavalapati, J. R., Stainback, G. A., and Carter, D. R. 2002. Restoration of the longleaf pine ecosystem on private lands in the US South: An ecological economic analysis. *Ecological Economics*, 40(3): 411-419.

* The longleaf pine ecosystem is one of the most biologically diverse in North America, supporting hundreds of plant and animal species. Because of its timber and many non-timber benefits, there is strong interest among forestry professionals, conservation groups, and the public at large in restoring longleaf pine ecosystems. However, many landowners are reluctant to grow longleaf pine on their lands on a commercial basis because the economic returns from longleaf pine timber production are usually less than those of slash pine. In this study, we develop a model that determines the profitability of longleaf and slash pine timber production after consideration of carbon sequestration, habitat for the endangered red-cockaded woodpecker, and other amenity benefits. Results suggest that internalizing carbon sequestration benefits and red-cockaded woodpecker habitat benefits alone is not enough for landowners to

switch from slash pine to longleaf. Additional payments of \$16 to 33 per ha per year, reflecting extra amenity benefits associated with longleaf pine relative to slash pine, make longleaf production financially competitive. Incentives that reflect carbon, biodiversity, and amenity benefits associated with longleaf production may be the optimal way of restoring longleaf pine ecosystems on rural private lands in the US South.

KEYWORDS: Biodiversity, Carbon sequestration, Habitat restoration, Longleaf pine, Red cockaded woodpecker

3. Antrop, M. 2006. Sustainable landscapes: contradiction, fiction, or utopia?

Landscape and Urban Planning, 75: 187-197.

* As landscapes change continuously in a more or less chaotic way, the concept of sustainable landscapes could be viewed as a utopian goal, New landscapes emerge with changing life-styles. Decision making for landscape planning, conservation and management use the concept of sustainability widely. To make it operational, many new associated and more specific concepts have been proposed such as natural and social capital, conservation economy and quality of life capital, Most of these are inspired by economic thinking and rarely refer directly to the landscape. This article reviews the background and meaning of these concepts and shows that landscape is not seen here as an integrating, holistic concept. As landscape changes, also its meaning and significance changes and consequently its management.

KEYWORDS: Heritage, Landscape change, Landscape management, Landscape protection, Sustainability

4. Arthur, L. M., Daniel, T. C., and Boster, R. S. 1977. Scenic assessment: An overview. Landscape planning, 4: 109-129.

* The authors present a synthesis and overview of techniques developed for evaluating the scenic beauty of natural resources. Literature is grouped into three categories: descriptive inventories, public evaluations, and economic analyses. Both quantitative and nonquantitative methods within each category are discussed, strengths and weaknesses of the general approaches noted, and, occasionally, alternatives suggested. Discussions are focused on methodological soundness and on utility of the evaluative systems for management of scenic resources.

KEYWORDS: Landscape planning, Scenic beauty

5. Atiyeh, S.B. and Hayek, N.S. 2008. Numeric expressions of aesthetics and beauty. *Aesthetic Plastic Surgery*, 32:209-216.

* Debate over what constitutes beauty, particularly beauty of the human body, has raged since philosophy began. Interested scholars have debated the meaning of beauty for centuries. However, it seems that numbers and the resulting numeric relationships play a fundamental role in the classification of the human body, and that a harmonic profile or body shape is produced only at certain definite numeric relationships. The beauty of individual features depends on “ideal” proportions, and it is suggested that expressing beauty in terms of geometry is possible. As the demand for aesthetic surgery has increased tremendously over the past few decades, it is becoming essential to be able to assess the possible satisfaction that can be expected after an aesthetic surgery procedure and to determine the beauty of the final result as precisely as possible.

KEYWORDS: Aesthetics, Beauty, Harmonic profile, Ideal proportions, Numeric expression

6. Bell, T. and Oliveras, I. 2006. Perceptions of prescribed burning in a local forest community in Victoria, Australia. *Environmental Management*, 38:867-878.

* The general perceptions of prescribed burning were elicited from forest users for an area that has been subject to this form of land management for at least 20 years. The largest group consisted of local residents living in and around the Wombat State Forest with two smaller groups of students from a nearby university campus and local professional land managers. A questionnaire was given to each participant in order to explore how the forest was used, to determine the level of knowledge of burning in the targeted forest and Victoria and the perception of the appearance, effectiveness of protection, and accessibility to the forest after prescribed burning. Generally all groups had similar responses with community members having stronger views on the effectiveness and practicalities of prescribed burning, whereas students were more neutral in their opinions. All participants claimed knowledge of prescribed burning activities within Victoria, but fewer had experience of planned fires in the Wombat State Forest. All groups agreed that areas that had not been recently burned had a better appearance than those that had, but this result may have included a range of value judgments. Land managers had a greater understanding of the ecological importance of season and timing of burning; however, some students and community members were equally knowledgeable. Prescribed burning did not impede access to the forest, nor did smoke from prescribed burns pose any great problem. The majority of the participants felt that the amount of prescribed burning done in the forest was adequate for engendering a feeling of protection to life and property, yet many were still suspicious of this management practice. These initial findings indicate several areas in which further research would be useful including the efficacy of education programs for community members and improved communication of burn plans by land managers.

KEYWORDS: Community, Fuel-reduction burning, Land management, Planned fire, Wildfire, Wombat State Forest

7. Blanchard, B. and Ryan, L.R. 2007. Managing the wildland-urban interface in the Northeast: Perceptions of Fire Risk and Hazard Reduction Strategies. Northern Journal of Applied Forestry, 24(3): 203-208.

* Much of the recent work in reducing wildland fire danger has occurred in the western and southeastern United States. However, high-risk areas do exist at the wildland–urban interface areas in the Northeast and very little work has been done to understand the fire management issues in this region. Therefore, this study used a survey of residents and landowners within the Plymouth Pine Barrens of southeastern Massachusetts to assess community members’ perceptions of wildland fire risk and hazard reduction strategies. The research results indicate that residents have a low perception of wildland fire risk but support the use of fire hazard reduction strategies, including prescribed fire, mechanical removal of trees and brush, and construction of firebreaks. Previous experience with wildland fire was a major factor influencing respondents’ perception of fire risk. Furthermore, participants’ knowledge about specific fuel treatments positively influenced their support for those treatments. Overall, respondents believe that actions should be taken to reduce fire hazard within the study area and would like to be involved in the development of fire hazard reduction plans.

KEYWORDS: Fire hazard reduction strategies, Homeowner perceptions, Northeast United States, Wildland fire risk, Wildland–urban interface.

8. Brockway, D. G., and Outcalt, K. W. 2000. Restoring longleaf pine wiregrass ecosystems: Hexazinone application enhances effects of prescribed fire. Forest Ecology and Management, 137(1): 121-138.

* A longleaf pine wiregrass ecosystem in the sandhills of north central Florida, upon which turkey oak gained dominance following a wildfire, was treated with applications of hexazinone

(1.1 or 2.2 kg/ha) in May 1991. All applications successfully reduced competition from oaks in the overstory and understory (mortality >80%), resulting in progressive increases in the foliar cover of wiregrass, all graminoids and forbs through time. Broadcast application caused a decline in forb cover and species richness during the initial growing season, which recovered by the following year. The 2.2 kg/ha spot application resulted in an increase in species richness, while evenness declined with the continuing expansion of wiregrass. The entire site was then burned in June 1995 by prescribed fire, which caused a widespread decrease in the cover of oaks, shrubs, wiregrass, all graminoids and forbs and plant species richness. In the following year, forb cover increased and oak cover remained significantly lower on plots treated with the combination of hexazinone plus fire than on fire-only plots. The overall cover of forbs, graminoids, shrubs and longleaf pines continued to increase through time. Broadcast application initially exposed a greater number of understory plants to direct contact with herbicide, posing a higher mortality risk than may be acceptable in restoration efforts. Although recovery occurred in subsequent years, the lower selectivity of broadcast application makes it a less suitable restoration technique. Spot application of hexazinone was more selective in its effects upon the plant community. The 2.2 kg/ha application produced increases in the cover of wiregrass, all graminoids and forbs and the highest levels of species richness and diversity. The 2.2 kg/ha application rate was also most effective in controlling woody plant competition and is therefore recommended for restoring longleaf pine wiregrass ecosystems in sandhills and similar environments. Hexazinone application followed by prescribed fire accelerates the rate of ecosystem restoration over that achievable by using fire alone. The ecological benefits of controlling competition and rebalancing floristic composition rapidly achieved through this

combination of treatments would likely require many cycles of prescribed fire, if used as an individual treatment, over a period of several decades.

KEYWORDS: *Aristida beyrichiana* Trin. and Rupr, Herbicide, Foliar cover, *Pinus palustris* Mill., Plant species diversity, *Quercus laevis*, Sandhills, Walt.

9. Carlson, A.A. 1977. On the possibility of quantifying Scenic Beauty. Landscape Planning, 4: 131-172.

* This paper is a critical discussion of some current work in the aesthetics of the natural environment. The discussion is from the point of view of philosophical aesthetics and consequently concentrates on the basic aspects of this work which constitute its overall approach or “philosophy” in regard to certain issues in aesthetics. Since work in the aesthetics of the natural environment comes from various areas, such as the social sciences, the resource management fields and the environmental design disciplines, it is initially necessary to describe this work in a general-way. In doing this, I bring out certain general themes which characterize this work and contribute to its overall approach. These themes involve objectivity, quantification, public opinion, and formalism and the way in which each of these relate to the aesthetic quality or scenic beauty of the natural environment. In order to consider these themes in a concrete manner, I center the discussion on one particular individual’s research, which is both important in its own right and typical in that it exemplifies the themes. This is the work of E.L. Shafer, a director of environmental forestry research with the United States Forest Service. I describe Shafer’s research, bringing out certain assumptions which correspond to the above themes. In the remainder of the paper I critically examine Shafer’s assumptions, arguing that those which have to do with public opinion and with formalism are untenable as a part of an approach to the aesthetics of the natural environment. I suggest certain alternatives to these assumptions,

alternatives which involve expert opinion and non-formalist approaches. The discussion of Shafer's assumptions and of the alternatives to these assumptions indicates that quantifying scenic beauty may be, even if possible, neither as useful nor as straightforward as much of the current work in environmental aesthetics would lead us to believe. I conclude with a brief discussion of objectivity, arguing that, even without quantification, the alternatives which I consider allow for objectivity in regard to scenic beauty.

KEYWORDS: Aesthetics, Landscape planning, Public perception, Scenic beauty

10. Clay, R.G. and Daniel, C.T. 2000. Scenic Landscape assessment: The effects of land management jurisdiction on public perception of scenic beauty. Landscape and Urban Planning, 49: 1-13.

* The research presented here evaluated viewer preferences for a road corridor in southern Utah that is managed in part by the USDA Forest Service, and in part by the National Park Service. Because philosophical differences per agency can lead to visible differences in landscape characteristics, a traveler can be presented with a mixed and potentially confusing experience en-route. This potential for ambiguity could impact a visitor's experience, which in turn might influence a region's tourist potential. A preliminary field study was first conducted to document the motivations and concerns of visitors to the study area. A systematic photographic inventory was then generated along the 12-mile corridor that links Cedar Breaks National Monument with segments of the Dixie National Forest. The acquired photographs were employed in a perceptual assessment effort that studied observer's perceptions of landscape scenic beauty as the road traversed from one jurisdiction to the other. The goal was to investigate the effects of jurisdictional differences on public perceptions of the scenic quality of the corridor. Preference scores were later related to expert-based assessments of the visible characteristics of the same

test scenes, using the landscape/scene variables indicated by the preliminary field study; depth of view, proportion of road in view, and proportion of open meadow in view. Results indicated highest preferences for park managed scenes with a central open meadow framed by forest. Similar scenes in the forest-administered sections of the corridor were less preferred, apparently due to the effects of seasonal livestock grazing on visual features within the meadows.

KEYWORDS: Landscape assessment, Scenic beauty, Visual resource management, Visual quality

11. Cortner, J.H., Zwolinski, J.M., Carpenter, H.E., and Taylor, G.J. 1984. Public support for fire-management policies. *Journal of Forestry*, 82(6):359–65.

* Members of the general public samples in Tucson, Arizona, recognize that fire in forests can be both beneficial and detrimental, Public acceptance and understanding of the purposes and benefits of fire management are high, and additional fire knowledge increases tolerance of fire. While entirely new approaches to fire education do not appear necessary, existing approaches could benefit from modifications that directly address several public concerns. To be most effective, public education should be directed to local forest conditions as well as to local knowledge and acceptance of fire management.

KEYWORDS: Fire management, Public perception, Public support

12. Daniel, C.T. 1988. Social/political obstacles and opportunities in prescribed fire management. In *Effects of fire management of Southwestern natural resources: Proceedings of the symposium. United States Forest Service General Technical Report RM-191, Washington, DC (pp. 134-138).*

** In order to increase public support through prescribed fire management, it is beneficial to provide public more information regarding forest ecosystems, how fire affects life and property,

and scenic and recreational effects. Prospective results of long-term aesthetic values of prescribed fire and increase appreciation of safety may be more contributing for public support and understanding the main aspects of prescribed fire management systems.

KEYWORDS: Prescribed fire management, Public support, Social obstacles

13. Daniel, C. T. 2001. Whither scenic beauty? Visual landscape quality assessment in the 21st century. *Landscape and Urban Planning*, 54(1): 267-281.

* The history of landscape quality assessment has featured a contest between expert and perception-based approaches, paralleling a long-standing debate in the philosophy of aesthetics. The expert approach has dominated in environmental management practice and the perception-based approach has dominated in research. Both approaches generally accept that landscape quality derives from an interaction between biophysical features of the landscape and perceptual/judgmental processes of the human viewer. The approaches differ in the conceptualizations of and the relative importance of the landscape and human viewer components. At the close of the 20th century landscape quality assessment practice evolved toward a shaky marriage whereby both expert and perceptual approaches are applied in parallel and then, in some as yet unspecified way, merged in the final environmental management decision making process. The 21st century will feature continued momentum toward ecosystem management where the effects of changing spatial and temporal patterns of landscape features, at multiple scales and resolutions, will be more important than any given set of features at any one place at any one time. Valid representation of the visual implications of complex geo-temporal dynamics central to ecosystem management will present major challenges to landscape quality assessment. Technological developments in geographic information systems, simulation modeling and environmental data visualization will continue to help meet those challenges. At a

more fundamental level traditional landscape assessment approaches will be challenged by the deep ecology and green philosophy movements which advocate a strongly bio-centric approach to landscape quality assessment where neither expert design principles nor human perceptions and preferences are deemed relevant. On the opposite side of the landscape–human interaction, social/cultural construction models that construe the landscape as the product of socially instructed human interpretation leave little or no role for biophysical landscape features and processes. A psychophysical approach is advocated to provide a more appropriate balance between biophysical and human perception/judgement components of an operationally delimited landscape quality assessment system.

KEYWORDS: Ecosystem management, Landscape aesthetics, Landscape quality assessment

14. Daniel, C.T. and Boster, S.R. 1976. Measuring landscape esthetics: the scenic beauty estimation method. Res. Pap. RM-RP-167. U.S. Department of Agriculture, Forest Service, Rocky Mountain Range and Experiment Station. 66 p.

** The article aims at discussing the Scenic Beauty Estimation Method (SBE) by looking at quantitative approaches to evaluate wildlife landscapes. Planning, managing, and designing tools were also combined with SBE by the contributions of public attendance. The main objectives of this paper was to determine the major requirements of scenic beauty assessments through forest landscapes and associated wildlands in a systematic way, and to point out the main issues encountered with scenic beauty assessment and predictions. The results of this study showed that SBE method has prominent effects on measures of public perceptual preferences for various landscapes by providing color scale representation. Also, SBE development could be used as the main criteria applicable to any kinds of measurement system. More importantly, the primary

results of the study indicated that the utility of SBE method may facilitate the appearance of aesthetic preference of public groups from users and professional groups.

KEYWORDS: Aesthetics, Scenic beauty, Landscape aesthetics

15. Daniel, C.T., and Meitner, M.M. 2001. Representational validity of landscape Visualizations: The Effects of Graphical Realism on Perceived Scenic Beauty of Forest Vistas. Journal of Environmental Psychology, 21:61-72.

* Photographs have long been used to represent environmental conditions in the context of landscape quality assessments and environmental perception research. Representational options have been significantly expanded by applications of computer modeling and computer graphic technologies that can provide precise visualizations based on inventoried or model-projected biophysical data. Final graphic displays from computer visualization systems can range from very abstract 'wire-frame' models to high resolution, photorealistic video images. An important assumption underlying the use of both photographic and computer rendered visualizations is that human viewers' responses to these representations provide valid indications of perceptions and judgments made in response to direct experience with the landscape conditions nominally represented. In this study the same set of forest landscape scenes was represented by visualizations rendered at four different levels of realism-abstraction. Each representation was shown to separate groups of observers who rated the perceived scenic beauty of the common set of forest landscape scenes. Correlations between the ratings of the same scenes in the different visualization conditions were very low, raising important questions about the representational validity of computer-generated landscape visualizations.

KEYWORDS: Environmental perception, Landscape visualization, Scenic beauty

16. Davenport, A.M. and Anderson, H.D. 2005. Getting from sense of place to place-based management: An interpretive investigation of place meanings and perceptions of landscape change. *Society and Natural Resources*, 18: 625-641.

* This article presents the findings of an interpretive investigation of the meanings that local community members attribute to the Niobrara National Scenic River in north central Nebraska and their perceptions of the river landscape. Twenty-five in-depth interviews were conducted and analyzed through an iterative qualitative analysis process. A holistic and integrative Web of River Meanings emerged from the analysis. The model provides insight into participants' perceptions of and attitudes toward landscape change, and in particular the highly contentious issue of river development, which proved to be a common theme in the interviews. The study findings expand on current conceptualizations of sense of place and place attachment. The findings also have implications for local planning and management by providing a more sophisticated meanings-based framework for understanding contentious management issues.

KEYWORDS: Natural resource management, Place attachment, Sense of place

17. Davis, M.J. and Stamps, A.J. 2004. The effect of natal experience on habitat preferences. *Trends in Ecology and Evolution*, 19(8): 411-416.

* Several important problems in ecology, evolution and conservation biology are affected by habitat selection in dispersing animals. Experience in the natal habitat has long been considered a potential source of variation in the habitat preferences displayed when dispersers select a post-dispersal habitat. However, the taxonomic breadth of this phenomenon is underappreciated, in part because partially overlapping, taxon-specific definitions in the literature have discouraged communication. Here, we explore the phenomenon of natal habitat preference induction (NHPI) and demonstrate that NHPI has been observed in a broad range of animal taxa. We consider the

potential adaptive significance of NHPI, identify implications of its occurrence for problems in evolution, ecology and conservation biology, and encourage further study of this phenomenon.

