HOW DO SEASONAL CHANGE AND DESIGN FEATURES INTERACT TO CONTRIBUTE TO AN ECO-VISUAL AESTHETIC FOR BIORETENTION PRACTICES?

by

KELSEY BROICH

(Under the Direction of JON CALABRIA)

ABSTRACT

Often bioretention practices exhibit an unconventional visual aesthetic, leading to improper management. This research investigates the potential for seasonality to contribute to a new eco-visual aesthetic that improves stewardship. Respondents in the Southeastern Coastal Plain, USA, (n=985) replied to an online survey comparing actual photos of five different bioretention sites taken throughout the year. The photo-based discrete choice experiment (DCE) captures the decision-making process by estimating weighted factors based on the respondents' chosen preferences. Results reveal a preference for the growing season over the dormant season ($X2$ (4, n = 985) = 928.490, $p<0.01$). Results suggest new directions in research such as exploring preferences within dormant seasons, preferences for qualities in vegetation, relationships between pro-environmental attitudes and behavior, and links to stewardship. While further research is needed, "cues to care" or intentional seasonal interest may improve appreciation and stewardship of bioretention practices.

INDEX WORDS: ecological aesthetics, green infrastructure, landscape architecture, New Ecological Paradigm, visual perception

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DEDICATION

This thesis is dedicated to my dear husband, Michael Broich, for his endless support. And to my cohort who helped me along the way. Especially Sarah, Deborah and Brandon, whose humor and kindness brought this thesis to the finish line.

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CHAPTER 1

INTRODUCTION

Landscape perception research informs the design and management of ecological designs through public perceptions. Researchers debate the importance ecological aesthetics (appreciation shaped by ecological knowledge) versus visual landscape aesthetics (appreciation as a visual aesthetic response) positing which one best promotes stewardship. To investigate these issues requires evaluating how ecological knowledge and visual qualities inform peoples' preferences. Many suggest the need to develop a "new ecological aesthetic" that integrates both visual aesthetics and knowledge (Howett 1987). Some landscape designers plan for seasonal change by developing planting designs that incorporate year-round seasonal interest (e.g. flowering in the spring, seed pods in the winter etc.). Perhaps year-round seasonality is a goal for landscape design to make ecological designs more visually appealing and, through better understanding, develop a better connection between people and nature.

In an effort to improve sustainability and resiliency in stormwater practices, urban planners and landscape architects implement green infrastructure. While gray stormwater infrastructure conveys water using conventional piped drainage and water treatment systems, green infrastructure conveys, treats and cools stormwater runoff using a variety of alternatives such as using “plant or soil systems, permeable pavement or other permeable surfaces, stormwater harvest and reuse, or landscaping to treat runoff” (“What Is Green Infrastructure?” 2019). Low impact development (LID) practices are a form of green infrastructure and represent

ways to use landscapes to minimize the negative effects of hydrological conditions ("Urban Runoff: Low Impact Development" 2018). Bioretention cells, rain gardens and bioswales are LID practices that mimic natural hydrologic processes by using vegetation and soil to slow, filter and cool stormwater runoff (Dunnett and Clayden, 2007). Bioretention provides ecological and economic benefits by improving water quality, providing habitat for wildlife, reducing pollutant treatment costs, increasing real estate value (Novotny, Ahern and Brown 2010, 188) and aesthetic benefits. However, if the specific benefits of LID practices are not known, they may not be appreciated and at risk of removal.

The appreciation of landscapes through the knowledge of ecologically beneficial functions is known as the "ecological aesthetic"(Gobster et al. 2007). If ecological function is not known, then sustainable practices may rely on visual aesthetics. Visual aesthetics represent the physical characteristics that people can see when visiting a site. Visual aesthetics have the potential to connect people with nature by using characteristics that are understood as human care or intervention (Gobster et al. 2007). For example, if plants are spaced evenly in groups or there is evidence of mowing, someone would read the landscape these characteristics as an intentional design or act of care (Nassauer 1995b). If the visual characteristics are not recognizable human interventions (visual aesthetics) and the knowledge of ecological functions is not known (ecological aesthetics), the site may not be appreciated or managed properly (Gobster et al. 2007; Nassauer 1995b; Mozingo 1997).

The problem of ecological designs lacking understanding or recognizable visual characteristics, leads to a call for a new visual aesthetic (Howett 1987). While a different stormwater practice than what is represented in this thesis, a stormwater treatment area in Davis,

California was cited as an example of an ecological design with poor visual aesthetics (Mozingo 1997). Mozingo uses it as an example of site that has many important ecological benefits, but describes the visual aesthetic experience as dull, except when there is a presence of migratory birds. When the birds are present, the site's ecological benefits are visible and understood by a visitor. The seasonal migration of the birds shapes how people experience the landscape and therefore, how they appreciate and value it. Without positive experiences or personal connections to place, sites like this are at risk of not being maintained to support their ecological functions (Meyer 2008). Research suggests that implementing interventions to improve the visibility of ecological designs could better promote stewardship. (Gobster et al. 2007; Nassauer 1995b; Mozingo 1997)

This study explores reactions to seasonal changes in the landscape because they can dramatically alter the visual appeal of the location. As well as the protection of bioretention systems, important practices occasionally removed because of their unconventional visual aesthetic. Few studies have measured perceptions of seasonal qualities, particularly in bioretention systems or vegetated stormwater management practices designed to treat and infiltrate stormwater runoff. Bioretention practices provide important ecosystem services, such as improved water quality and wildlife habitat, but may not conform to traditional neat and tidy, short-mown landscape design aesthetics and may appear to be mismanaged, despite their ability to improve water quality. Seeking to clarify knowledge about visual preferences for the necessary changes of seasonality can lead to informing a "new ecological aesthetic" that will encourage the stewardship of landscapes.

Objectives and Justification

Sometimes planting design for bioretention practices falls outside of cultural norms and acceptable aesthetics for landscape design, that lack of appreciation then leading to mismanagement. People are more likely to engage with landscapes with planting designs that they find "iconic", beautiful or exhibit care (Howett 1982; Mozingo 1997; Nassauer 1997). We know people are drawn to flowering plants and fall color, but perhaps not to the bare stems and floppy grasses in the winter, therefore it is important to gain a better understanding about preferences for seasonality. This thesis tests peoples' preferences for the season appearances of bioretention cells and how these preferences can inform better management of bioretention systems. While the overall goal of this thesis is to contribute to knowledge supporting better management and stewardship of bioretention practices, an understanding of seasonal preference can inform broader directions for future research. Identifying the seasons people prefer can lead to deeper studies to understand the preferred qualities within a particular season. Finally, embracing and expressing these qualities of seasonality can be used in design to inform a "new ecological aesthetic" and contribute to improved stewardship.

Overview

Seasonality is often referred to in the literature as phenology, ephemera and most often seasonal change. While seasonal change inherently alters the visual aspect of a landscape over time, there is a paucity of information regarding seasonality in the literature. We know people respond to seasonal qualities such as flowering plants and fall color, however few studies exist to better understand seasonality as it relates to preferences for landscapes and only recently have studies found evidence that seasonality influences their preference.

Vegetation changes cyclically over time with reoccurring forms and colors through plant life cycles. Phenology, the term for research exploring recurring phenomena, encompasses seasonal change in landscape disciplines. The phenology of landscape signifies the changes of colors and shapes representative and recurring at a particular season or time of year (Stobbelaar, Hendriks and Stortelder 2004). One study explored seasonality as it relates to perceptions of regional identity between organic farms and conventional farms. These researchers paid close attention to how seasonal change impacts human activities like deciding to visit a place because something is flowering or changing color. To conduct the study researchers defined seasonal coherence, the specific moment and expression of a time of year in the landscape, and coherence of change, a point that indicates what happened in previous seasons and what will happen. In the study, they used the terms to select seasonal "highpoints", or moments that accentuate seasonal qualities the color of vegetation. The study revealed that seasonal change was indeed an important aspect of the identity of a region. It concluded with proposals for further research about seasonality and suggested developing landscape designs with "an all-round image" of the landscape's seasonal interest. (Stobbelaar, Hendriks and Stortelder 2004)

In a study identifying important visual concepts for evaluating the visual quality of landscapes, the term *ephemera* emerged as a term encompassing visual seasonal change as well as human activities associated with change (Tveit, Ode, and Fry 2006, Kuper 2013). The researchers conducted a literature review and identified the following nine concepts for evaluating visual quality: stewardship, coherence, disturbance, historicity, visual scale, imaginability, complexity, naturalness and *ephemera*. Researchers articulate the importance of ephemera through considering the effects of landscape change (seasonal change and weather) on

visual character and perception. A landscape in the summer may look completely different in the winter, resulting in varying perceptions and value. (Tveit, Ode, and Fry 2006)