KEYWORDS: Habitat preference, Ecology and evolution, Conservation aesthetics

18. Edwards, D., Jay, M., Jensen, S.F., Lucas, B., Marzano, M., Montagne, C., Peace, A., and Weiss, G. 2012. Public preferences for structural attributes of forests: Towards a pan-European perspective. *Forest Policy and Economics*, 19:12-19.

* This paper presents the findings of a Delphi survey, conducted in four European regions (Great Britain, Nordic Region, Central Europe and Iberia) to assess public preferences for 12 key structural attributes of forests. The objectives were to explore the extent to which generalizations can be made about preferences of forests as sites for recreational use, and how regional variations in preferences may be explained in terms of cultural differences in local populations and bio-physical characteristics of the forests in each region. Survey participants were asked to classify the relationship, and quantify the relative importance, of each attribute to the recreational value of forests in their respective regions. While there was agreement across regions on the type of relationship and level of importance for many of the attributes, there were some notable outliers, for example 'residue from felling and thinning' scored lowest in Central Europe and highly in the other three regions. Indicative explanations for regional variations are proposed, focusing on combinations of cultural and biophysical factors, and drawing on the literature on forest preferences, place attachment and cultural landscapes.

KEYWORDS: Culture, Delphi, Europe, Forest structure, Public preference, Recreation

19. Falk, H. J. and Balling, D. J. 2010. Evolutionary Influence on Human Landscape Preference. *Environment and Behavior*, 42(4):479-493.

* Individuals residing in the rainforest belt of Nigeria were shown photographs of five biomes: rain forest, deciduous forest, coniferous forest, savanna, and desert. Subjects overwhelmingly selected savanna scenes as representing the most desirable place to live. These results, coupled with extensive American data, support the hypothesis that humans possess an innate preference and enculturation. Findings are discussed in relation to anthropological, biological, and psychological research.

KEYWORDS: Cross-cultural, Evolutionary psychology, Human evolution, Habitat preference, Landscape preference, Savanna

20. Frost, C. C. 1993. Four centuries of changing landscape patterns in the longleaf pine ecosystem. In Proceedings of the Tall Timbers Fire Ecology Conference, 18: 17-43.

* Longleaf pine was exploited from first European settlement, but before 1700, dependence on navigable water for travel and trade limited impacts to coastal regions and belts along navigable streams. In these settled landscapes, effects of domestication included land clearing and establishment of saturation densities of open range cattle and hogs which fed on longleaf pine seedlings in nearby woods. Effects of commercial logging were negligible until introduction of the water-powered sawmill in 1714, but by the 1760s hundreds of these were turning out milled lumber. Still, deforestation was limited to narrow patterns defined by streams and rivers. By this time much of the eastern Piedmont was fully settled and the frontier had passed on almost to the Appalachians. By the Civil War, all the best land on the Atlantic slope was in fields and pasture, but much virgin forest remained on the Gulf coast. The naval stores industry began in Virginia, where boxing longleaf for crude turpentine was practiced all through the Colonial Period, and most of the longleaf there was decimated by 1840, but there had been little impact to the south, with the exception of stands along rivers in North Carolina. Then, in 1834, adaptation of the

copper whiskey still to turpentine distillation made the process vastly more efficient and profitable. This activity, which left most of the primeval pine forest weakened or destroyed, swept south and then west along the Gulf, decade by decade, as northern stands were exhausted, reaching full swing in the last stands in Texas around 1900. Steam technology mushroomed by 1870, with proliferation of logging railroads, steam log skidders and steam sawmills, and virtually all remaining virgin timber in the South came down during the era of intensive logging from 1870 to 1920. The 1920s saw the beginning of conversion of unmanaged woodlands to pine plantation, now about 15% of southern uplands. The presettlement range of longleaf pine is estimated at 92 million acres, of which 74 million were longleaf dominant and 18 million had longleaf in mixtures with other pines and hardwoods. By 1946, longleaf pine had dwindled to 1/6 its original acreage. This decline has continued until only about 3% remains.

KEYWORDS: Fire ecology, Longleaf pine, Social impacts

21. Galliano, J. S. and Loeffler, M. G. 2000. Scenery assessment: Scenic beauty at the ecoregion scale. United States Department of Agriculture, Gen. Tech. Rep. PNW-GTR-472. Portland, OR: U.S., 30 p.

* Scenic quality is an important amenity on public lands in the interior Columbia basin (hereafter referred to as the basin). People's interests in and expectations about ecosystems can help establish desired aesthetic conditions for the varied landscapes found in the basin. This paper, a portion of the social science assessment for the Interior Columbia Basin Ecosystem Management Project, explains the procedures used to inventory scenic quality throughout the basin by using two primary indicators: landscape character and scenic condition. Landscape character is expressed as landscape themes, which portray the overall images of a large geographic area. Scenic condition is measured in degrees of scenic integrity, which express various levels of

alteration to the landscape by humans to natural-appearing landscapes. Most landscapes in the basin are forests and shrub-grasslands having a predominantly natural appearance. Urban and rural developments visually dominate relatively few of the basin's landscapes although they are highly visible where they do occur. The overall scenic integrity of landscapes in the basin remains at a relatively high level with over 80 percent dominated by natural-appearing views.

KEYWORDS: Landscape character, Landscape themes, Scenery assessment, Scenic beauty, Scenic integrity

22. Garren, K. H. 1943. Effects of fire on vegetation of the southeastern United States. Botanical Review, 9(9): 617-654.

** The aim of this paper was to provide a brief description about historical background of longleaf pine and how vegetative distribution of southeastern U.S. has been affected by fire management. Longleaf pine has unique features when exposed to fire and the paper pointed out the association of fire with longleaf-slash pine forests and understory vegetation. Furthermore, there were also important information regarding the coastal plain and bottomland hardwood forests from Mississippi Delta and pocosins. Natural and artificial non-forested areas were additionally summarized by indicating the southern vegetative distribution and how public attitude has considerably impacted coastal and swamp marshes over time.

KEYWORDS: Fire ecosystem, Longleaf pine, Public attitude

23. Glitzenstein, J. S., Platt, W. J., and Streng, D. R. 1995. Effects of fire regime and habitat on tree dynamics in north Florida longleaf pine savannas. Ecological Monographs, 65(4): 441-476.

* Frequent, low intensity fire was an important component of the natural disturbance regime of presettlement savannas and woodlands in the southeastern USA dominated by longleaf pine

(*Pinus palustris*), and prescribed burning is now a critical part of the management of these endangered habitats. Fire season, fire frequency, and fire intensity are three potentially important, though still little understood, components of both natural and managed fire regimes. In this long-term (8-yr) study, we experimentally (through the use of prescribed burning) tested for effects of fire season (eight different times throughout the year) and fire frequency (annual vs. biennial burning), on population dynamics (recruitment, growth, mortality, change in density, and change in basal area [the total basal area of all stems in a plot]) and species composition of trees in two quite different types of longleaf-pine-dominated habitats (north Florida sandhills and flatwoods). Limited fire temperature and intensity data were also collected during one year to examine the relationship between fire behavior (temperature and intensity) and tree mortality. Contrary to prior hypotheses, our results showed few systematic or predictable effects of season or frequency of burning on dynamics of longleaf pine. Instead, variability in the population dynamics of this species appeared to be related largely to variation in fire behavior, regardless of the season of burning. Consistent with prior hypotheses, we found that deciduous oak species (*Quercus laevis*, *Q. margaretta*, and *Q. incana*) were least vulnerable to dormant-season burning and most vulnerable to burning early in the growing season. This was shown particularly by seasonal trends in the effect of burning on oak mortality (both top kill and complete kill) and, to a lesser extent, on oak recruitment. Oak densities and basal areas also declined in the spring-burned plots, resulting in a shift away from oaks and towards increased dominance by longleaf pine. Detrimental effects of spring burning on oaks were partly explained by fire behavior, but there appeared also to be an important residual effect of burning season, particularly on complete kill. Though longleaf pine population dynamics did not differ markedly as a result of burning season and frequency, we did find important differences in pine dynamics between the two

habitats (i.e., sandhills and flatwoods). In general, populations of longleaf pines in the sandhills appeared to be density regulated, while flatwoods pine populations were declining regardless of the level of intraspecific competition. This suggests that long-term persistence of longleaf pine, and perhaps other fire-adapted species in frequently burned longleaf-pine-dominated communities, may be determined by complex interactions between habitat factors and fire regimes.

KEYWORDS: Burning frequency, Burning season, Competition, Fire regimes, Flatwoods, Habitat, North Florida, *Pinus palustris*, *Quercus incana*, *Quercus laevis*, Sandhills, Species change

24. Gobster, H. P. 1996. Forest aesthetics, biodiversity, and the perceived appropriateness of ecosystem management practices. In: Brunson, Mark W.; Kruger, Linda E.; Tyler, Catherine B.; Schroeder, Susan A., tech. eds. Defining social acceptability in ecosystem management: a workshop proceedings; 1992 June 23-25, Kelso, WA. Gen. Tech. Rep. PNW-GTR-369. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 77-97.

* The social acceptability of "ecosystem management" and related new forestry programs hinges on how people view the forest environment and what it means to them. For many, these conceptions are based on a "scenic aesthetic" that is dramatic and visual, where both human and natural changes are perceived negatively. In contrast, appreciation of biologically diverse forests created through ecosystem management practices depends on experience of the subtle, multimodal characteristics of a dynamic environment, an aesthetic attitude that is acquired and cognitive rather than immediate and affective. Society is unlikely to quickly adopt this "ecological aesthetic" as espoused by Aldo Leopold and others. However, the concept of

appropriateness could serve as a short-term alternative for resolving perceived conflicts between aesthetic and biodiversity values. Unlike scenic assessments, assessments of appropriateness address the question "what belongs where?" and work to integrate aesthetic and biodiversity goals rather than to seek absolutes. This concept also ties aesthetics together with land ethics by seeking a harmonious "fit" between human activity and the natural world. Approaches are outlined that suggest how perceptions of appropriateness might be studied and used in the context of ecosystem management practices. Additional thought is given to how researchers and managers can begin to broaden ideas of aesthetics over the long term.

KEYWORDS: Appropriateness, Biodiversity, Ecological aesthetic, Ecosystem management, Human-landscape interactions, Landscape aesthetics, Scenic beauty, Visual management practices

25. Gonzalez-Benecke, C. A., Samuelson, L. J., Stokes, T. A., Cropper, W. P., Martin, T. A., and Johnsen, K. H. 2015. Understory plant biomass dynamics of prescribed burned *Pinus palustris* stands. *Forest Ecology and Management*, 344: 84-94.

* Longleaf pine (*Pinus palustris* Mill.) forests are characterized by unusually high understory plant species diversity, but models describing understory ground cover biomass, and hence fuel load dynamics, are scarce for this fire-dependent ecosystem. Only coarse scale estimates, being restricted on accuracy and geographical extrapolation, are available. We analyzed the dynamics of ground cover biomass under different prescribed burning regimes in longleaf pine stands in the southeastern United States. We developed a set of functions to simulate ground cover biomass dynamics in stands of varying age, basal area and fire management history. The subsequent models allow for estimation of ground cover biomass for unburned stands and living woody and herbaceous ground cover biomass for burned stands. Woody ground cover was

highly reduced as fire frequency increased, and also affected by stand basal area when time since last burning was longer than two years. Herbaceous ground cover was affected little by burning frequency but was reduced as basal area increased. This novel model system is a useful tool that can be incorporated into fire management and carbon balance models.

KEYWORDS: Fire management, Ground cover, Longleaf pine, Modeling, Restoration ecology

26. Gundersen, S.V. and Frivold, H.L. 2008. Public preferences for forest structures: A review of quantitative surveys from Finland, Norway, and Sweden. *Urban Forestry and Urban Greening*, 7:241-258.

* We reviewed 53 studies of forest landscape preferences carried out as quantitative surveys in Finland, Sweden and Norway and published between 1972 and 2006. Most of these were related to boreal coniferous forests in which even-aged forestry had been the rule. There was a great diversity in survey designs, ranging from nation-wide or regional surveys where target populations and sampling frames were clearly defined, to studies where neither a target population nor a sampling frame could be identified. The latter type of surveys, however, often had a high validity, with measurements made either in the forest or indoors by use of color slides or advanced digital imaging. A common feature was that people's preferences for a forest stand increased with increasing tree size and advancing stage of stand development. Some surveys indicated that the public tended to give high scores to irregular stands with a mixture of trees of different sizes, but on the other hand, a feeling of accessibility and provision of a view was also very important. Large clear-cuts and obvious traces from forest operations were little appreciated. Trained foresters were more positive to clear-cuts than the general population. Few studies included virgin stands, and those that did mostly found low scores for unmanaged forests.

Preferences appeared to be fairly stable over time. Elderly or handicapped people, and children and young adolescents, were strongly under-represented in the surveys.

KEYWORDS: Aesthetics, Forest management, Recreation, Scenic beauty, Silviculture, Urban forestry

27. Hauru, K., Koskinen, S., Kotze, J.D., and Lehvavirta, S. 2014. The effects of decaying logs on the aesthetic experience and acceptability of urban forests—Implications for forest management. *Landscape and Urban Planning*, 123:114-123.

* Decaying logs and other dead wood are ecologically important in boreal and hemi-boreal forests. However, allowing the creation of logs in forests, especially in urban settings, is difficult without the acceptance of residents. As aesthetic appreciation has been suggested to influence the acceptance of natural environments, understanding how dead wood affects forest visitors' aesthetic experiences is important. This study involved an on-site survey where respondents observed three types of urban forest environments with old, fresh or no logs, and evaluated them in terms of their multisensory aesthetic experience and acceptability. Aesthetic experience and acceptability were measured using a multiple-scale questionnaire consisting of 27 statements that were hypothesized to load on different perceived components of aesthetic experience and acceptability. We tested the loading of statements on components by using factor analysis, and the effects of decaying logs on the aesthetic experience with ANOVA. Statements formed five aesthetic components that were termed coherence, aesthetic diversity, biodiversity, restorativeness and order, and one component reflecting acceptability of the site. Of these components, perceived coherence and order varied statistically significantly between sites with old, fresh and no logs. In general, sites with fresh logs were considered more aesthetically appealing than sites with old or no logs; however, the differences between sites were small.

Furthermore, respondents also accepted logs as natural features in urban forests in general, We recommend that downed logs be left in urban forests in places where they do not disturb recreational use, e.g. act as barriers along cycling and walking trails.

KEYWORDS: Coarse woody debris, Dead wood, Environmental aesthetics, Landscape preference, Urban woodlands

28. Hull, B.R., Robertson, P.D., Buhyoff, J.G., and Kendra, A. 2000. What are we hiding behind the visual buffer strip?: forest aesthetics reconsidered. Journal of Forestry, 98(7): 34-38.

* The forestry profession has no official policy on forest aesthetics: Neither foresters nor the public have clear guidelines as to what a socially acceptable, actively managed forest should look like. Hints of an implicit policy can be found in the Society of American Foresters (SAF) position statements on timber harvesting and in various recommendations for best management practices found in state, federal, and industrial forestry publications. These implicit policies may send a hypocritical message to the public about the practice, intent, and ethics of forestry.

KEYWORDS: Aesthetics, Ecological policies, Forestry, Society of American Foresters

29. Howley, P. 2011. Landscape aesthetics: Assessing the general public's preferences towards rural landscapes. Ecological Economics, 72:161-169.

* The central aim of this study was to gain greater insights into the factors that affect individuals' preferences for a variety of landscape settings. Using a nationally representative survey conducted in the summer of 2010 of 430 individuals living in Ireland, this paper derived dependent variables (based on a factor analysis of respondents mean ratings of 47 landscape images) representing 5 different landscape categories. These variables were then utilized in separate OLS regression models to examine the effect of personal characteristics, residential

location and environmental value orientations on landscape preferences. First in terms of visual amenity the results suggest that the general public have the strongest preference for landscapes with water related features as its dominant attribute which was followed by cultural landscapes. Second the results also demonstrate how there is significant heterogeneity in landscape preferences as both personal characteristics and environmental value orientations were found to strongly influence preferences for all the landscape types examined. Moreover the effect of these variables often differed significantly across the various landscape groupings. In terms of land use policy, given the diversity of preferences a one size fits all approach will not meet the general publics' needs and desires.

KEYWORDS: Environmental value orientations, Landscape preferences, Land use policy

30. Jorgensen, A. 2011. Beyond the view: Future directions in landscape aesthetics research. *Landscape and Urban Planning*, 100:353-355.

* The dominant view of landscape research in the latter half of the 20th century saw landscape aesthetics as a discrete area of study, a socio-cultural value detached from other considerations. This view was later challenged by proponents of ecological aesthetics, who countered that what makes landscapes beautiful is often intimately linked to other intrinsic landscape values, such as biodiversity, and that these other values can shift perceptions of how we perceive and appreciate the beauty of landscapes. At the same time, environmental psychologists and others wrestled with questions regarding the extent to which landscape aesthetics had a biological or cultural basis, and examined the impact of individual differences and life experiences. More recently landscape urbanism has reexamined the drivers of urban landscape change, prompting questions of whether landscape aesthetics should be abandoned in favor of landscape pragmatism and instrumentality. Furthermore, new understandings of how we might best sustain biological

diversity in the context of global climate change signal an end to the perceived biological status quo and the advent of aesthetics of necessity. This essay outlines these trends and explores their implications for researching landscape aesthetics.

KEYWORDS: Ecological, Landscape urbanism, Preference, Scenic, Theory

31. Jorgensen, S.B. and Stedman, C.R. 2001. Sense of place as an attitude: Lakeshore owners' attitudes toward their properties. *Journal of Environmental Psychology*, 21: 233-248.

* Existing attempts to measure Sense of Place (SOP) are open to a number of different interpretations, some of which are well established in attitude research. Attitude theory can provide a basis for conceiving of SOP as cognitive, affective and conative relationships with human environments. In this study, Sense of Place was defined as a multidimensional construct comprising: (1) beliefs about the relationship between self and place; (2) feelings toward the place; and (3) the behavioral exclusivity of the place in relation to alternatives. A 12-item SOP scale, consistent with a multidimensional theoretical prescription, was developed and subsequently tested in the field with a sample of lakeshore property owners in northern Wisconsin (n= 282). A number of measurement models based on attitude structure were posed as potential explanations of the scale's construct validity. Results suggested that the SOP scale measured a general Sense of Place dimension that gained expression in property owners' thoughts, feelings and behavioral commitments for their lakeshore properties. This general evaluative dimension was more explanatory of observed responses than were the three univariate dimensions having interpretations consistent with place identity, place attachment, and place dependence. The dominance of the SOP factor over the narrower dimensions was prevalent in three different measurement models that posited both general and specific factors. Future

research in this vein could be oriented towards reflecting the domains of attitude more closely, rather than being organized around the domains of sense of place as described in the literature.

KEYWORDS: Measurement models, Sense of place, Visual assessments

32. Kauffman, B.J. 2004. Death rides the forest: Perceptions of fire, land use, and ecological restoration of western forests. *Conservation Biology*, 18(4): 878-882.

* Large wild fires occurring in forests, grasslands, and chaparral in the last few years have aroused much public concern. Many have described these events as “catastrophes” that must be prevented through aggressive increases in forest thinning. Yet the real catastrophes are not the fires themselves but those land uses, in concert with fire-suppression policies that have resulted in dramatic alterations to ecosystem structure and composition. The first step in the restoration of biological diversity (forest health) of western landscapes must be to implement changes in those factors that have caused degradation or are preventing recovery. This includes changes in policies and practices that have resulted in the current state of wildland ecosystems. Restoration entails much more than simple structural modifications achieved through mechanical means. Restoration should be undertaken at landscape scales and must allow for the occurrence of dominant ecosystem processes, such as the natural fire regimes achieved through natural and/or prescribed fires at appropriate temporal and spatial scales.

KEYWORDS: Catastrophic wildfires, Forest restoration, Forest thinning, Fuel-hazard reduction, Prescribed fire, Wildfires, Wildland fire

33. Knapp, E. E., Schwilk, D. W., Kane, J. M., and Keeley, J. E. 2006. Role of burning season on initial understory vegetation response to prescribed fire in a mixed conifer forest. *Canadian Journal of Forest Research*, 37(1): 11-22.

* Although the majority of fires in the western United States historically occurred during the late summer or early fall when fuels were dry and plants were dormant or nearly so, early-season prescribed burns are often ignited when fuels are still moist and plants are actively growing. The purpose of this study was to determine if burn season influences postfire vegetation recovery. Replicated early-season burn, late-season burn, and unburned control units were established in a mixed conifer forest, and understory vegetation was evaluated before and after treatment. Vegetation generally recovered rapidly after prescribed burning. However, late-season burns resulted in a temporary but significant drop in cover and a decline in species richness at the 1 m² scale in the following year. For two of the several taxa that were negatively affected by burning, the reduction in frequency was greater after late-season than early-season burns. Early-season burns may have moderated the effect of fire by consuming less fuel and lessening the amount of soil heating. Our results suggest that, when burned under high fuel loading conditions, many plant species respond more strongly to differences in fire intensity and severity than to timing of the burn relative to stage of plant growth.

KEYWORDS: Fire burns, Prescribed fire, Understory vegetation, Wildland fires

34. Kohsaka, R. and Flitner, M. 2004. Exploring forest aesthetics using forestry photo contests: Case studies examining Japanese and German public preferences. Forest Policy and Economics, 6(3): 289-299.

* In sustainable forest management (SFM) forest organizations are required to communicate to the public to broaden the general understanding of their efforts in maintaining multiple forest service functions. Thus, there is a renewed interest in the scientific study of the perception and representation of forests. Forestry photo contests provide valuable resources to deepen the knowledge about 'images' from the perspective of laypeople. The paper aims to identify such

'icons' through a new methodology that involved examining group discussion dynamics based on using two sets of prize-winning pictures. The pictures were from Japanese and German photo contests with the common theme of 'forest/trees.' Data collected included sets of forest pictures from both cultures. Interviewees were asked to categorize the pictures. Results showed that images preferred differed greatly between Japan and Germany, indicating a difference in accepted forestry practices in the two cultures. In addition to these representational differences in 'icons', perception of German and Japanese groups differed in certain themes.

KEYWORDS: Forest aesthetics, Germany, Group interview, Japan, Photo contest, Public relations

35. Lim, S. S., Innes, L. J., and Meitner, M. 2015. Public awareness of aesthetic and other forest values associated with sustainable forest management: A cross-cultural comparison among the public in four countries. Journal of Environmental Management, 150:243-249.

* Korea, China, Japan and Canada are all members of the Montreal Process (MP). However, there has been little comparative research on the public awareness of forest values within the framework of Sustainable Forest Management, not only between Asia and Canada, but also among these three Asian countries. This is true of aesthetic values, especially as the MP framework has no indicator for aesthetic values. We conducted surveys to identify similarities and differences in the perceptions of various forest values, including aesthetic values, between residents of the four countries: university student groups in Korea, China, Japan and Canada, as well as a more detailed assessment of the attitudes of Koreans by including two additional groups, Korean office workers, and Koreans living in Canada. A multivariate analysis of variance test across the four university student groups revealed significant differences in the

rating of six forest functions out of 31. However the same test across the three Korean groups indicated no significant differences indicating higher confidence in generalizability of our university student comparisons. For the forest aesthetic values, an analysis of variance test showed no significant differences across all groups. The forest aesthetic value was rated 6.95 to 7.98 (out of 10.0) depending on the group and rated relatively highly among ten social values across all the groups. Thurstone scale rankings and relative distances of six major forest values indicated that climate change control was ranked as the highest priority and scenic beauty was ranked the lowest by all groups. Comparison tests of the frequencies of preferred major forest values revealed no significant differences across the groups with the exception of the Japanese group. These results suggest that public awareness of aesthetic and other forest values are not clearly correlated with the cultural backgrounds of the individuals, and the Korean university students' awareness could potentially be representative of the Koreans general public's opinion. We expect this research to contribute to the development of aesthetic and social indicators, and to expect this research to contribute to the development of aesthetic and social indicators, and to the enhancement of balancing social with environmental and economic values within the SFM framework.

KEYWORDS: Cross-cultural comparison, Forest aesthetic indicator, Public awareness, Social forest value, Sustainable forest management

36. Leopold, A. 1949. A Sand County Almanac and Sketches Here and There. Oxford University Press, Oxford, 226 p.

*First published in 1949, Aldo Leopold; A Sand County Almanac is an established environmental classic. Beginning with a beautifully written description of the seasonal changes in nature and their effect on the delicate ecological balance, the book proceeds to examples of

man's destructive interference and concludes with a plea for a Wilderness esthetic that is even more urgent and timely today than ever before.

KEYWORDS: Aesthetical view, Conservation aesthetics, Ecology, Land ethic, Scenic beauty

37. Loomis, B.J., Bair, S.L., and Caban, G. A. 2001. Prescribed Fire and Public Support. Journal of Forestry, 99(11): 18-22.

* Florida residents' knowledge of and attitudes toward wild and prescribed fire were elicited before and after receiving educational information. The results indicate that Florida residents exhibit knowledge and tolerance of prescribed fire similar to respondents of past surveys. Florida residents are less tolerant of wildfire than residents in past surveys but hold similar knowledge scores concerning wildfire. Respondents became more knowledgeable and tolerant of prescribed fire after the introduction of educational information.

KEYWORDS: Communication, Education, Public relations

38. Lorimer, G.C. 1984. Methodological considerations in the analysis of forest disturbance history. Canadian Journal of Forest Research, 15:200-213.

* A number of nondestructive techniques for analyzing the timing, frequency, and magnitude of natural disturbances in forest stands are discussed in this paper. Intensive age determination of trees is desirable for reconstructing forest disturbance history, but age distribution alone is not always a sufficient basis for a disturbance chronology. Frequently all-aged forests have undergone severe past disturbance which cannot be readily identified from the distribution of trees among age-classes. Radial growth patterns provide more direct evidence of past canopy tree deaths. In cases where a large sample of tree ages and growth records is not feasible, structural attributes of forests can provide valuable supplementary evidence. Evidence of the effects of

disturbance history and age structure on diameter distributions and diameter distributions of non-suppressed trees potentially appear to be more reliable structural indicators of past canopy disturbance than simple size distributions. For regional studies of disturbance frequency, random dispersal of medium to large plots across large landscape units is recommended as a sample design.

KEYWORDS: Chronology, Distribution history, Forest disturbance history

39. Lothian, A. 1999. Landscape and the philosophy of aesthetics: is landscape quality inherent in the landscape or in the eye of the beholder? *Landscape and Urban Planning*, 44: 177-198.

* The paper proposes that landscape quality assessment may be approached on the basis of two contrasting paradigms, one which regards quality as inherent in the physical landscape, and the other which regards quality as a product of the mind-eye of the beholder. These are termed, respectively, the objectivist and subjectivist paradigms. These paradigms underlie the surveys of the physical landscape and studies of observer preferences. Examination of these paradigms through the approaches taken by philosophers from Plato to modern times demonstrates the ubiquity of the paradigms in underlying human perception of landscape. Until recent centuries, the objectivist paradigm provided philosophers with the basis for understanding beauty, including landscape beauty. However, the philosophers Locke, Hume, Burke and particularly Immanuel Kant identified beauty as lying in the eyes of the beholder rather than in the object. The parallels between Kant's aesthetic philosophy and contemporary theories of landscape quality based on an evolutionary perspective are examined. Most philosophers over recent centuries have adopted the subjectivist view of aesthetics. The paper concludes by proposing that only the subjectivist model should be used in research of landscape quality.

KEYWORDS: Kant, Landscape perception paradigms, Landscape theory, Philosophy of aesthetics

40. McCaffrey, Sarah M. 2006. Prescribed fire: What influences public approval?. In: Dickinson, Matthew B., ed. 2006. Fire in eastern oak forests: delivering science to land managers, proceedings of a conference; 2005 November 15-17; Columbus, OH. Gen. Tech. Rep. NRS-P-1. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 192-198.

* Except in remote areas, most prescribed fires will have some effect on members of the public. It is therefore important for land managers to work with the public before, during, and after a prescribed burn. To do this effectively, managers need to have an accurate idea of what people do and do not think about prescribed fire and they need to understand what shapes those opinions. This paper summarizes findings from recent research studies on the social acceptability of prescribed burns and identifies the key factors that people consider in forming their opinions of prescribed fire. Results indicate that there is a fairly high level of public acceptance for use of prescribed fire and that smoke, concerns about escape, and trust are key issues shaping that support. In addition, there is a clear link between understanding of the purpose and intended benefits of prescribed fire and approval of its use. The lesson for managers who wish to introduce prescribed fire in their communities is that they are most likely to gain public support if they: 1) increase familiarity with the practice; and 2) work to build trust between officials from the implementing agency and the public.

KEYWORDS: Aesthetical views, Prescribed fire, Public perception

41. Mitchell, R. J., Hiers, J. K., O'Brien, J. J., Jack, S. B., and Engstrom, R. T. 2006. Silviculture that sustains: the nexus between silviculture, frequent prescribed fire, and

conservation of biodiversity in longleaf pine forests of the southeastern United States.

Canadian Journal of Forest Research, 36(11): 2724-2736.

* The longleaf pine (*Pinus palustris* Mill.) forest ecosystems of the US southeastern Coastal Plain, among the most biologically diverse ecosystems in North America, originally covered over 24×10^6 ha but now occupy less than 5% of their original extent. The key factor for sustaining their high levels of diversity is the frequent application of prescribed fire uninterrupted in time and space. Pine fuels, critical to application of fire and regulated by canopy distribution, provide the nexus between silviculture and fire management in this system. Typical silvicultural approaches for this type were, in large part, developed to maximize the establishment and growth of regeneration as well as growth and yield of timber, with much less regard to how those practices might influence the ability to sustain prescribed burning regimes or the associated biodiversity. However, many landholdings in the region now include conservation of biodiversity as a primary objective with sustained timber yield as an important but secondary goal. This review synthesizes the literature related to controls of biodiversity for longleaf pine ecosystems, and silvicultural approaches are compared in their ability to sustain natural disturbance such as fire and how closely they mimic the variation, patterns, and processes of natural disturbance regimes while allowing for regeneration.

KEYWORDS: Conservation biology, Frequent burning, Prescribed fire

42. Ostergren, M.D., Abrams, B.J., and Lowe, A.K. 2008. Fire in the Forest: Public perceptions of ecological restoration in north-central Arizona. Ecological Restoration, 26(1): 51-60.

* In recent years residents of the intermontane West have experienced a series of expensive and high-profile fire seasons. One result is that the concept of ecological restoration has moved

squarely into public view. As scientists and practitioners continue to refine the definition of ecological restoration as a practical matter, citizens are forming their own perceptions of how restoration should be applied to local forests. We used a recent public opinion survey in north-central Arizona to assess public views of restoration. Our findings indicate broad support for restoration although portions of the population, particularly those in rural areas, see restoration primarily as a means to protect human lives and property from fire. Most importantly, our findings suggest that a majority of the public in this region have a view of restoration beyond fire risk reduction, but vary in their willingness to accept dramatic changes to forest conditions.

KEYWORDS: Arizona, Fire, Ponderosa pine, Public opinion, Restoration

43. Orland, B. 1994. Visualization techniques for incorporation in forest planning geographic information systems. *Landscape and Urban Planning*, 30:83-97.

* Visual representations are increasingly used to communicate the impacts of environmental changes. Geographic information systems (GISs) are becoming common sources of the spatially organized data needed to create valid and defensible visualizations. However, these data lack the detail and richness needed to create the realistic imagery felt to be critical for public review. This paper describes exploratory studies in the application of techniques drawn from remote sensing and applied to ground-level photographic images of sensitive locations to achieve realistic images with demonstrable relationships to an underlying GIS. Digital filtering and image sampling processes have been used to simulate the visual consequences of forest pests, of timber management activities, of forest wildfires, and of recovery from all of these impacts. The resulting images have been used to communicate expected outcomes to participants in policy-development settings, and to initiate the development of public perception models relating

impacts to public preferences. Although integration of these techniques with GIS systems has not yet been achieved, the necessary development steps are outlined in this paper.

KEYWORDS: Forest planning, GIS, Visualization

44. Outcalt, K. W. 2000. The longleaf pine ecosystem of the South. *Native Plants Journal*, 1(1): 42-53.

* Longleaf pine (*Pinus palustris* P. Mill. [*Pinaceae*]) was once the most prevalent pine type in the southern US. Stands of longleaf were also habitat for a vast array of plant species. Decades of timber harvest followed by conversion to agriculture, urban development, or to other pine species, have reduced longleaf dominated areas to less than 5% of its original range. My paper discusses the habitat and history of this once vast resource, outlining its key role as an integral part of native plant communities. I also focus on the more recent recognition of the ecological importance of longleaf pine ecosystems. This appreciation, along with advances in technology and additional information, are combining to reverse the long-term trend and should help ensure that longleaf communities remain as a viable and valuable part of the South's heritage.

KEYWORDS: Bluestem, Fire, Restoration, Wiregrass

45. Palmer, F.J. 2008. The perceived scenic effects of clearcutting in the White Mountains of New Hampshire, USA. *Journal of Environmental Management*, 89: 167-183.

* The scenic effects of clear-cutting have been a volatile issue for the American public for much of the past century. A better understanding of the scenic perceptions associated with the cumulative visible effects of clear-cutting should contribute to better decisions about its use. This study evaluates the scenic impacts of simulated alternative clear-cutting management systems for the White Mountain National Forest. Alternatives represented an unharvested view, and views with removal of 1–5% of the timber every 12 years using either scattered or concentrated clearcut

units of 5, 15 and 30 acres in two view/sheds. A random sample of local citizens, four groups of opinion leaders, and US Forest Service employees evaluated these alternatives. Each factor accounts for significant differences in scenic value. All groups rated the scenic value of unharvested scenes very high. All groups find a large drop in scenic value with the introduction of even the least intense harvesting activity. All groups indicated a statistically significant decrease in visual quality as the intensity of harvesting increases. This effect continues throughout the range of harvesting intensities until the level of sustainable yield is reached. In addition, patches 12–15 acres in size were preferred to larger and smaller ones.

KEYWORDS: Clearcutting, Forest aesthetics, Forest management, Landscape perception

46. Panagopoulos, T. 2009. Linking forestry, sustainability and aesthetics. *Ecological Economics*, 68: 2485-2489.

* In forest planning, little research has been devoted towards examining how visual-impact assessment can improve the public acceptance of forest activities and augment forest sustainability. The objective of the present work is to review the methods of aesthetic assessment of forest landscapes, which will help the implementation of visual-impact assessment in sustainable forestry. From the numerous techniques of landscape evaluation that have been devised in recent years, the expert approach techniques have dominated in environmental management practices and the perception-based approach in research. The non-market economic valuation techniques are essentially trade-off methods and not aesthetic assessments by themselves. Revealed preference methods, such as hedonic-price, use actual market choices of individuals to get their preferences towards non-market attributes, and stated preference methods, such as contingent valuation method, rely on surveys to get directly the individual's willingness to pay for the non-market attributes. Psychophysical preference modeling is a

popular quantitative holistic technique of landscape evaluation and if used in combination with indirect aesthetic evaluation methods might create new standards and protocols for techniques of objectively estimating public perception of aesthetic quality and thus to enhance social sustainability in forest space.

KEYWORDS: Environmental perception, Forest aesthetics, Landscape assessment, Social sustainability, Visual resource management

47. Ribe, R. G., Armstrong, E. T., and Gobster, P. H. 2002. Scenic vistas and the changing policy landscape: visualizing and testing the role of visual resources in ecosystem management. Landscape Journal, 21(1): 42-66.

* The Northwest Forest Plan applies a shift in policy to national forests in the U.S. Pacific Northwest, with implications for other public landscapes. This shift offers potentially strong scenic implications for areas that have historically emphasized clearcutting with little visual impact mitigation. These areas will now emphasize biocentric concerns and harvests formed accordingly. Public perceptions of a simulation of this landscape transformation indicate that it offers to improve the beauty of large vistas. Changes in small vistas and harvests nearer to viewers will still require visual management. Implications for policy stability and the management of forest aesthetics are discussed.

KEYWORDS: Ecosystem management, Scenic vista, Visualization

48. Ribeiro, C.M.S. and Lovett, A. 2011. Is an attractive forest also considered well managed? Public preferences for forest cover and stand structure across a rural/urban gradient in northern Portugal. Forest Policy and Economics, 13: 46-54.

* There is an extensive body of empirical research focusing on public preferences for forest landscapes. However, it is also recognized that visually appealing landscapes may not be

ecologically healthy and these differences may cause tensions as indirect ecosystem services become an increasingly important focus for forest management. This study used a questionnaire survey to investigate the extent to which public preferences for characteristics such as forest cover and stand structure varied when framed in terms of attractiveness or good management objectives. The research took place in northern Portugal and also examined the implications of using verbal prompts or visual stimuli (e.g. photographs) as means of eliciting preferences. Key results from the study were: 1) public preferences regarding forest cover and stand structure do not, in general, differ under attractiveness and management criteria, 2) there were statistically significant differences in preferences for forest cover and stand structure amongst user groups 3) because ground cover vegetation was not regarded as attractive or good then strategies for future whole catchment management may face some tension, and 4) there were some inconsistencies identified in the preferences derived from verbal prompts and visual stimuli. By contrasting preferences for attractiveness and management criteria the research presents a simple quantitative approach that provides a basis for interventions through design or knowledge exchange to help align aesthetic and ecological goals. However, it also suggests that research approaches able to provide a deeper engagement with the public regarding the indirect ecosystem services from forests via qualitative approaches such as focus groups and incentive mechanisms are likely to be important.