While seasonal change is commonly known for spring blooms and fall colors, landscape architecture considers human activities and broader geographical aspects. In a study conducting a literature evaluating the concept of seasonality in landscape architecture, Purs covers the previously mentioned concepts of phenology and ephemera through a series of categories embodying seasonality: time, human, space, architecture and phenomenon. The commonly thought of visual characteristics fall under space and include scape, light, color, weather, biota and change. Time refers to change and rhythm. It is similar to seasonal coherence, or the characteristics marking a particular time of year. Human represents the human activities and perceptions with seasonal change like regional identity. Architecture refers to planning and objects associated with seasonal change. Finally, phenomenon covers the broader seasonal change from a geographic perspective. (Purs 2007)

Within the existing studies about seasonality, many evaluate seasonality in an agricultural context like the study that explored perceptions of seasonality in organic and conventional farms (Stobbelaar, Hendriks, and Stortelder 2004, Nassauer 1988). However, it is important to explore seasonality in an urban context. When looking at landscape aesthetics, restorative effect and perceived biodiversity in urban spaces, one study found evidence for respondents preferring flower coverage as well as greenery outside of the flowering window (Hoyle, Hitchmough and Jorgensen 2017). The study took place over the course of a year and their participants saw the landscape change. Results reveal that landscapes with a large flower coverage were perceived as significantly more colorful and attractive (Hoyle, Hitchmough and Jorgensen 2017). However, the study also found that respondents considered the subtle greens at other times of the year

provided a restorative effect. While not a surprise that people enjoy flowing plants, the importance of greenery introduces seasonal qualities that should be considered during low flowering periods of the year. In addition, their findings suggest that people within the UK may be increasingly more accepting of the "messy" aesthetic because they are receiving increasing exposure to the naturalistic meadow-style plantings, but more research is needed to understand acceptability in the urban context. (Hoyle, Hitchmough and Jorgensen 2017)

Findings about seasonality challenge typical methods for landscape perception research. Many studies structure the methods on a theory that people experience landscapes based on what they understand (legibility and coherence) and what they explore (mystery and complexity) (Kaplan and Kaplan 1995). Legibility refers to an inferred understanding such as how one would navigate an environment. Coherence is more of an immediate understanding about an environment's organization and structure. As for exploration, mystery is an inferred exploration referring to one's desire to explore the environment further. Finally, complexity represents an immediate exploration of what one can see and how many different kinds of elements are present. (Stamps 2004)

One study specifically addresses the Kaplans' theory and how it interacts with seasonality. Kuper observes the Kaplan's theory (mystery, complexity, legibility, coherence) in expert perceptions of the Kaplans' concepts in seasonal photos of landscapes (Kuper 2013). Kuper found that seasonal change impacts estimations of legibility (Kuper 2013). Because of the variability in legibility estimations, this study supports other research questioning the reliability of using the Kaplans' theory for landscape perception research (Stamps 2004, Tveit, Ode, and Fry 2006, Kuper 2013). Many landscape perception studies depict a landscape during a single season, or the most attractive time of year. Additional calls have been made for more research

about improving the evaluation of landscape preferences (Stamps 2004, Tveit, Ode, and Fry 2006, Kuper 2013). This includes improving methods to support landscape change, such as seasonality. Like Kuper's study, often perception studies evaluate landscapes using the Kaplans' indicators of preference (coherence, complexity, legibility and mystery). However, in research evaluating the Kaplans' model, Stamps found that similar landscape perception studies were not reproducible (Stamps 2004). Stamps found that legibility was one of the more difficult indicators to reproduce. Again, legibility represents an inferred understanding, or how the viewer would navigate a site (Stamps 2004). Kuper also found variability in estimating legibility. His results reveal that seasons had a significant effect on legibility estimates, but not on the other concepts (coherence, complexity and mystery) (Kuper 2013). Kuper's results point to new directions in research. His study only focused on changes between summer, late summer and fall. He wonders if estimates wonders if seasonality would impact the other concepts if winter and spring were also observed. He also acknowledges that his findings are based on expert opinions and recommends that further research explores non-expert opinions. In addition, it further justifies the need to better understand seasonality as it relates to the preference of landscapes. If estimates varied for observations across summer, late summer and fall, greater variation may occur when observing change from dormant season into growing seasons such as winter and spring. Finally, it supports the need to explore alternative methods for evaluating preference other than the Kaplan's theory (Kuper 2013, Tveit, Ode, and Fry 2006).