KEYWORDS: Ecosystem services, Forest attractiveness, Forest management, Portugal, User preferences, Visual prompts

49. Rideout, S., Oswald, P.B., and Legg, H.M. 2003. Ecological, political and social challenges of prescribed fire restoration in east Texas pineywoods ecosystems: a case study. *Forestry*, 76(2): 261-269.

* The effectiveness of prescribed fire restoration of forested sites in three state parks in east Texas, USA was studied. Two sites consisted of mixed shortleaf (*Pinus echinata* Mill.) or loblolly pine (*Pinus taeda* L.) and broadleaf overstory. The third site was a longleaf pine (*Pinus palustris* Mill.)/little bluestem (*Schizachyrium scoparium* (Michx.) Nash.) stand. Mid- and understory at all sites consisted of a variety of shrubs and herbaceous vegetation. Prolonged drought resulting in county burn bans prohibited burning until immediately after rain events. Results indicated no effect from the burns in the overstory, seedling, shrub or herbaceous layers at any park. At two sites, there was a significant increase in the percentage of dead standing saplings in the burn plots from pre- to post-burn. The only significant decreases in fuels were in the weight and depth of combined Oi and Oe horizons (litter). Compliance with burn bans greatly reduced the restorative powers of the burns. Park visitors' attitudes concerning fire were also examined, indicating a need for education concerning differences between wildfire and prescribed fire, and benefits of prescribed fire.

KEYWORDS: Ecosystems, Longleaf pine, Prescribed fire restoration

50. Sheppard, R.J.S. and Meitner, M. 2005. Using multi-criteria analysis and visualisation for sustainable forest management planning with stakeholder groups. *Forest Ecology and Management*, 207: 171-187.

* While there is an increasing demand for active public involvement in forestry decision-making, there are as yet few successful models for achieving this in the new sustainable forest management (SFM) context. This paper describes the special needs of forest managers conducting participatory SFM planning in a sometimes-polarized public context, and outlines criteria for designing decision-support processes to meet these needs. These criteria were used to develop a new approach to public participation in British Columbia, by means of a pilot study

using multi-criteria analysis of forest management scenarios while integrating public priorities. Researchers, working with stakeholder groups in the Arrow Forest District, obtained public weightings of criteria and indicators for SFM. Alternative forest management scenarios were presented using realistic 3D landscape visualizations. Modeling-based expert evaluations of the scenarios were weighted according to the priorities of the stakeholder groups, in order to test implications for scenario preferences. There was considerable commonality of results among groups, with general agreement between experts and stakeholder groups on scenario preferences. Based on the results and participant evaluations, techniques such as this appear effective as decision-support tools in conflict-prone areas. Pilot studies like these can play a vital role in developing a more comprehensive, engaging, open and accountable process to support informed and socially acceptable decision-making for sustainable forest management.

KEYWORDS: Criteria and indicators, Decision-support systems, Forest management plans, Multi-criteria analysis, Participatory decision support, Public involvement, Sustainable forest management, Visualization

51. Sheppard, S. R., Achiam, C., and D'Eon, R. G. 2004. Aesthetics: are we neglecting a critical issue in certification for sustainable forest management? *Journal of Forestry*, 102(5): 6-11.

* Current forest certification programs may be neglecting aesthetics and related public perception and acceptance issues, concentrating on more easily quantified socioeconomic and ecological criteria. Because aesthetics is an important value for forest users, and to avoid potential conflicts between certification status and public perception, we suggest that forests should be certified for aesthetic performance. Current forest certification programs weakly address aesthetics, if at all. Those systems that do consider aesthetics tend to be procedural rather

than outcomes-based and generally do not encourage solid or consistent approaches to the problem. Visual resource management approaches provide some precedents that are not as yet widely used in certification, but they also have their limitations. We recommend that more effort be put into developing more robust indicators for aesthetics as part of certification programs.

KEYWORDS: Environmental management, Forest, Forest management, Forest resources, Forestry, Forestry research, Forestry science, Natural resource management, Natural resources, Public perceptions, Third-party certification

52. Smardon, R.C. 1988. Perception and aesthetics of the urban environment: Review of the role of vegetation. *Landscape and Urban Planning*, 15: 85-106.

* This paper is a review of the role that urban vegetation plays in regard to human behavior and the perception of urban environments. This includes a review of the functions or benefits of urban vegetation to human use-economic benefits, instrumental or physiological functions and perceptual functions including visual, sensory benefits and symbolic aspects. The second part of the paper reviews the roles of urban vegetation in performing these various functions at different environmental scales and in different contexts. Finally, there is a review of means to assess change in the quality of urban vegetation in the environment as well as using vegetation to improve urban environmental perceptual quality.

KEYWORDS: Perception and aesthetics, Urban planning, Visual assessments

53. Stainback, G. A., and Alavalapati, J. R. 2004. Restoring longleaf pine through silvopasture practices: an economic analysis. *Forest Policy and Economics*, 6(3): 371-378.

* The longleaf pine ecosystem is one of the most biologically diverse in North America, supporting hundreds of plant and animal species. Because of its timber and many non-timber benefits, there is strong interest among forestry professionals, conservation groups, and the

public at large in restoring longleaf pine ecosystems. However, many landowners are reluctant to grow longleaf pine on their lands on a commercial basis because the economic returns from longleaf pine timber production are usually less than those of slash pine. In this study, we develop a model that determines the profitability of longleaf and slash pine timber production after consideration of carbon sequestration, habitat for the endangered red-cockaded woodpecker, and other amenity benefits. Results suggest that internalizing carbon sequestration benefits and red-cockaded woodpecker habitat benefits alone is not enough for landowners to switch from slash pine to longleaf. Additional payments of \$16 to 33 per ha per year, reflecting extra amenity benefits associated with longleaf pine relative to slash pine, make longleaf production financially competitive. Incentives that reflect carbon, biodiversity, and amenity benefits associated with longleaf production may be the optimal way of restoring longleaf pine ecosystems on rural private lands in the US South.

KEYWORDS: Biodiversity, Carbon sequestration, Habitat restoration, Longleaf pine, Red-cockaded woodpecker

54. Steelman, A.T. and McCaffrey, M.S. 2011. What is more flexible fire management—public or agency pressure? *Journal of Forestry*, 109(8): 454-461.

* Conventional wisdom within American federal fire management agencies suggests that external influence such as community or political pressure for aggressive suppression are key factors circumscribing the ability to execute less aggressive fire management strategies. Thus, a better understanding of external constraints on fire management options is essential. This entails validating or refuting the perceptions of fire managers about the relative constraints that external pressures place on their ability to implement more flexible fire management options. In the summer of 2008, our research team traveled to two fires—the Gap in California and Gunbarrel in

Wyoming—each of which used a different strategy for managing the fire. At each site, we interviewed key agency individuals and asked them about internal and external factors that influenced their fire management decisions. We also interviewed community members to understand whether they sought to influence fire management. Internal factors included procedural requirements and agency beliefs and attitudes. External factors included political and community pressures from the public who are often perceived to demand an aggressive suppression response. This article details how these internal and external factors influence flexibility in fire management. Our findings did not wholly support conventional wisdom and suggest that internal pressures are as important as external pressure in shaping fire management strategy.

KEYWORDS: Community pressure, Fire management, Fire suppression, Political pressure, Wildfire costs, Wildfire policy

55. Tahvanainen, L., Tyrvainen, L., Ihalainen, M., Vuorela, N., and Kolehmainen, O. 2001. Forest management and public perceptions- visual versus verbal information. *Landscape and Urban Planning*, 53: 53-70.

* Forest and landscape management measures have impacts on the amenity value of forests. People may have certain attitudes towards management, in particular near urban areas. The aim of this study was to evaluate the impacts on scenic beauty and recreational value of five different management practices: small clear cutting, thinning, removal of undergrowth, natural state, and traditionally managed cultural landscape. In order to compare visual perceptions with preconceptions, two evaluation methods, visual presentation (pictures produced by image-capture technology) and verbal questions were used. Scenic beauty and recreational value were assessed from slides in which management measures were presented by the pairwise comparison

technique. The results indicate that scenic beauty and recreational preferences differ considerably from each other. In the study areas, small clear cuttings had the most positive effect on scenic beauty and natural state had most positive effect on recreational value. Furthermore, preconceptions concerning different silvicultural measures did not consistently correspond to perceptions based on the assessment of visual images. This fact supports the use of visual presentation methods in future preference studies as well as in participatory forest planning projects.

KEYWORDS: Amenity values, Forest recreation, Landscape planning, Scenic beauty, Visualization

56. Toman, E., Shindler, B., and Reed, M. 2004. Prescribed Fire: The influence of site visits on citizen attitudes. Journal of Environmental Education, 35(3): 13-17.

** This research highlighted the importance of site visits on public preference of prescribed fire management. Questionnaires were mailed to interviewees to compare results with prior survey responses. Survey questions were developed to assess public perception of forest management practices and gauge concerns related to site applications. The results of the study pointed out that perception was not different based on survey methods. However, signs of management and reduced fuel levels were treatments most often supported by respondents.

KEYWORDS: Attitude, Public perception, Prescribed fire, Site visit

57. Tyrvaainen, L., Silvennoinen, H., and Kolehmainen, O. 2003. Ecological and aesthetic values in urban forest management. Urban Forestry and Urban Greening, 1: 135-149.

* In the planning processes of urban forests there are frequent conflicting opinions about the extent to which forests should be managed. On the one hand, management is needed to deal with the intensive use of forests, as well as unfavorable growing conditions, security factors and

aesthetic variables. On the other hand, there is an increasing demand for unmanaged areas which is based primarily on ecological arguments. This paper presents research that was conducted in connection with the participatory planning process of Helsinki City forests. The main aim of this research was to study whether aesthetic and ecological values can be combined in the management of urban forests. Furthermore, the stability of forest landscape preferences during the participatory planning process was studied, along with the representativeness of planning groups compared to larger user groups. The data was collected in planning group meetings and public hearings in Helsinki during 1998–2000. Respondents evaluated a set of photographs designed to cover the main conflict situations in urban forest management: Thinning, understory management, the leaving of dead snags and decaying ground-wood. These results show that the majority of residents in Helsinki prefer managed forests. The preferences are, however, closely connected to the background characteristics of respondents. Younger residents with a higher education and active urban forest users prefer more ecologically-oriented management when compared to older residents with less education, or less active users. The individuals had a rather clear and relatively stable opinion of what constitutes suitable management in urban forests, but the views differed considerably as a whole. This means that a participatory planning process will typically lead to some type of compromise. Moreover, the planning groups in Helsinki reflected the opinions of the larger user groups rather well. This indicates that the currently used participatory planning approach sufficiently integrates public values into its planning process.

KEYWORDS: Aesthetics, Ecology, Landscape preferences, Participatory planning, Urban forestry, Visualization

58. Ueda, H., Nakajima, T., Takayama, N., Petrova, E., Matsushima, H., Furuya, K., and Aoki, Y. 2012. Landscape image sketches of forests in Japan and Russia. Forest Policy and Economics, 19: 20-30.

* With increased economic and tourism interests in both Japan and Russia, culturally different meanings of ‘forest’ need to be understood for future cooperative environmental management. In this study, we propose Landscape Image Sketching Technique as an original, practical methodology to externalize an individual landscape image as a scene sketch aiming to represent the viewer's fundamental way of seeing the landscape. To discuss different perceptions and interpretations of forests in a cultural framework, we conducted cross-national research in Japan and Russia. A total of 325 respondents were asked to make a landscape image sketch of an imaginary forest and to include keywords and text. The sketches were analyzed by means of four aspects: ‘linguistic knowledge’, ‘spatial view’, ‘self-orientation’ and ‘social meaning’, which were represented by landscape elements, the shape of elements, the subject's standpoint and the combination of the elements in the framework. As a result, landscape image sketches revealed differences between respondents in Japan and Russia. The typical landscape images of a forest were represented objectively, as aesthetic scenery in Russia and subjectively, as a practical place in Japan. The results suggested a fundamental difference in ways of seeing the landscape through individual perceptions rather than normative views on forests. This methodology for visualizing ways of seeing a landscape can be useful in understanding different assumptions about environmental issues, not only for a global environmental discussion regarding each locality, but also for local environmental management and public participation.

KEYWORDS: Cultural difference, Landscape image sketching technique, Landscape image, Japan, Russia

59. Ulrich, S.R. 1986. Human responses to vegetation and landscapes. *Landscape and Urban Planning*, 13: 29-44.

* The rapidly expanding research record concerning aesthetic, emotional and physiological response to visual landscapes is summarized, with emphasis on aesthetic preferences for views containing trees and other vegetation. The survey is set within a conceptual perspective suggesting that affective responses such as aesthetic preference are central to a landscape observer's thoughts, conscious experience and behavior. Substantial progress has been made in developing models that relate aesthetic responses to specific visual properties of environments. When aesthetic preferences are compared for urban and unspectacular natural views, American and European adult groups evidence a strong tendency to prefer nature. However, liking for urban scenes usually increases when trees and other vegetation are present. Views of nature, compared to most urban scenes lacking natural elements such as trees, appear to have more positive influences on emotional and physiological states. The benefits of visual encounters with vegetation may be greatest for individuals experiencing stress or anxiety. Recent research demonstrates that responses to trees and other vegetation can be linked directly to health, and in turn related to economic benefits of visual quality.

KEYWORDS: Aesthetics, Human perception, Visual assessment, Vegetative evaluation

60. Valente, S., Coelho, C., Ribeiro, C., Liniger, H., Schwilch, G., Figueiredo, E., and Bachmann, F. 2015. How much management is enough? Stakeholder views on forest management in fire-prone areas in central Portugal. *Forest Policy and Economics*, 53:1-11.

* With the increasing pressure to improve the contribution of forests to help dealing with global changes, it is critical to understand the different perceptions of those involved in the forest. How do forest owners, managers and members of local communities who often depend on the forest,

value it and what are the problems affecting the forests in terms of being able to meet these new challenges? In Portugal, this task has taken on an even greater priority as more than 90% of the forest is private and forest management relies on the individual decisions of thousands of forest owners. To understand stakeholder views on forest and forest management, a transversal social perception survey was implemented in the form of a case study of central Portugal which included decision-makers, local technicians, forest owners and the general public. The results show that there is a consensus on the main issues affecting forests and forest management. A shift from classic forest owners to the emergence of indifferent forest owners was observed, although this shift has not been recognized by the forest owners in the survey, who maintain the individual management of their properties.

KEYWORDS: Forest fires, Forest management, Forest owners, Forest stake- holders, Perceptions

61. Wagner, G.R., Flynn, J., Gregory, R., Mertz, K.C., and Slovic, P. 1998. Acceptable practices in Ontario's forests: Differences between the public and forest professionals. *New Forests*, 16: 139-154.

* We compare and contrast survey responses to statements about 1) environmental values, 2) agreement with forest management goals and approaches, 3) perceptions of risk, 4) trust in science and government, and 5) acceptability of forestry practices between the public and three groups of forestry professionals (government biologists, government foresters, and industry foresters) in Ontario. The survey emphasized issues surrounding forest vegetation management due to the contentious nature of herbicide use. Responses were gathered from a 140-question telephone survey administered from September and November 1994 to 1,500 members of the general public and 201 forestry professionals across the province. Forestry professionals tended

to be less supportive of some environmental values and forest management goals, perceive everyday and forestry activities to be less risky, be more trusting of science and government, and be more accepting of forestry activities than the general public. Among the three groups of forestry professionals, industry foresters tended to be most different from the public, followed by government foresters, and government biologists. These differences reveal potential sources of conflict and miscommunication between the public and forest managers. Recognizing these differences can help improve communications with the public about forest management plans.

KEYWORDS: Conflict resolution, Environmental values, Forest management preferences, Herbicide alternatives, Public communication, Risk perceptions, Social acceptability, Trust

62. Winter, G. and Fried, S.J. 2000. Homeowner perspectives on fire hazard, responsibility, and management strategies at the wildland-urban interface. *Society and Natural Resources*, 13: 33-49.

* Following a survey of forest homeowners in rural Michigan to assess the value of reducing the risk of damage from wildfires at the wildland-urban interface, focus-group discussions were conducted with a subset of survey participants to learn about their perceptions concerning specific components of fire hazard (e.g., how fires start, fire control, fire damage), their understanding of how fire protection responsibility is allocated between government and individuals, and their understanding of and preferences for alternative fire management strategies. Focus-group data were analyzed using a framework based on behavioral economics and psychometric models of risk. Attributes associated with the fire risk help explain the relative popularity of different fire protection strategies. Because participants consider forest fires inherently uncontrollable, and the resulting damage essentially random, they are only weakly supportive of investments in firefighting infrastructure, unlikely to take all possible steps to

safeguard their own properties, and resolute in their emphasis on solutions that reduce the number of fire ignitions. Their universally negative perceptions of prescribed fire may ultimately preclude its use as a risk management tool in Michigan's wildland- urban interface forests.

KEYWORDS: Fire management, Fire prevention, Prescribed fire

63. Yang, D., Luo, T., Qiu, Q., and Luo, Y. 2014. Combining Aesthetic with Ecological Values for Landscape Sustainability. PLOS ONE 9(7): e102437. doi: 10.1371/journal.pone.0102437.

*Humans receive multiple benefits from various landscapes that foster ecological services and aesthetic attractiveness. In this study, a hybrid framework was proposed to evaluate ecological and aesthetic values of five landscape types in Houguanhu Region of central China. Data from the public aesthetic survey and professional ecological assessment were converted into a two-dimensional coordinate system and distribution maps of landscape values. Results showed that natural landscapes (i.e. water body and forest) contributed positively more to both aesthetic and ecological values than semi-natural and human-dominated landscapes (i.e. farmland and non-ecological land). The distribution maps of landscape values indicated that the aesthetic, ecological and integrated landscape values were significantly associated with landscape attributes and human active intensity. To combine aesthetic preferences with ecological services, the methods (i.e. field survey, landscape value coefficients, normalized method, a two-dimensional coordinate system, and landscape value distribution maps) were employed in landscape assessment. Our results could facilitate to identify the underlying structure-function-value chain, and also improve the understanding of multiple functions in landscape planning. The situation context could also be emphasized to bring ecological and aesthetic goals into better alignment.

KEYWORDS: Ecological values, Landscape sustainability, Public perceptions

64. Zube, E. H., Sell, J. L., and Taylor, J. G. 1982. Landscape perception: Research, application and theory. *Landscape Planning*, 9(1): 1-33

* Landscape perception research during the past two decades has responded to legislative mandates and landscape management, planning and design issues in a number of countries. It has also engaged the interests of individuals from a variety of disciplines and professions. This paper presents an analysis of the paradigms that have been followed in assessing perceived landscape values, and identifies the theoretical or conceptual bases which underlie these approaches. Four paradigms are identified from review of over 160 articles published in 20 journals during the period 1965-1980. Publications in each paradigm (expert, psychophysical, cognitive and experiential) are reviewed with reference to contributions to pragmatic landscape planning and management issues and to the evolution of a general theory of landscape perception. Trends in publications within the paradigms are indicated over time and by professional-disciplinary orientation. Overall, the absence of an explicit theoretical foundation is noted. Arguments in support of the development of a theoretical framework for landscape perception research are advanced and a proposed framework based on an interactive perception process is presented.

KEYWORDS: Landscape management, Landscape perception, Visual quality

Chapter 3

Examining the Relationship Between Prescribed Fire Management and Forest Aesthetics in Longleaf Pine (*Pinus palustris* Mill.) Forests

3.1 Introduction

Historic accounts state that longleaf pine (*Pinus palustris*) forests historically dominated much of the southern forest landscape, including Alabama. It is estimated that longleaf pine could be found on just over 50 percent of southern uplands, or about 36 million hectares (Frost 1993). These forests were often described as “park-like”, maintained by fire every 2-4 years that was the result of both natural and human-ignition. In the early 1900s southern woods fires were part of the culture and the ecosystem. This is not so today.

Increasingly, the general public is insulated from nature, with fewer individuals living in rural environments. In 1900, the United States Census Bureau estimated that over 60 percent of the U.S. population was considered “rural” (US Census 2010). This is in sharp contrast to today where it is estimated that only about 19 percent live in rural areas (US Census 2010). For example, between the 2000 and 2010 census, almost half of Alabama’s counties showed population loss, with notable losses in the rural counties of the Black Belt. Almost half of the state’s population (49 percent) is now located in four major metropolitan areas. Also, prescribed fire was frequently used in longleaf pine forests. Has this shift in population dynamics caused a perceptible change in the way that the public relates to and perceives the natural environment and especially the use of prescribed fire in longleaf pine forests?

One way that we may better understand public perceptions of land management activities such as prescribed fire management is through the public perception assessments of scenic beauty and forest aesthetics. There have been many studies (Kauffman 2004; Loomis et al. 2001; Ostergen et al. 2008) which focused on public perceptions of ecological restoration, specifically fire management in the North, West, and southeastern U.S. Loblolly (*Pinus taeda*) and shortleaf (*Pinus echinata*) pine forests were examined with regard to forest aesthetics (Ray 1994; Gan and Miller 2001), yet longleaf pine is one notable exception in the literature. Most commonly these studies sought to understand public opinion around how forest management practices such as prescribed fire might influence perceptions of forest structure or scenic vistas. However, a gap remains in understanding relationships between forest aesthetics and frequent fire management, specifically the influence of prescribed fire management on longleaf pine forests including various seasons and timing of burns. Therefore, in this study, we aimed to expand upon the work of public attributes through the evaluation of scenic beauty and aesthetic values of longleaf pine. The second purpose of this research was to improve our understanding of how prescribed fire management in longleaf pine forests are perceived by public with regard to forest aesthetics and scenic beauty assessment.

3.2 Aesthetic theory and the origins of scenic beauty assessments

Aesthetic theory has been defined as *"a logically vain attempt to define what cannot be defined, to state the necessary and sufficient properties of that which has no necessary and sufficient properties, to conceive the concept of art as closed when its very use reveals and demands its openness"* (Weitz 1956). Santayana (1904) described aesthetics as the expression of the various forms of appreciation, intuition, or imaginative analysis. According to Kant's aesthetics and judgements theory, aesthetic judgement is comprised of feelings such as pleasure

and displeasure. There are three different types of aesthetic judgement; the agreeable, the beautiful, and the sublime (Stanford Encyclopedia of Philosophy 2013). Public preference of landscape aesthetics is also defined by Sheppard and Meitner (2005:7) as “*the degree to which a person or group prefers a situation or feature over other situations or features*”. Also, public preference is the fundamental approach of assessment of aesthetic quality and scenic beauty of the landscapes (Calvarho and Lovett 2011).

The term "landscape" was first used in order to abstract pictorial representations of ecosystems in the sixteenth century (Shepard 2003). During the romantic and transcendentalist movements of the mid-1800s obstacles in accessibility and understanding of nature started to diminish (Gobster 1996). Landscape art became more popular during mid-1800s as people in the US were widely attracted to natural landscapes. Rocks, water, flora and fauna were considered the most substantial elements of nature and were therefore the primary aesthetic features in these landscape art images. In mid-19th century Europe and North America, where the term "picturesque" originated, there was an increased emphasis on creating environments with different landscape forms and arrangements (Ellison 2014). Nash (1967) supported the idea that aesthetic preferences primarily originated from 19th century artists and writers who conveyed the combinations of the sublime and picturesque. Modern artists from 20th century promoted contemporary arts and design in landscape aesthetics and as a result many US National Parks, ecology preserves, and ecosystems around the world have been influenced by the picturesque design features (Carr 2007). As a result, over the last 40 years there have been numerous studies such as those by Kaplan and Kaplan (1989) and Ellison (2014) that report that people-landscape interaction is influenced primarily by aesthetics causing an increased interest in visual resource management.

Modern forest aesthetics research began the 1960s (Purcell et al. 2001). Some of the earliest work was completed by Daniel and Boster (1976) using the Scenic Beauty Estimation (SBE) model to obtain perception rankings on scenic beauty of vistas. They also defined SBE as a psychophysical method which tests subjects scoring the visual quality of photographs of forest stands that have been measured on-site by forest management techniques. In the application of SBE model, rating scales can be used to evaluate observers' perception preferences of the different forest scenes, and these scales are effective and widely-accepted means of recording perceptual preferences (Ray 1994).

The judgements made by a number of observers provide the scenic beauty values for different landscape scenes. The criterion component of the SBE model is also applied by set of values to test the perceived scenic beauty dimension. These criterion values are also used during the judgement situation of the scenic beauty of landscapes. During the evaluation process of forested scenes, each observer expresses his own judgement of landscape beauty by a numerical rating such as 1 (extremely low scenic beauty) to 10 (extremely high scenic beauty) (Daniel and Boster 1976). In addition, to analyze visual quality as a compatible way of scaling process, RMRATE was commonly used to correlate rating judgements of scenic beauty estimation method (Daniel and Boster 1976, Ray 1994).

Since those early studies, the assessment of forest aesthetics has continued incorporating components such as landscape biodiversity and human-landscape interactions (Kalidindi, et al. 1996, Daniel and Meitner 2001, Frank et al. 2013, Pierskalla et al. 2016). For example, Kalidindi, et al. (1996) reported that public experience along with the characteristics of the scene such as color, size of the plants, and ground cover influenced landscape-level visual quality assessments. Specifically they found that less plant cover and increased visual depth in an image

was considered as high scenic beauty, where a high density of foliage in the understory and small diameter stems were defined as low scenic beauty landscapes (Kalidindi et al. 1996). According to Frank et al. (2013), landscape aesthetics and its effects on human well-being have gained a momentum due to increase in public perceptions of scenic beauty. There are also several interests such as economic benefits, relative abundance of plant species, and scenic beauty which are balanced because of the relationship between landscape aesthetics and public preference (Blaschke 2006).

3.3 Environmental Design

Involvement of environment to design and planning is a significant contribution that enables professionals develop more sustainable communities and forested landscapes (Steiner et al. 2013). Environmental design can be defined by Krasner (2013:3) as *"the planning of a coherent program and set of procedures to effect the total human and nonhuman environment in ways that increase the probability that certain goals of needs will be achieved."* The main objective of environmental design is also relevant with social behavior such as perception of aesthetics, and it applies the empirically derived principles of social behavior to the landscapes and public involvement. Moreover, the human concept is one of the most important components of environmental design and it consists of explicit assumptions about the nature of humanity (Zube et al. 1982). Visual appearance of the landscape is also another important factor that influences the environmental design because the majority of the public judge environment based on what they observe and what is seen in the landscape (Twiss 1969). Therefore, understanding the interactions between public, nature, and the design plays a significant role to implement environmental design concept.

Environmental design can provide more accurate location to landscape planning and homeowners (Twiss 1969). Location of the landscape affects the human perception of environment and design by using the observers' position, landscape form, spatial definition, light, and sequence (Burton 1968). Another important factor effecting the perception of a landscape is the distance of observers to the scene of a landscape (Burton 1968). In designing a sustainable landscape, distance to the landscape is divided into three zones, foreground, middleground, and background zones which establish an optimum proportion between the scale of the landscape and distance from the view point of observers (Burton 1968). Moreover, there are three main methods of designing an aesthetic forest scene, such as integrating forest management practices with other resources and products, justification for land use decisions, and improving the relationship between landowners and forest managers (Daniel and Boster 1976). Thus, understanding the factors effecting the perception of landscape can positively impact the contribution of design and planning in an aesthetical environment.

3.4 Prescribed Fire Management and Longleaf Pine (*Pinus Palustris* Mill.) Forests

Fire was once a common disturbance in numerous ecologically important ecosystems. Bartram (1791:52), an early traveler through the Southeast, described forested communities this way “*This plain is mostly a forest of the great long-leaved pine (P. palustris Linn.), the earth covered with grass, interspersed with an infinite variety of herbaceous plants, and embellished with extensive savannahs, always green, sparkling with ponds of water...*”. The landscape that Bartram and early settlers encountered was largely the result of the frequent, low intensity, non-lethal fires that swept through the pre-settlement (Mattoon 1922, Chapman 1932, Kush et al. 1999).

Recently-developed models suggest that prior to the 1800s large areas of the United States burned multiple times a decade (Guyette et al. 2012). In the southeastern U.S., Virginia to Texas, experienced the most frequent fire return interval (FRI), possibly as short as every 1.5 – 4.0 years (Frost 2006; Guyette et al. 2012). An important result of these very short FRIs was to create and maintain an open tree canopy with a diverse herbaceous ground layer (van Lear et al. 2005). These fires were ignited by a combination of lightning strikes (Komarek 1974) and aboriginal burning (Robbins and Myers 1992). The frequent fire had an incredible impact on the flora. Within frequently burned communities, there may be more than 50 plant species existing in a single square meter (Frost 1993; Peet and Allard 1993; Mitchell and Duncan 2009).

However, Peet and Allard (1993) stated that suppression of fires has substantially increased the woody understory vegetation. The longleaf pine ecosystem is primarily connected with frequent fire which prominently helps to control understory composition (Frost 1993; Outcalt 2000; Barlow et al. 2010). Suppression of frequent fire has significantly decreased the stand maintenance of longleaf pine stands (Frost 1993). In the past, the identity of longleaf pine forests were defined by the existence of frequent fire which vigorously affected the flora and abated forest alterations for centuries (Chapman 1932). According to Glitzenstein et al. (1996), fire regimes in the Southeast can importantly affect the vegetative distribution and stand dynamics. They also indicated that fire frequency, fire intensity, and season of burning can be important factors for sustainability of longleaf pine ecosystems. Lack of fire on this landscape has contributed to a loss of longleaf pine forests due to increased woody understory vegetation growth (Frost 1993; Peet and Allard 1993; Outcalt 2000; Barlow et al. 2010).

In addition to fire frequency, season of burn can have an impact on resulting vegetation and forest structure. Growing season fires which typically occur in the spring months of March

through May while dormant season or winter fires typically occur in December through February (Boyer 1990). In general, growing season fires tend to promote growth of longleaf pine forests as they are more efficient than dormant season fires in terms of controlling hardwoods and promoting natural biodiversity (Boyer 1990; Brockway and Lewis 1997). Growing season fires can also increase the fire-dependant species richness. For instance, Sparks et al. (1998) compared the impacts of late dormant-season and late growing season prescribed fire on herbaceous species in shortleaf pine grassland and found that total forb and legume abundance increased following growing season fires.

3.5 Project objectives

The objective of this study was to assess the perceived scenic beauty of photographic images depicting longleaf pine stands managed under different timings and seasons of prescribed fire. The images were assessed by survey participants who were students from the disciplines of Biology, Economics, Fine Arts, Forestry, and "Others" at Auburn University to distinguish the differences of scenic beauty assessment among these survey groups.

3.6 Methods

3.6.1 Photographic inventory

The survey photographs used in this study were taken at the Escambia Experimental Forest (EEF) in Escambia County, Alabama in 2015. The EEF was established in 1947 on 1,214 hectare area to research the longleaf pine ecology (Adams et al. 2003). The original study was initiated in 1984 on the EEF to examine the impact of winter and spring burns on longleaf pine stands along with the four FRIs. Plots used in this current study were 0.1 acre in size with approximately 40 crop trees thinned for fairly uniform spacing at project initiation (Boyer 1990). There are three treatment blocks in close proximity to each other. Prescribed fires were initiated

on the plots in the winter and spring 1985 and the areas have been burned on 2-, 3-, and 5-year intervals since that time. Winter fires were performed in January/February while spring fires were usually in April/May. Flank or strip head fires were used to minimize crown scorch and were often set following soaking rains, fine fuel moisture of 7-10%, relative humidity 35-55%, and steady winds. The study also has no-burn check plots.

The photographs of the study area were taken at the corner of each treatment plot by focusing on the foreground and middle-ground forest scenes. A tripod-mounted digital SLR camera was used to take the photographs by setting up the camera over the plot corners at the average viewer's height (1.7m) (Figure 3.1). The photographs of each composition were taken by turning the camera approximately 30 degrees to derive a successful representation of the view in-situ. Per each corner of the plots, there were at least 10 photographs taken by adjusting the elevation angle using lines in the viewfinder (close to 1/3 down from the top of the frame). To reduce the occurrence of noise in the photographs, an ISO of 800 or lower degree was used (Craft 2015). The sampling method of photographs was derived from Daniel and Schroeder (1979). Time, date, plot number, corner number, and other associated information were recorded to be used in selection of the survey photographs.

3.6.2 Perceptual Preferences of Respondents

The photographs derived from different FRIs of longleaf pine forest were analyzed by the School of Forestry and Wildlife Sciences and Department of Art faculty members at Auburn University to select slides for the best quality images, exposure, the trueness of their colors, and general clarity. Each photograph was then selected based on the best representation of the study area and distracting elements such as tree numbers were eliminated to minimize bias. Then eight photographs representing the most accurate visualization of each treatment were chosen based on

prescribed fire treatment type: Spring 2 years, Spring 3 years, Spring 5 years, Winter 2 years, Winter 3 years, Winter 5 years and no burn.

A by-slide method of analysis (Daniel and Boster 1976; Clay and Daniel 2000) was used to examine the perceptual differences of each photograph, and the photographs were presented to a total of 115 students (n=115) from a cross-section of disciplines: Forestry (19 students), Biology (11 students), Fine Arts (19 students), Economics (8 students), and "Others" (58 students) at Auburn University, Auburn, Alabama, USA. The "Others" discipline consists of students from various backgrounds and does not include Forestry, Biology, Fine Arts, and Economics.

Each survey group was tested individually using same set of photographs. Images were projected on a screen for 6 seconds with an automatic transition to allow for rating between transitions of photographs. Respondents were asked to rate each image on a scale of 1-10 based on the perception of the images scenic beauty where a 1 indicated very low scenic beauty and a 10 represented a very high scenic beauty (Daniel and Boster 1976; Clay and Daniel 2000).

After viewing 56 pictures, each participant was asked to fill out a follow-up survey which included questions such as participants' educational background and demographics. The demographic questions consist of information such as individuals' gender and hometown location (suburban, urban, and rural), and general knowledge of forest management and prescribed fire (Appendix-A).

3.6.3 Data Analysis

Results of visual preference surveys were analyzed using the RMRATE rating data software to derive SBE scores (Daniel and Boster 1976; Brown and Daniel 1990; Ray 1994). In the SBE method, each stimulus is ranked based on condition of interest, then each category was

converted to a Z score (as a reference to standard normal distribution). In order to eliminate biases of SBE analysis, the baseline-adjusted Z-Score procedure was applied on the survey data.

In this analysis, the procedure computes standard scores as:

$$SBE_i = (MZ_i - BMMZ)100$$

Where SBE_i is SBE of stimulus i , MZ_i is the mean Z of stimulus i , and BMMZ is the mean Zs of the baseline stimuli. For each survey group, each 4th stimulus was used as a baseline during the SBE calculation process. Then, stimuli were calculated based on these baseline categories for each survey group (Daniel and Boster 1976; Ray 1994).

Duncan's multiple range test is generally used to estimate the relationship between two or more variables (Cruz 2013). In this study, Duncan's test was used to examine the potential relationship among the following variables:

- the survey participants' SBE ratings for 7 different FRIs and disciplines of individuals,
- the SBE ratings of individuals, the disciplines, and gender,
- the SBE ratings of individuals, the disciplines, and hometown locations (urban, rural and suburban)
- the SBE ratings of individuals, the disciplines, and knowledge of forestry by survey participants (1 to 10 point scale).

For the other survey questions, a percentile distribution was calculated based on each survey group's responses.

3.7 Results

Previous studies have shown that individuals tend to rate scenes similarly regardless of their background interest when forest aesthetics and perceptual estimates are considered (Daniel and Boster 1976; Ray 1994). In fact, survey groups of this study consisting of 5 different

disciplines were expected to rank the photographs similarly, within each group and among the disciplines. Mean SBE scores associated with seven different FRIs that were viewed by the survey groups are shown in Table 3.1.

Mean SBE scores suggested that excluding the Fine Arts discipline, the groups had similar perceptions such as higher SBE scores and approval of images of more frequent FRI treatment such as Spring 2 and Winter 2 years. The most frequent burning treatment received the highest visual quality ratings overall, but no burn treatment had the highest mean SBE score ranked by Fine Arts discipline. As the frequency of prescribed fire management decreases, the perception of the scenic quality also decreases for all disciplines, except Fine Arts (Figure 3.2).

Considering the gender of individuals from all survey disciplines, females ranked the survey photographs at 7.99 mean SBE score, while males ranked the same photographs at 14.5 mean SBE score. Also, survey photographs were ranked at 8.34 mean SBE score overall by individuals living in suburban areas, whereas individuals living in urban and rural areas rated the photographs at 15.42 and 15.22 mean SBE scores, respectively. Overall, women appeared to perceive survey photographs as having lower levels of visual quality than men, and participants living in urban and rural areas perceived higher scenic quality of survey photographs than individuals living in suburban areas. Other survey questions and responses of survey participants by disciplines were given in Appendix-B.