In addition to improving methods to support landscape change, studies suggest improving or exploring alternatives to rating (Palmer and Hoffman 2001). Photo-based visual preference studies typically conduct surveys asking respondents to rank photos of landscapes. However, when we make decisions based on our preferences, we are not making choices based on rankings

(Johnson et al. 2013, Gobster, Ribe and Palmer 2019). In this study, we explore the potential of using discrete choice experiment (DCE) to reveal indicators of preference using a series of tradeoffs (Johnson et al. 2013, Schirpke et al. 2019). DCE or stated preference survey methods aim to represent a person's overall preference using underlying attributes and attribute levels (Schirpke et al. 2019).

While DCE was designed for market research and is still new to landscape perception, it has potential to understand chosen preferences (Louviere, Flynn and Carson 2010). DCE better represents the decision making process because it presents respondents with simple choices between two alternatives, each represented by photos, each coded with attributes (such as season) and attribute levels (such as winter, spring, etc.), and tracks the influence of those attributes in combination on the respondents' selection of one image over another. When the respondent selects an image, they are choosing certain combinations of attributes over others (such as seasonality vs. site, biodiversity or visual quality). DCE has the potential to extract more information about which landscape characteristics exhibit more weight in determining preference, and where respondents are willing to trade off having less of one attribute in order to have more of a second (Louviere, Flynn and Carson 2010; Molin 2011).

Outcomes

Identifying preference indicators can lead to an improved understanding of the relationship between people and their landscapes (Nassauer 2011). Evaluating preferences at the site scale is important because it is at that scale that people interact daily with the landscape. It is where decisions can be made impacting landscape management (Gobster et al. 2007). Through new methods to extract more information about preferences and gaining a better understanding of seasonal qualities, landscape architects can design landscapes with people's weights and

trade-offs of landscape factors in mind. Landscapes are designed with these factors in mind may be able to steer people to become more likely to engage with their landscape and improve stewardship

Limitations

Because of the use of an online survey, it is difficult to fully represent the general population (Dillman 2014). For example, because our target population is in the Coastal Plain ecoregion, many of our respondents are from Florida and resulted in a higher response from retired residents ("Ecoregions" 2016). I used a commercial online respondent panel (Qualtrics panels) that resulted in an imbalance of gender. Instead of 49% male and 51% female ("U.S. Census Bureau QuickFacts" 2020), the larger sample was 65% female and 35% male. This imbalance is typical for respondent panels, but has been found not to affect study reliability or validity. Hundreds of social science papers use internet-based crowdsourced online convenience sampling to access a large population at a low cost and within a short time frame (Hays, Liu and Kapteyn 2015, Chandler and Shapiro 2016). Upon review 7300 respondents across three different online platforms for convenience sampling, Boas, Christenson and Glick observed an imbalance of gender for Qualtrics panels, but overall found good representation and diversity in the sample (Boas, Christenson and Glick 2018). In addition, the literature suggests “a high degree of consensus in environmental aesthetics for many demographic distinctions” (Stamps 1999).

I conducted the study from December 2018 to January 2020. Because the bioretention sites are in the Coastal Plain, site visits were limited to every other month (December 2018-September 2019) and revisiting sites for perfect weather or to capture ponding was challenging.

Delimitations

The scope of this perception study focuses on the Southeastern Coastal Plain. I selected the sites using The University of Georgia Marine Extension and Georgia Sea Grant ("Coastal Georgia Low Impact Development (LID) Inventory" 2017) and the findings may thus be limited to landscapes in the same region.

CHAPTER 2

LITERATURE REVIEW

Bioretention

The following section introduces the increased awareness of sustainability and how cities implement low impact stormwater management practices to become more sustainable. Bioretention serves as a low impact development practice to cool, treat and filter stormwater runoff. Finally, the section concludes by introducing challenges in managing bioretention systems.