3.7.1 Results by Disciplines

3.7.1.1 Forestry

The members in Forestry perceived the most frequent fire treatments with higher mean SBE scores than less frequent treatments. For example, Spring 2 and Winter 2 years FRI treatments received the highest SBE scores at 97.7 and 84.77, respectively (Table 3.1). Also, the

survey ratings showed that there was a positive relationship between mean SBE scores and frequency of fire for this discipline of students. Individuals of this discipline rated no burn photographs with the lowest mean SBE score at -130.58 (Table 3.1). Regarding the survey questions, all of the individuals in this group responded that forest fires are always good and 95 percent of them stated that they have heard of prescribed fire before. Just over 52 percent of the respondents answered that their family actively manages the forest land they own. Moreover, 84 percent of the individuals from this discipline responded that a forest's beauty is associated with beautifulness and usefulness (See Appendix-B).

3.7.1.2 Biology

The visual quality responses of Biology students suggested that the most frequent FRI treatments (Spring 2 and Winter 2 years) received the highest mean SBE scores at 97.73 and 87.14, respectively (Table 3.1). Also, the survey ratings showed that there was a positive relationship between mean SBE scores and frequency of fire for this discipline of students. Individuals of this discipline rated no burn photographs with the lowest mean SBE score at -131.52 (Table 3.1). Based on the survey question responses, all of the individuals in this discipline responded that forest fires are always good and 82 percent of the individuals stated that they have heard of prescribed fire before. In addition, 64 percent of the individuals responded that a forest's beauty is associated with naturalness, and 81 percent answered that a forest's beauty is associated with usefulness (See Appendix-B).

3.7.1.3 Economics

The members of Economics discipline perceived the most frequent FRI treatments with higher mean SBE scores (Table 3.1). The survey ratings showed that there was a positive relationship between mean SBE scores and frequency of fire for these students. Students rated no

burn photographs with the lowest mean SBE score at -125.82 (Table 3.1). Based on the survey questions, all of the participants responded that forest fires are always good and they have heard of prescribed fire before. Moreover, 75 percent of the individuals stated that the forest land they know of is actively being managed. Also, 88 percent responded that forest beauty is associated with naturalness, and 50 percent answered that a forest beauty is also associated with usefulness (See Appendix-B).

3.7.1.4 Others

The visual quality responses of students in "Others" found the most frequent FRI, Spring 2 and Winter 2 years, received the highest mean SBE scores at 80.23 and 67.23, respectively (Table 3.1). The survey rankings also showed that there was a positive relationship between mean SBE scores and frequency of fire treatment for this discipline of students. Individuals of this discipline rated no burn photographs with the lowest mean SBE score at -116.08 (Table 3.1). Based on participants' survey responses, all of the individuals in this group responded that forest fires are always good and 90 percent stated that they have heard of prescribed fire before. Also, 53 percent of the respondents answered that their family owns forested land, yet 62 percent of the individuals responded that their family not actively manage the forest. Moreover, 88 percent of the individuals responded that a forest's beauty is associated with beautifulness and 57 percent of the individuals answered a forest's beauty is associated with usefulness (See Appendix-B).

3.7.1.5 Fine Arts

In contrast to the other groups, the members of Fine Arts discipline perceived the no burn treatment with the highest mean SBE score at 64.06 (Table 3.1). The survey rankings also demonstrated that there was not any relationship found between mean SBE scores and frequency of fire treatment for Fine Arts students. Survey responses also suggested that 95 percent of the

participants thought forest fires are always good, and 74 percent of them stated that they have heard of prescribed fire management before. Moreover, 79 percent of the participants responded that a forest's beauty is associated with naturalness, yet 58 percent of the individuals stated that a forest's beauty is not associated with usefulness (See Appendix-B).

3.7.2 Comparison of Survey Disciplines

The results showed that SBE scores of survey participants ranged from -46.11 and 51.15 for the 7 different FRI groups. The lowest SBE rating was from the Fine Arts discipline, and the highest was from “Others” (Figure 3.2). There was a positive relationship between FRI and SBE ratings of Forestry, Biology, Economics, and “Others” survey groups. For these groups, Spring-2 years and Winter-2 years prescribed fire management had the highest SBE rating, whereas no burn photographs were ranked with the lowest rating (Figure 3.3-a,b,c,d). In contrast to these survey groups, SBE results of Fine Arts survey group had an opposite view of the frequency of prescribed fire. They ranked the no burn photographs with the highest rating score, and there was not any relationship found between FRI and SBE rating scores (Figure 3.3-e). Therefore, SBE analysis results showed that excluding Fine Arts survey group, there was a positive relationship between the frequency of fire and SBE approval of survey groups (Figure 3.3-f).

Furthermore, for all survey groups, Duncan's test results showed that SBE ratings of Spring-2, 3, Winter 2 and Winter3 years FRI groups were not significantly different from each other. Also, Winter-3, 5 and Spring-5 years were perceived similar to each other. However, photographs with no burn FRI were perceived significantly different than other FRI groups (Table 3.2). Considering disciplines of individuals, SBE ratings of participants from Economics, Biology, Forestry, and “Others” were not significantly different among each other. However, Fine Arts was different from the rest in the perception of photographs of seven FRI groups

(Table 3.3). Duncan's test results were consistent with the findings of SBE analysis in which we found a positive relationship with the frequency of fire and SBE approval of disciplines of survey respondents. One exception was that mean SBE rating of participants from the Fine Arts discipline had an opposite view of the increase in frequency of FRIs.

The responses of questions associated with the gender, hometown location, and knowledge of forestry of participants showed that based on the gender of individuals, participants in Biology, Economics, Forestry, and "Others" were not significantly different in relation to their SBE scores, whereas mean SBE score of Fine Arts students was different from the other survey groups (Table 3.4). Also, there was a significant difference between mean SBE scores of Fine Arts and Biology students based on their hometown location, and participants in Economics, Forestry, and "Others" disciplines had similar SBE ratings (Table 3.5). Moreover, based on the ratings of "knowledge of forestry" question, Biology, Economics, and Forestry students were not significantly different in mean SBE scores, but were different from mean SBE ratings of Fine Arts and "Others" (Table 3.6). The results of gender, hometown location, and "knowledge of forestry" survey question responses showed that participants in Fine Arts had a significantly different mean SBE score from the rest of disciplines.

3.8 Discussion

In this study, we compared the influence of prescribed fire treatments on the perceived scenic beauty of longleaf pine stands in South Alabama. Survey participants were chosen of students from various disciplines such as Biology, Economics, Fine Arts, Forestry, and "Others" to distinguish the differences of scenic beauty assessment among these survey groups. In order to create a relationship between how people perceive forest aesthetics of prescribed fire interval and season in longleaf pine forest, we examined the photos assessed by the survey participants using

SBE analysis to see if there is a trend related to the impact of prescribed fire on scenic beauty and diversification in visual appearance of longleaf pine stands, and to determine the correlation between aesthetics and fire treatments through a visual assessment survey. Based on our findings, there was a positive relationship between seven different FRI and SBE scores of Forestry, Biology, Economics, and “Others” survey groups. Further, only Fine Arts had an opposite view of the frequency of fire and its perception based on SBE rankings of survey photographs.

Based on the Duncan's Test results, we found that SBE ratings of Spring-2, 3 and Winter-2 years FRI were not significantly different from each other. This is probably due to the fact that more frequent fires have a similar impact on understory vegetation and participants did not perceive them images as having different levels of scenic beauty. Moreover, photographs with no burn FRI were perceived significantly different than other FRI groups which shows that the majority of survey participants have preferred frequently burned longleaf pine sites in contrast to absence of fire. Our observations were consistent with Carvalho-Ribeiro and Lovett (2011)'s study which examined the public preference of fire as a forest management strategy using photographic inventory and questionnaires in pine forests. They concluded that prescribed fire management photographs had the highest appreciation and ratings as a management method in pine forests. Moreover, Blanchard and Ryan (2006) used a similar surveying method on residents and landowners to assess the public's perception on usage of fire hazard reduction strategies such as prescribed fire management. They found that respondents with higher rates of knowledge about prescribed fire had a higher level of support for its application, and there was a substantial increase in the support for involving the public in fire management.

Considering the disciplines of survey participants, we found that SBE ratings from Economics, Biology, Forestry, and “Others” were not significantly different, but respondents from Fine Arts were different from the rest in the perception of photographs of seven FRI groups (Table 3.3). Also, the responses of questions associated with the gender, hometown location, and knowledge of forestry of participants showed that based on the gender, participants in Biology, Economics, Forestry, and “Others” were not significantly different in relation to their SBE scores, whereas mean SBE score of Fine Arts students was different from them. This suggests that there may be a positive relationship between the knowledge of forestry and the SBE score of more frequent fire photographs because specifically Fine Arts students had the highest SBE scores for the photographs of absence of fire, and they also ranked with the lowest rate of knowledge of forestry (Figure 3.3-e; Table 3.6). As a result, SBE analysis results showed that excluding Fine Arts, there was a positive relationship between the frequency of fire and SBE ratings of survey groups (Figure 3.3-f).

Furthermore, other studies (Kauffman 2004; Toman et al. 2004; Steelman and McCaffrey 2011) have suggested that prescribed fire management is essential in conservation of forested ecosystems and restoration of forested landscapes is highly associated with public acceptance and participation. Our findings have shown that there may be a positive relationship between knowledge of forestry and approval of prescribed fire management in longleaf pine ecosystems. In addition, we also assume that the public can have higher approval of more frequent FRI landscapes if they are informed about the scenic beauty of longleaf pine forests and significance of frequent prescribed fire management. Among our survey participants, the majority of Fine Arts students responded that a forest's beauty is associated with naturalness in contrast to usefulness. This may suggest that survey participants of Fine Arts perceived longleaf pine stands

in the absence of fire as natural because they consider forest management activities such as prescribed fire is not associated with naturalness of longleaf pine forests.

However, fire is natural and a substantial process which has also been maintained for longleaf pine forests and their sustainability. Our findings were also consistent with Bell and Oliveras's (2006) study which examined the relationship between perception of prescribed burning and public acceptance in a local forest in Australia and found that participants thought absence of fire is natural and lack of knowledge about prescribed burning can negatively affect the scenic beauty perception of forestlands which are frequently burned. Another study by Rideout et al. (2003) examined the perception of effects of prescribed fire management on pine forest lands in Texas. They found that the majority of survey participants believe wildfire and prescribed fire are the same, and there was a substantial need for education concerning the positive impacts of prescribed fire management on longleaf pine scenic beauty. Therefore, the public may consider longleaf pine forests in the absence of burning as natural because of a lack of knowledge about prescribed fire management and its application on longleaf pine forests.

3.9 Conclusion

This research has revealed that understanding the process of frequent prescribed fire management plays an important role in public perception of forest aesthetics for different FRI groups applied to longleaf pine forests. In the absence of fire, hardwoods and shrubs invade these forests, limiting forest growth and regeneration. Natural resource Extension educators and technical service providers should use the results of this study to target fire-based education events that improve public perception of prescribed fire and its positive outcomes. The results of this study can also be used to increase the awareness of the role fire plays in managing forest

aesthetics in longleaf pine ecosystems in addition to wildlife habitat, investment, and recreation (Way 2011).

Public land managers may be uncertain about the use of prescribe fire as a land management tool due to fear of negative public attitudes (Winter and Fried 2000). Results from this current study can be used to help land managers understand the need for public support for fire management practices such as prescribed fire management, especially among the segments of the population that may be less familiar with the practice (Winter and Fried 2000). From this perspective, conducting surveys with public participants can enhance the perception of prescribed fire and how it stimulates the aesthetic view of longleaf pine forests.

While it is widely believed that forest aesthetics and forest management practices, such as prescribed fire, are separate subjects, there is a potential relationship between post-fire landscape views and the process of frequent fire over time. This research has shown that public perception of post-fire conditions on natural landscapes can be weighted differently by observers depending on their knowledge of forestry, their hometown location, and how they perceive natural landscapes. Further public surveys can be also conducted with public landowners and forest managers to identify roles of knowledge of forestry and education in the awareness of prescribed fire management and its association with forest aesthetics.

Furthermore, results of this study may be used to raise awareness with forestland owners and local agencies about the importance of fire in longleaf pine forests and incorporate management practices from a landscape perspective. There is a potential for future collaboration on prescribed fire management and forest aesthetics such as The Longleaf Alliance and Alabama Cooperative Extension Service (ACES). These programs provide beneficial information in consideration of sustainability of longleaf pine ecosystems, fire treatment and benefits education

for forest landowners, implementing longleaf pine initiative, restoration and conservation. Additionally, NRCS provides Environmental Quality Incentives Program (EQIP) Working Lands for Wildfire (WLFW) and technical assistance on maintaining habitat by providing technical guidance. Alabama's Longleaf Ecosystem Restoration Team also provides technical assistance for managing longleaf pine ecosystems as a long term goal of the project.

3.10 References

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Table 3.1. Visual perception comparisons of mean SBE scores for seven different FRIs by five student survey groups evaluated by students at Auburn University, Auburn, Alabama in 2016 (FRI: Fire Return Interval, SBE: Scenic Beauty Estimation).

	Economics	Biology	Forestry	"Others"	Fine Arts
FRI Groups	Mean SBE	Mean SBE	Mean SBE	Mean SBE	Mean SBE
Spring 2 years	108.2	97.73	97.7	80.23	-25.33
Spring 3 years	66.04	55.73	54.42	51.87	36.65
Spring 5 years	0.42	5.50	2.64	-9.03	-60.12
Winter 2 years	79.82	87.14	84.77	67.23	-40.52
Winter 3 years	53.81	40.5	39.9	41.95	21.67
Winter 5 years	-14.61	8.00	-14.72	8.09	-56.84
No Burn	-125.82	-131.52	-130.58	-116.08	64.06

Table 3.2 Duncan's multiple range test results between mean SBE scores of FRI survey photographs of longleaf pine stands evaluated by students at Auburn University, Auburn, Alabama in 2016 (FRI: Fire Return Interval, SBE: Scenic Beauty Estimation).

Waller Grouping*	Mean SBE	N	FRI**
A	71.71	5	Spring 2
A	55.69	5	Winter 2
A	52.94	5	Spring 3
B	39.57	5	Winter 3
B	-12.12	5	Spring 5
B	-14.02	5	Winter 5
C	-87.99	5	No Burn
		F Value 4.42	Pr > F 0.0014

*Means with the same letter are not significantly different, **Spring 2: Prescribed fire every 2 years in Spring, Winter 2: Prescribed fire every 2 years in Winter, Spring 3: Prescribed fire every 3 years in Spring, Winter 3: Prescribed fire every 3 years in Winter, Spring 5: Prescribed fire every 5 years in Spring, Winter 5: Prescribed fire every 5 years in Winter, No Burn: Absence of fire)

Table 3.3. Duncan's multiple range test results between mean SBE scores of 7 different FRIs and 5 different survey groups of students at Auburn University, Auburn, Alabama in 2016 (FRI: Fire Return Interval, SBE: Scenic Beauty Estimation).

Waller Grouping*	Mean SBE	N	Discipline**
A	23.98	7	E
A	23.30	7	Bi
A	19.16	7	F
A	17.75	7	O
B	-8.63	7	FA
		F Value	Pr > F
		6.99	0.002

*Means with the same letter are not significantly different, **E: Economics, Bi: Biology, F: Forestry, O: "Others", and FA: Fine Arts disciplines).

Table 3.4. Duncan's multiple range test results between mean SBE scores of 5 different survey groups of students and gender of these students at Auburn University, Auburn, Alabama in 2016 (SBE: Scenic Beauty Estimation)

Waller Grouping*	Mean SBE	Number of Females	Number of Males	N	Discipline**
A	19.795	3	8	11	Bi
B	18.486	3	5	8	E
B	18.095	3	16	19	F
B	11.704	17	41	58	O
B	3.743	15	4	19	FA
				F Value	Pr > F
				2.43	0.0473

*Means with the same letter are not significantly different, **E: Economics, Bi: Biology, F: Forestry, O: "Others", and FA: Fine Arts disciplines.

Table 3.5. Duncan's multiple range test results between mean SBE scores of 5 different survey groups of students and settlement information (Suburban, Urban, and Rural) of these students at Auburn University, Auburn, Alabama (SBE: Scenic Beauty Estimation).

Waller Grouping*	Mean SBE	Suburban	Urban	Rural	N	Discipline**
A	19.795	4	0	7	11	Bi
B	18.486	2	0	6	8	E
B	18.095	7	0	12	19	F
B	11.704	26	2	30	58	O
B	3.743	12	2	5	19	FA
					F Value	Pr > F
					2.03	0.0684

*Means with the same letter are not significantly different, **E: Economics, Bi: Biology, F: Forestry, O: "Others", and FA: Fine Arts disciplines.

Table 3.6. Duncan's multiple range test results between mean SBE scores of 5 different survey groups of students and knowledge of forestry (rating from 1 to 10) of these students at Auburn University, Auburn, Alabama in 2016 (SBE: Scenic Beauty Estimation).

Duncan Grouping*	Mean SBE	Knowledge of Forestry	N	Discipline**
	A	19.795	6.36	11 Bi
	A	18.486	4.55	8 E
	A	18.095	7.2	19 F
B	A	11.704	4.63	58 O
B		3.743	3.52	19 FA
			F Value	Pr > F
			2.50	0.0459

*Means with the same letter are not significantly different, **E: Economics, Bi: Biology, F: Forestry, O: "Others", and FA: Fine Arts disciplines.

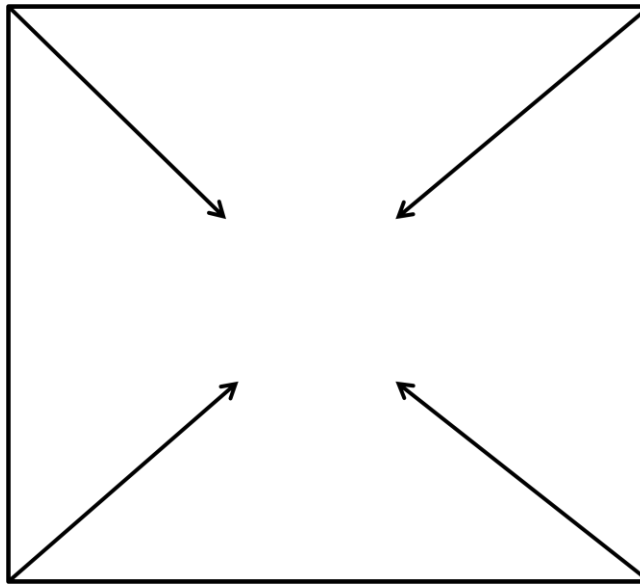


Figure.3.1. The illustration of photograph-taking method at each plot in study area. Each photograph was taken from the corner of each plot by looking into the center of the plot.



Figure.3.2 The distribution of Scenic Beauty Estimation (SBE) rating scores of survey photographs and disciplines of survey groups (1: Biology, 2: Economics, 3: Fine Arts, 4: Forestry, and 5: "Others").

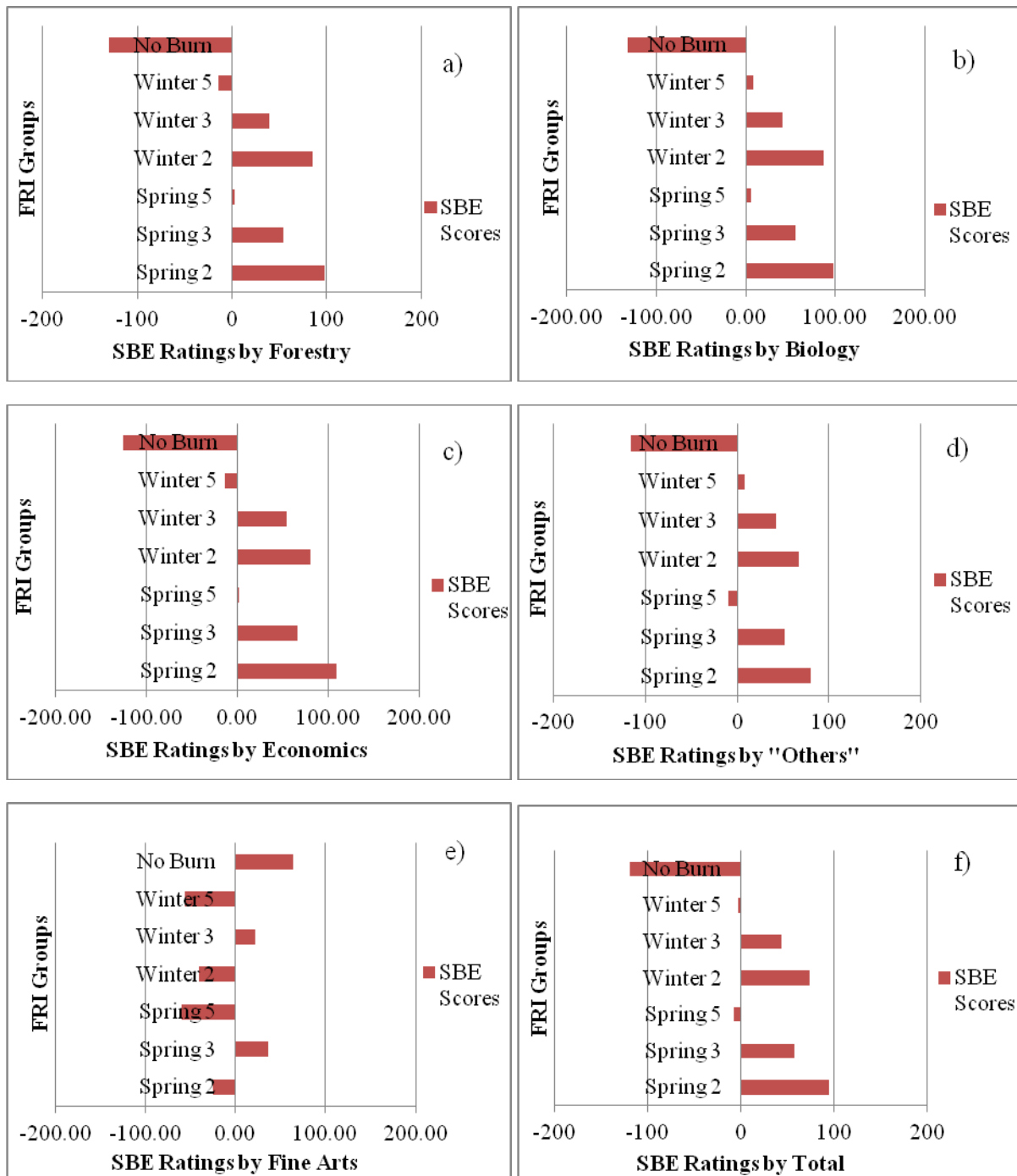


Figure.3.3. The relationship between 7 different Fire Return Interval (FRI) groups and Scenic Beauty Estimation (SBE) scores of photographs rated by the disciplines of a) forestry, b) biology, c) economics, d) "others", e) fine arts, and f) total SBE scores.

3.11 Appendix

3.11.1 Appendix-A

SURVEY SHEET

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE IF YOU WANT TO PARTICIPATE IN THIS RESEARCH PROJECT. IF YOU DECIDE TO PARTICIPATE, THE DATA YOU PROVIDE WILL SERVE AS YOUR AGREEMENT TO DO SO. THE LETTER PROVIDED IS YOURS TO KEEP.

During this session, you will be viewing 56 slides of forest scenes. Each slide will be shown for approximately 6 seconds. Please rate each slide for the visual quality or scenic beauty of each individual scene by circling a number on the scale for 1- 10, where 1 represents the lowest visual quality and 10 represents the highest visual quality. It is important that you rate each scene for its visual quality and not the quality of the photography.

EXAMPLE OF HOW TO MARK THE RATINGS

IMAGE #	RATING VALUE									
	LOW QUALITY					HIGH QUALITY				
1	1	2	3	4	5	6	7	8	9	10

Please circle the rating value for each photograph on a scale from 1-10 with 1 being the least beautiful and 10 being the most beautiful.

Practice images

IMAGE #	RATING VALUE									
	LOW QUALITY					HIGH QUALITY				
A	1	2	3	4	5	6	7	8	9	10
B	1	2	3	4	5	6	7	8	9	10
C	1	2	3	4	5	6	7	8	9	10
D	1	2	3	4	5	6	7	8	9	10

Please answer the following questions. These questions are optional.

1) What is your gender? (Please circle one)

Male Female

2) Do you consider yourself urban, suburban, or rural? _____

3) How would you rate your knowledge of forestry? (with 1 meaning you have almost no knowledge and 10 meaning you are a forestry professional)

1 2 3 4 5 6 7 8 9 10

Please circle either Yes or No as your response for each question below:

- | | |
|---|-----------|
| 4) Have you ever heard of longleaf pine? | Yes or No |
| 5) Can you identify longleaf pine as distinct from other pines? | Yes or No |
| 6) Do you think forest fires are always bad? | Yes or No |
| 7) Have you ever heard of prescribed fire? | Yes or No |
| 8) Do you or your family own forested land? | Yes or No |
| 9) If so, does the owner actively manage it? | Yes or No |
| 10) Do you camp and/or hike for recreation? | Yes or No |
| 11) Do you ever pay fees for camping/hiking areas? | Yes or No |
| 12) Would you pay a higher fee to recreate in more beautiful areas? | Yes or No |
| 13) Do you hunt for recreation? | Yes or No |
| 14) If so, do you pay for a hunting lease? | Yes or No |
| 15) Would you pay a higher fee to hunt in more beautiful areas? | Yes or No |
| 16) Do you think a forest's beauty is associated with "naturalness"? | Yes or No |
| 17) Do you think a forest's beauty is associated with being "old-growth"? | Yes or No |
| 18) Do you think a forest's beauty is associated with "usefulness"? | Yes or No |
| 19) Do you think a forest's beauty is associated with "fond memories"? | Yes or No |
| 20) Do you think a forest's beauty is relative to its location? | Yes or No |

3.11.2 Appendix-B

Survey Responses to Questions Between Question 4 (Have you ever heard of longleaf pine?) and Question 20 (Do you think a forest's beauty is relative to its location?) By Disciplines of Participants

Questions Q4-Q20	FINE ARTS		BIOLOGY		ECONOMICS		FORESTRY		"OTHERS"	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Q4) Have you ever heard of longleaf pine?										
YES	14	73.68	11	100	7	87.5	19	100	58	100
NO	5	26.32	0	0	1	12.5	0	0	0	0
Q5) Can you identify longleaf pine as distinct from other pines?										
YES	5	26.32	10	90.91	6	75	18	94.74	49	84.48
NO	14	73.68	1	9.09	2	25	1	5.26	9	15.52
Q6) Do you think forest fires are always bad?										
YES	1	5.26	0	0	0	0	0	0	0	0
NO	18	94.74	11	100	8	100	19	100	58	100
Q7) Have you ever heard of prescribed fire?										
YES	14	73.68	9	81.82	8	100	18	94.74	52	89.66
NO	5	26.32	2	18.18	0	0	1	5.26	6	10.34
Q8) Do you or your family own forested land?										
YES	11	57.89	7	63.64	2	25	12	63.16	39	67.24
NO	8	42.11	4	36.36	6	75	7	36.84	19	32.76
Q9) If so, does the owner actively manage it?										
YES	4	21.05	5	45.45	2	25	10	52.63	22	37.93
NO	15	78.95	6	54.55	6	75	9	47.37	36	62.07
Q10) Do you camp and/or hike for recreation?										
YES	14	73.68	9	81.82	8	100	17	89.47	53	91.38
NO	5	26.32	2	18.18	0	0	2	10.53	5	8.62
Q11) Do you ever pay fees for camping/hiking areas?										
YES	12	63.16	7	63.64	5	62.5	10	52.63	41	70.69
NO	7	36.84	4	36.36	3	37.5	9	47.37	17	29.31

Q12) Would you pay a higher fee to recreate in more beautiful areas?										
YES	14	73.68	10	90.91	8	100	17	89.47	50	86.21
NO	5	26.32	1	9.09	0	0	2	10.53	8	13.79
Q13) Do you hunt for recreation?										
YES	3	15.79	6	54.55	3	37.5	15	78.95	35	60.34
NO	16	84.21	5	45.45	5	62.5	4	21.05	23	39.66
Q14) If so, do you pay for a hunting lease?										
YES	2	10.53	4	36.36	2	25	8	42.11	21	36.21
NO	17	89.47	7	63.64	6	75	11	57.89	37	63.79
Q15) Would you pay a higher fee to hunt in more beautiful areas?										
YES	3	15.79	6	54.55	2	25	13	68.42	33	56.9
NO	16	84.21	5	45.45	6	75	6	31.58	25	43.1
Q16) Do you think a forest's beauty is associated with "naturalness"?										
YES	15	78.95	7	63.64	7	87.5	16	84.21	51	87.93
NO	4	21.05	4	36.36	1	12.5	3	15.79	7	12.07
Q17) Do you think a forest's beauty is associated with being "old-growth"?										
YES	17	89.47	10	90.91	7	87.5	16	84.21	48	82.76
NO	2	10.53	1	9.09	1	12.5	3	15.79	10	17.24
Q18) Do you think a forest's beauty is associated with "usefulness"?										
YES	8	42.11	9	81.82	4	50	16	84.21	33	56.9
NO	11	57.89	2	18.18	4	50	3	15.79	25	43.1
Q19) Do you think a forest's beauty is associated with "fond memories"?										
YES	16	84.21	9	81.82	8	100	18	94.74	51	87.93
NO	3	15.79	2	18.18	0	0	1	5.26	7	12.07
Q20) Do you think a forest's beauty is relative to its location?										
YES	12	63.16	8	72.73	4	50	9	47.37	44	75.86
NO	7	36.84	3	27.27	4	50	10	52.63	14	24.14

Chapter 4

Evaluating the Relationship Between Vegetative Composition and Forest Aesthetics of Prescribed Fire Management in Longleaf Pine (*Pinus palustris* Mill.) Forests

4.1 Introduction

Most of the forested lands in the southeastern United States were dominated by longleaf pine (*Pinus palustris* Mill.) as fire-maintained pine forests along the Gulf and Atlantic coastal plains, from eastern Texas north to southern Virginia and inland to the Piedmont to the mountain provinces of Alabama and Georgia (Schwarz 1907). Historically, two-thirds of the Southeast was once covered by longleaf pine communities at approximately 36 million ha which significantly declined to nearly 1.2 million ha land cover (Frost 1993). The longleaf pine forests were often described as “park-like” and maintained by natural and human-ignition fires every 2-4 years. Also, southern woods fires were also part of the culture and the ecosystem, nevertheless, there is a lack of understanding the positive outcomes of fire application today.

The public has been continuously insulated from nature in the United States (Brockway et al. 2006), and only about 19 percent of its residents live in rural areas (US Census 2010). More importantly, between the 2000 and 2010 census, there was a significant population loss in the rural counties of the state of Alabama which shifted to relocation in major metropolitan areas (US Census 2010). This prominent change can also lead to alterations in perception of natural environment, specifically, application of prescribed fire in longleaf pine forests as a natural management method.

4.1.1 Importance of Forest Aesthetics Assessments

Forest aesthetics can be defined as the application of the management practices that improve the visual quality of the forested landscapes (Purcell et al. 2001). Forest aesthetics and landscape preference have been studied since the 1960s, and scenic beauty of the landscapes is not only scientific, but also carried out as public interest (Purcell et al. 2001). Kalidindi et al. (1996) reported that the concept of scenic beauty can be a major component of landscapes because public experience of the visual appearance of landscapes has a significant effect on scenic beauty consideration. According to Frank et al. (2013), landscape aesthetics and its effects on human well-being have gained a momentum due to increase in importance of public perceptions of scenic beauty. There are also several interests such as energy production, economic benefits, relative abundance of plant species, and scenic beauty which are balanced because of the relationship between landscape aesthetics and public preference (Blaschke 2006). However, there have been few studies documented the relationship between longleaf pine forests and forest aesthetics considering application of prescribed fire in different seasons.

The judgment of scenic beauty of landscapes is highly associated with the opinion of observers, and forests are considered to have a positive effect on the psychological and physiological health of public (Chen et al. 2015). There has been an increase in the aesthetic assessment of landscapes, and there are two methods of aesthetic assessment, objective and subjective methods (Daniel and Boster 1976). Photographic surveys are considered a subjectivist method of assessment of scenic beauty, and photographs are used to determine the landscape quality of environmental components including forest lands (Daniel and Boster 1976). Also, photographic evaluations provide economical and efficient methods of visual evaluation (Zubelzu and del Campo 2014).

In the assessment process of forest aesthetics, Scenic Beauty Estimation (SBE) model was first applied by Daniel and Boster (1976) who involved the observers' perception rankings on scenic beauty of vistas. SBE is defined as a psychophysical method which tests subjects scoring the visual quality of photographs of forest stands that have been measured on-site by forest management techniques (Edwards et al. 2012). Moreover, the scenic beauty values of landscapes can be derived from different landscape scenes by participation of various observers and results of visual preference surveys can be analyzed using the RMRATE rating data software (Daniel and Boster 1976). The SBE method is considered as accurately depicting observers' perceptions of changes in a landscape and how they impact the scenic beauty (Ray 1994). Therefore, using software programs such as RMRATE can help assess the aesthetics of forests, how it is perceived by public, and significant outcomes of ecosystem management.

The judgements made by a number of observers provide the scenic beauty values for different landscape scenes. The criterion component of the SBE method is also applied by set of values to test the perceived scenic beauty dimension. These criterion values are also used during the judgement situation of the scenic beauty of landscapes. During the evaluation process of forested scenes, each observer expresses his own judgement of landscape beauty by a numerical rating such as 1 (extremely low scenic beauty) to 10 (extremely high scenic beauty) (Daniel and Boster 1976).

4.1.2 Factors That Influence the Scenic Beauty Estimation

Scenic beauty of a landscape is mainly affected by characteristics of the scene such as color, size of the plants, and ground cover (Daniel and Boster 1976). In fact, less plant cover and increased visual depth in an image is considered as high scenic beauty, where thin trees with high density of foliage understory and small diameter stems are defined as low scenic beauty

landscapes (Kalidindi et al. 1996). People prefer mostly mature forest stands with clear visibility and understory, and a green field layer, in contrast, direct traces of tree cutting and logging residues have negative effect on scenic beauty preference of public (Silvennoinen et al. 2002; Ribe 2009; Tyrvaïnen 2016).

Several studies reported basal area and tree density can influence the preference of scenic beauty. For instance, Arthur (1977) applied a physical feature model to ponderosa pine stands with variable tree density, and concluded that higher densities of ponderosa pine tree in stand had a positive impact on scenic beauty preference. Also, Vodak et al. (1985) claimed that there was a positive and significant relationship between SBE and basal area of forest stands. Another study by Rudis et al. (1988) found that there was a positive relationship between pine stand density and scenic value of the landscape in east Texas. Hoffman and Palmer (1996) additionally asserted that forest measurements and silvicultural methods have a significant impact on understanding the fundamental concepts of forest aesthetics and scenic beauty.

Regenerating forested stand using the shelterwood or seedtree methods are generally thought more picturesque than open regeneration landscapes (Silvennoinen et al. 2002; Ribe 2009; Tyrvaïnen 2016). Ribe (2009) additionally claimed that SBE can also impact cognitive judgments of timber harvests' preference, and the frequency of harvests along with economic benefits. More importantly, there is a lack of understanding if there is an optimal tree density which influences the scenic quality approval of a landscape by public (Schroeder and Green 1985). Therefore, in this study, we assumed that tree measurements, specifically basal area and tree density of longleaf pine forests can influence estimation of scenic beauty and public perception of scenic beauty towards forest management practices such as prescribed fire applications.

Forest management activities play a substantial role in understanding scenic beauty and public perception. The characteristics of landscape and scenic beauty are generally influenced by the appearance of vegetation, and seasonal change may lead positive public perceptions of forest stands (Ahas et al. 2005). Tyrvaïnen et al. (2016) reported that natural conservation activities such as protection of native forests have decreased the negative attitudes towards forest management practices, and this has improved understanding the relationship between naturally regenerating forest stands and its positive impacts on scenic beauty estimation by public.

Prescribed fire management is one of the most effective methods to naturally regenerate forests. In fact, according to Kauffman (2004), it is estimated that ten times more landscape was burned in the history than today. More importantly, prescribed burning has more positive impact on naturally regenerating forest stands than grazing, timber harvest, thinning, and biomass utilization (Kauffman 2004). Thus, determination of the effects of fire on naturally regenerating forest stands can be associated with SBE and public preference of prescribed fire management.

4.1.3 Longleaf Pine and Prescribed Fire Management

Longleaf pine (*Pinus palustris* Mill.) forests are one of the most important ecosystems dependant on naturally regeneration methods such as prescribed fire management in the southeastern United States, (Frost 1993; Kush et al. 2000). At present, due to inadequate regeneration, the cover of longleaf pine forests dramatically declined to less than 1.2 million hectares (Alavalapati et al. 2002). Moreover, lightning strikes in the southeastern United States led to frequent fire occurrence in the region which resulted with the dominance of longleaf pine forests (Croker 1987). In addition, native Americans set fire to control their landscape in the southern Coastal Plain (Croker 1987). Longleaf pines are also more resistant to fire, diseases, and insects than any other southern pines, and succession to hardwoods, new plantation

applications, and suppression of natural fire regimes have caused significant reduction in longleaf pine forest stands (Croker and Boyer 1975; Brockway et al. 2006). There has been also an increase in the restoration of the longleaf pine forests because they are considered species at high risk in the United States (Brockway and Outcalt 2000; Frost 2006). More importantly, in the absence of frequent fire, hardwood trees and woody shrubs occupy the ground cover of longleaf pine forests (Barlow et al. 2010).