The Rise of Sustainable Cities

Sustainability, the ability to withstand disturbance, becomes more important as cities alter the changing landscape and seek to preserve and improve natural resources, like water, which is essential for all life (Novotny, Ahern and Brown 2010, 137). As stormwater runoff moves across urban landscapes, it conveys nutrients and pollutants directly into nearby waterways or into the ground through infiltration. Landscape designers and managers use landscape interventions such as bioretention to mitigate pollution by filtering pollutants with vegetation within an urban context. This is one example of a sustainable water management practice used to preserve and improve water quality. Sustainability once emphasized the preservation of undeveloped environments, but now it includes built environments like green spaces within cities that could be used for bioretention.

In the 1980s ecological, social and economic well-being were identified as a trinity of principles to ensure a holistic approach to sustainability (Meyer 2008; Novotny, Ahern and

Brown 2010, 138). While some practices promote an ecological perspective first, economic opportunity and a social acceptance ensure that the practice becomes sustainable. Landscape architects have the opportunity to use aesthetics to connect communities to such practices — aesthetically preferred settings are more likely to be sustained. Previously, literature emphasized the ecological and hydrological processes of the design of rain gardens, but studies more frequently advocate for the role of aesthetics (Nassauer 1996; Mozingo 1997; Meyer 2008; Nassauer 2011). Landscape architects and managers can address the trinity of sustainability by identifying ecosystem services including aesthetic quality.

Ecosystem Services

As landscape architects and managers address complex problems within the landscape, they must consider the landscape as a system. McHarg, in his seminal work *Design with Nature* (1992), articulated a process of design challenging landscape architects, managers and planners to better address the complex systems in the landscape (ecological, social and economic) (McHarg 1992). By developing an ecological inventory, the landscape architect gives value to the most critical needs within the landscape. While conservation began by preserving commonly appreciated landscapes like our national parks (Meyer 2008), the general population typically perceives critical needs such as a bioretention system as insignificant (McHarg 1992). The McHargian design process reveals the potential for landscape architects to bring value to the "seemingly" insignificant landscapes through beauty, or visual aesthetics, as well as biophysical factors (McHarg 1992, 185). This requires attention not only to ecological needs, but to cultural needs as well.

Landscape managers measure sustainability by setting goals with ecosystem services, or sustainable practices that provide ecological, cultural and economic benefits (Novotny, Ahern

and Brown 2010 138). They connect societal and ecological needs through a form of provision, regulation or culture within a landscape (Novotny, Ahern and Brown 2010 138). Examples include drinking water (provisioning), flood protection (regulating), and recreational and aesthetic benefits (Novotny, Ahern and Brown 2010, 138). When implementing new unfamiliar practices like low impact development, it is important to provide set ecosystem services. Beauty and aesthetics can serve as an ecosystem service as well as a critical role in connecting people to unfamiliar ecological design principles (Gobster 2008; Meyer 2008).

Low Impact Development

Low impact development (LID) supports sustainability by using vegetation to mitigate the hydrologic impact of development. This can be accomplished through bioretention practices like bioretention cells, rain gardens and bioswales. Environmental ecosystem services include cleaning stormwater through infiltration, providing erosion control, increasing groundwater recharge and wildlife habitat. They also provide economic ecosystem services such as reducing pollutant treatment costs and increasing real estate value. (Novotny, Ahern and Brown 2010, 188)

What is a Bioretention System?

Figure 1: Bioretention Cross Section

The above image illustrates a bioretention system, in this case a depression in the landscape that uses vegetation in modified soil to treat stormwater runoff and increase infiltration.

Bioretention is a low impact development practice that collects, treats and cools stormwater runoff through infiltration and evaporation (Dunnett and Clayden, 2007). The vegetated depression collects surface runoff and infiltrates a fraction into the soil (Novotny, Ahern and Brown 2010). Bioretention cells, rain gardens, bioswales and vegetated filter strips and buffers are all examples of bioinfiltration practices, but they differ in structure, size and scale (Dunnett and Clayden, 2007).

The Importance of Understanding Perceptions of Bioretention

Literature often cites bioretention systems and stormwater wetlands as examples of landscape management practices with increased ecological benefit, but that may exhibit poor landscape aesthetics (Nassauer 1988; Nassauer 1995b; Mozingo 1997; Gobster et al. 2007; Meyer 2008). Like the detention pond example in the introduction, while it provides ecological benefits, it is a dull visual aesthetic experience without the visibility of its function and benefits (Mozingo 1997). People may not be familiar with bioretention as a sustainable practice and if

they are not able to recognize it they may be unaware of the benefits, leading to improper management.