The purpose of this study was to expand upon the work of public perceptions through the examination of the relationship between the scenic beauty estimation of prescribed fire management and vegetative composition of longleaf pine stands. There have been many other studies (Kauffman 2004; Loomis et al. 2001; Ostergen et al. 2008) which focused on public perceptions of ecological restoration, specifically fire management in the north, west, and southeastern U.S. The most common point of these studies was that public opinion surveys on forest management practices such as prescribed fire plays a vital role because public has a view of prescribed fire management beyond fire risk management, and in their perception, there might be dramatic changes in forest structure and vista. Also, more information is needed about the influence of prescribed fire management on longleaf pine forests including various treatment seasons, its relationship with scenic beauty preference of public and vegetative cover of longleaf pine forests. Therefore, this study was used to examine the photographs assessed by the survey participants to see if there is a trend related to the impact of different Fire Return Intervals (FRI) of prescribed fire on scenic beauty and vegetative composition of longleaf pine stands, and to determine the correlation between aesthetics and fire treatments through a visual assessment survey. We compared the influence of prescribed fire on the vegetative composition of longleaf pine stands in relation to visual quality assessment. Photographs used during the surveys were

taken from: a) two-year FRI, b) three-year FRI, c) five-year FRI, and d) no-burn treatment of Spring and Winter seasons.

4.2 Methods

4.2.1 Photographic inventory

The survey photographs used in this study were taken at the Escambia Experimental Forest (EEF) in Escambia County, Alabama in 2015. The EEF was established in 1947 on 1,214 hectare area to research the longleaf pine ecology (Adams et al. 2003). This study site was initiated in 1984 on the EEF to examine the impact of winter and spring burns on longleaf pine stands. Plots used in this current study were 0.1 acre in size with approximately 40 crop trees thinned for fairly uniform spacing at project initiation (Boyer 1990). There are three treatment blocks in close proximity to each other. Prescribed fires were initiated on the plots in the winter and spring 1985 and the areas have been burned on 2-, 3-, and 5-year intervals since that time. Winter fires were performed in January/February while spring fires were usually in April/May. Flank or strip head fires were used to minimize crown scorch and were often set following soaking rains, fine fuel moisture of 7-10%, relative humidity 35-55%, and steady winds. The study also has no-burn check plots.

The photographs of the study area were taken at the corner of each treatment plot by focusing on the foreground and middle-ground forest scenes. A tripod-mounted digital SLR camera was used to take the photographs by setting up the camera over the plot corners at the average viewer's height (1.7m) (Figure 4.1). The photographs of each composition were taken by turning the camera approximately 30 degrees to derive a successful representation of the view in-situ. Per each corner of the plots, there were at least 10 photographs taken by adjusting the elevation angle using lines in the viewfinder (close to 1/3 down from the top of the frame). To

reduce the occurrence of noise in the photographs, an ISO of 800 or lower degree was used (Craft 2015). The sampling method of photographs was derived from Daniel and Schroeder (1979). Time, date, plot number, corner number, and other associated information were recorded to be used in selection of the survey photographs.

4.2.2 Perceptual Preferences of Respondents

The photographs derived from different FRIs of longleaf pine forest were analyzed by the School of Forestry and Wildlife Sciences and Department of Art faculty members at Auburn University to select slides for the best quality images, exposure, the trueness of their colors, and general clarity. Each photograph was then selected based on the best representation of the study area and distracting elements such as tree numbers were eliminated to minimize bias. Then eight photographs representing the most accurate visualization of each treatment were chosen based on treatment type: Spring 2 years, Spring 3 years, Spring 5 years, Winter 2 years, Winter 3 years, Winter 5 years and no burn.

A by-slide method of analysis (Daniel and Boster 1976; Clay and Daniel 2000) was used to examine the perceptual differences of each photograph, and the photographs were presented to a total of 115 students (n=115) from a cross-section of disciplines: Forestry (19 students), Biology (11 students), Fine Arts (19 students), Economics (8 students), and "Others" (58 students) at Auburn University, Auburn, Alabama, USA. The "Others" discipline consists of students from various backgrounds and does not include Forestry, Biology, Fine Arts, and Economics disciplines.

Each survey group was tested individually using same set of photographs. Images were projected on a screen for 6 seconds with an automatic transition to allow for rating between transitions of photographs. Respondents were asked to rate each image on a scale of 1-10 based

the perception of the images scenic beauty where a 1 indicated very low scenic beauty rating and a 10 represents very high scenic beauty rating (Daniel and Boster 1976; Clay and Daniel 2000).

4.2.3 Basal Area (BA) and Vegetative Composition Assessment

Basal area is defined as the cross-sectional area of a tree at breast height and it is calculated as follows:

$$BA = 0.005454 \times DBH^2$$

Where BA is the basal area (sqft), the number 0.005454 is called the foresters constant, and DBH is diameter at breast height of a single tree.

Also, to calculate number of trees per each photograph, we visually evaluated the survey photographs by counting the number of pine trees on each survey photograph of the fire treatments. Then, we observed the understory vegetation to evaluate the SBE rating differences between survey photographs of each fire treatment used in the survey.

4.3 Data Analysis

SBE analysis is a psychophysical method which tests subjects scoring the visual quality of photographs of forest stands that have been measured on-site by forest management techniques (Edwards et al. 2012). For the SBE analysis, each survey group was tested individually using the same set of photographs. Results of visual preference surveys were analyzed using the RMRATE rating data software (Daniel and Boster 1976; Brown and Daniel 1990; Ray 1994).

In SBE method, each stimulus was ranked based on condition of interest, then each category was converted to a Z score (as a reference to standard normal distribution). In order to eliminate biases of SBE analysis, the baseline-adjusted Z-Score procedure was applied on the survey data. In this analysis, the procedure computes standard scores as:

$$SBE_i = (MZ_i - BMMZ)100$$

Where SBE_i is SBE of stimulus i , MZ_i is the mean Z of stimulus i , and BMMZ is the mean Zs of the baseline stimuli. For each survey group, each 4th stimulus was used as a baseline during the SBE calculation process. Then, stimuli were calculated based on these baseline categories for each survey group (Daniel and Boster 1976; Ray 1994).

F test was used to examine if there was any statistical differences among seasons of prescribed fire and SBE scores of photographs taken from seven different FRI groups. For this purpose, SBE score was used as the dependent variable, and seasons were independent variables. To find where exactly the differences came from, Duncan/Waller test was applied. Duncan's multiple range test is generally used to estimate the relationship between two or more variables (Cruz 2013). In this study, Duncan's test was used to examine the potential relationship between the survey participants' SBE ratings for seven different FRIs in the study area.

4.4 Results

Based on the basal area calculations, the highest basal area was found at 157.13 sqft/ac for Spring 5 years FRI group, whereas the lowest basal area was 120.56 sqft/ac for no burn treatment group. Also, for Spring 2 years and Spring 3 years treatments, basal areas were found at 124.9 sqft/ac and 138.61 sqft/ac, respectively. For Winter -2, -3, and -5 years treatment groups, basal areas were found at 141.95 sqft/ac, 130.14 sqft/ac, and 142.09 sqft/ac, respectively. For both Spring and Winter season FRI groups, there was not any relationship observed between SBE score of FRI groups and basal area calculations (Figure 4.2; Table 4.1).

Considering the Duncan's tests, the results of the study were statistically significant at the level of 0.01 alpha value. Also, SBE ratings of all FRI groups were statistically significant than each other (Table 4.2). Both Duncan and Waller tests scores based on SBE means showed that

no burn treatment group was statistically significant and different than other FRI groups (Table 4.2). To derive why no burn treatment was different than other FRIs, we reevaluated the survey photographs of each FRI groups.

As a result of manually counting the number of pine trees on photographs, there was also a positive relationship found between SBE scores and number of pine trees counted on the survey photographs of each treatment group. For instance, Figure 4.3 was rated at 56.9 mean SBE score whereas individuals ranked Figure 4.4 at 147.11 mean SBE score, though both photographs were taken from Spring 2 years treatment plots. Also, in Figure 4.4, number of pine trees was 67, whereas it was 46 in Figure 4.3, and Figure 4.4 has lower understory cover than Figure 4.3. Moreover, Figure 4.5 was ranked at 89.4 mean SBE score, while Figure 4.6 received 147.39 mean SBE rating by survey participants, yet both photographs were taken at Winter 3 years fire treatment plot. In Figure 4.6, the number of pine trees counted was 60, whereas it was 35 in Figure 4.5, and understory level is lower in Figure 4.6 than observed in Figure 4.5. Therefore, based on individuals' responses, we found that understory height level negatively affected the mean SBE scores, and the number of pine trees counted on photographs positively affected the mean SBE ratings for each treatment group.

4.5 Discussion

The purpose of this study was to examine the relationship between the scenic beauty estimation of prescribed fire management and vegetative composition of longleaf pine stands. We examined the photographs assessed by the survey participants to see if there was a trend related to the impact of different FRIs of prescribed fire on scenic beauty and vegetative composition of longleaf pine stands through a visual assessment survey. The results of this study showed that survey photographs derived from frequent fire return interval groups had the highest

SBE scores which also indicates participants preferred frequently burned plots in contrast to no burn plots. Moreover, the influence of prescribed fire on the vegetative cover of longleaf pine stands showed that pine tree density and lower understory cover had a positive impact on the perception of forest aesthetics. Then, we found density of understory cover had a negative impact on the SBE scores of participants for all FRI groups. Therefore, we can assume that observers perceived photographs with higher number of pine trees and lower density understory cover more aesthetically pleasant.

Considering the seasons of prescribed fire and SBE relationship, the lowest SBE scores were derived from no burn treatment groups, in contrast, photographs of the most frequent fire treatment seasons had the highest SBE scores. Moreover, basal area calculations were found similar among the FRI groups while the mean SBE scores were significantly different than each other. This may suggest that frequency and season of fire impacted the SBE scores more than basal area due to open understory, clear vision, and increase in number of pine trees counted in more frequently-burned longleaf pine stands. Also, as tree density decreases, people prefer large diameter trees, and thinner pine forests are generally perceived aesthetic when tree density is high (Mao et al. 2015). Considering all assessed survey photographs, understory height > 1.4 m (which is also adjusted camera height) obstructed the appearance of pine trees which may also have reduced the SBE scores of these photographs. As a result, more frequently burned plots, small diameter and dense longleaf pine stands with lower understory vegetation might be another factor that increased the SBE scores even though the basal area was lower for those plots of FRI groups.

4.6 Conclusion

In the absence of fire, hardwoods and shrubs invade longleaf pine forests, and understanding public perception of prescribed fire can help land managers and policy makers by increasing the awareness of importance of prescribed fire management. The outcomes can also increase the awareness of benefits of improvement in scenic beauty perception, thus, the role of forest aesthetics on demonstrating the scenic beauty of longleaf pine ecosystems. This research has highlighted that understanding the process of frequent prescribed fire management has a prominent effect on public perception of forest aesthetics from different FRI groups applied for longleaf pine forests and SBE relationship. Also, importance of vegetative cover on aesthetical perception of different FRI groups associated with longleaf pine forests can help increasing the awareness of forest management activities and their positive outcomes for sustainability.

Furthermore, scenic beauty of a landscape is mainly affected by characteristics of the scene such as color, size of the plants, and ground cover. In fact, less plant cover and increased visual depth in an image is considered as high scenic beauty, where small trees with high density of foliage understory and small diameter stems are defined as low scenic beauty landscapes (Kalidindi et al. 1996).

In addition to characteristics of the scene, forest aesthetics have a significant relationship with forest management practices such as prescribed fire, and perception of various tree growth forms in terms of tree density measurement can facilitate understanding the post-fire landscape views and how they encompass with the process of frequent fire establishment. More importantly, frequent post-fire conditions of longleaf pine understory can enhance the visual quality of these ecosystems which may also increase the aesthetic perception of public. This research has shown that public perception of post-fire conditions on natural landscapes can be

weighted differently by observers depending on how they determine understory density, tree measurements such as tree density, and correlate them with the post-fire views of FRI groups in longleaf pine stands. Further public surveys can be also conducted with public landowners and forest managers to demonstrate the importance of forest management practices such as prescribed fire management on basal area and tree density perception of land owners and policy makers. To evaluate the forest aesthetics of landscapes, visual evaluation methods such as pixel calculation of photographs can be also applied using ICY and LIDAR software programs for the future studies.

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Table 4.1. The relationship between mean basal area and SBE scores for each FRI treatment group (FRI: Fire Return Interval; SBE: Scenic Beauty Estimation).

FRI Groups*	Mean Basal Area (sqft/ac)	Mean SBE Scores
Spring 2 years	124.9	94.95
Spring 3 years	138.61	67.07
Spring 5 years	157.13	2.53
Winter 2 years	141.95	64.79
Winter 3 years	130.14	25.66
Winter 5 years	142.09	33.19
No Burn	120.56	-120.55

*Spring 2 years: Prescribed fire every 2 years in Spring, Spring 3 years: Prescribed fire every 3 years in Spring, Spring 5 years: Prescribed fire every 5 years in Spring, Winter 2 years: Prescribed fire every 2 years in Winter, Winter 3 years: Prescribed fire every 3 years in Winter, Winter 5 years: Prescribed fire every 5 years in Winter, No Burn: Absence of fire).

Table 4.2. Duncan's multiple range test results between basal areas of study area and mean SBE scores of FRI survey photographs of longleaf pine stands evaluated by students at Auburn University, Auburn, Alabama in 2016 (FRI: Fire Return Interval, SBE: Scenic Beauty Estimation).

Waller Grouping*	Mean SBE Scores	N	FRI**
A	94.95	2	Spring2
A	67.07	2	Spring3
A	64.79	3	Winter2
A	33.19	3	Winter5
A	25.66	3	Winter3
A	2.53	3	Spring5
B	-120.55	2	No Burn
		F Value	Pr > F
		4.79	0.019

* Means with the same letter are not significantly different. **Spring 2: Prescribed fire every 2 years in Spring, Winter 2: Prescribed fire every 2 years in Winter, Spring 3: Prescribed fire every 3 years in Spring, Winter 3: Prescribed fire every 3 years in Winter, Spring 5: Prescribed fire every 5 years in Spring, Winter 5: Prescribed fire every 5 years in Winter, No Burn: Absence of fire).

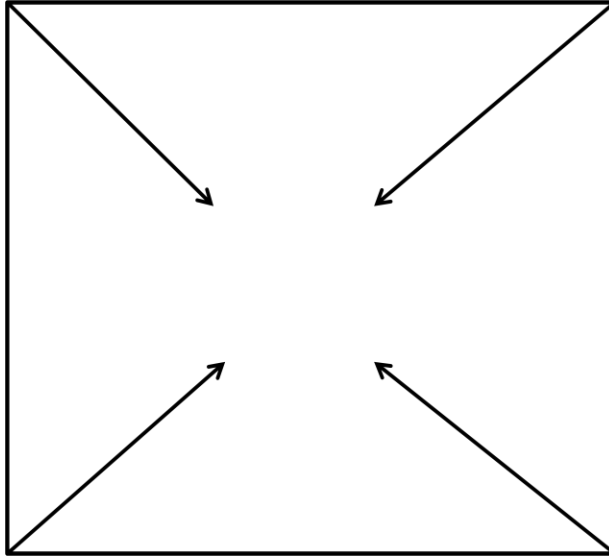


Figure.4.1. The illustration of photograph-taking method at each plot in study area. Each photograph was taken from the corner of each plot by looking into the center of the plot.

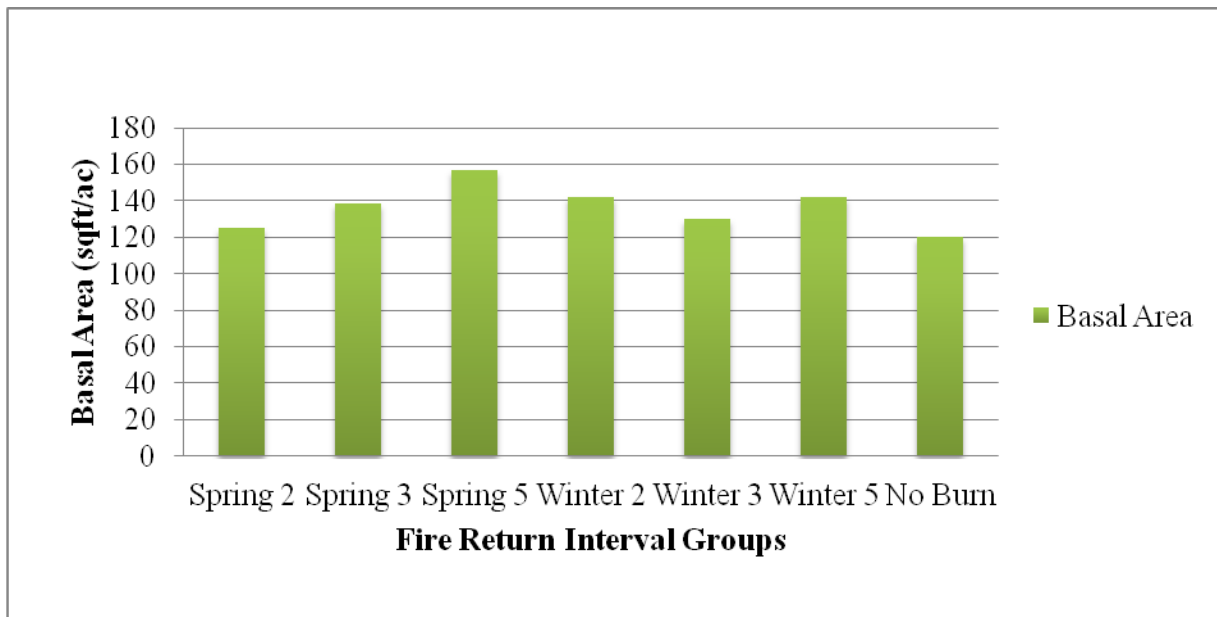


Figure.4.2. Basal area of the study area with relevant 7 fire return interval groups



Figure.4.3. Survey photograph taken from prescribed fire management applied every 2 years in Spring season on study area ranked at 56.9 mean SBE score by participants.



Figure.4.4. Survey photograph taken from prescribed fire management applied every 2 years in Spring season on study area ranked at 147.11 mean SBE score by participants.



Figure.4.5. Survey photograph taken from prescribed fire management applied every 3 years in Winter season on study area rated at 89.4 mean SBE score by individuals.



Figure.4.6. Survey photograph taken from prescribed fire management applied every 3 years in Winter season on study area rated at 147.39 mean SBE score by individuals.