Many landscape managers focus their thinking on ecological protection or preservation on large scale landscapes such as national parks, but they must consider protecting the landscapes people interact with daily (like the detention pond in Davis, CA) (Nassauer 1988; Mozingo 1997). Smaller scale practices such as bioretention cells use vegetation to achieve ecosystem services such as filtration and wildlife habitat (Dunnett and Clayden, 2007). However, someone may perceive the grassy vegetation typically used as messy and outside of cultural norms like the mown lawn (Nassauer 1995b). Therefore, the unfamiliarity with the practice leads to improper management and even removal (Nassauer 1995b; Meyer 2008). Landscape architects can use visual aesthetics to make the sites more visible and better connect communities to ecological processes such as the use of a mown edge or a design element recognized as care (Nassauer 1995b; Mozingo 1997; Parsons and Daniel 2002; Gobster et al. 2007; Meyer 2008).

Visual aesthetics

Visual aesthetics are often identified as an ecosystem service to connect people with ecological designs. This section introduces the aesthetic experience, landscape aesthetics, ecological aesthetics and how visual aesthetics can influence management.

The Aesthetic Response and Experience

Landscape architects use visual aesthetics to build a connection between people and nature (Gobster et al. 2007). An aesthetic response or experience is a reaction to the properties of an object or event that are "considered worthy of attention (perception or reflection) within a particular culture" (Eaton 1989, 10). Within the landscape, one may experience visual aesthetics as a feeling of pleasure from "directly perceivable characteristics of spatially and/or temporally

arrayed landscape patterns" (Gobster et al. 2007, 964). Eaton believes an aesthetic experience centers around perception and attention. It is often shaped by three concepts: an aesthetic response is learned, culture-bound or socially prescribed and proscribed. Context and background influence a person's response such as a learned response that depends on language to communicate. Eaton uses the example that people learn the contrast between a pretty flower (prescribed) and an ugly garbage can (proscribed). Culture may shape a "special vocabulary" such as how one reacts to a large natural resource like a cliff. For some, the reaction might be to yell at the top of the cliff, but others may admire it in silence. Finally, specific cultures identify and admire socially prescribed and proscribed experiences that may influence aesthetic response. (Eaton 1989)

A History of Landscape Aesthetics and Tastes

The aesthetic response is believed to be a basic need for humans (Eaton 1989). Since early human existence, people sought places not only for the functional attributes of prospect and refuge, but also for “pleasing views” (Daniel 2001). This exemplifies how visual aesthetics promote a personal and emotional connection to the land (Parsons and Daniel 2002). Often, landscape aesthetics, or the pleasure derived from the experience of visible spatial patterns in the landscape, influences decisions about landscape management (Gobster et al. 2007). In the late 1700s, William Gilpin, a clergyman from the English lowlands, published his observations of physical attributes and personal emotional responses to landscapes he visited along his travels (Appleton 1996). In Gilpin’s *Observations on the River Wye*, his sketches and accounts reflect the picturesque qualities found in the English countryside (Gilpin 1782, Appleton 1996). He describes an area in the South of Wales as very beautiful because of its trees, lawn and undulating forms (Gilpin 1782, 62). He contrasts the “beautiful” open free forms to formal

qualities with stricter geometries (Gilpin 1782, Gilpin 1808). Ultimately, his writings served as an early documentation of human perceptions of specific places (Appleton 1996). In the United States, tastes in landscape aesthetics grew out of the style described in Gilpin's writing (Appleton 1996, Parsons and Daniel 2002).

A major shift in the design of landscapes occurred in the eighteenth century. Landscapes were often "reduced to a simple and comprehensible geometry" such as the geometric design of Versailles by Andre Le Notre (McHarg 1992, 72). As identified in Gilpin's writings, the new style emerged from the idealization of nature by poets, artists and writers (McHarg 1992). Eighteenth century landscape designers, such as Kent, Brown and Repton, began imitating these idealizations (McHarg 1992). They evoked natural ecology, however, they actually imitated the pastoralism of the countryside with which they were familiar. While the intention to exhibit nature was there, even though execution was not quite what they intended, they did introduce the use of native plants and a reflection of natural processes (McHarg 1992, 72). Ultimately, the eighteenth century designers moved away from geometry, as in William Kent's dictum "nature abhors a straight line", and embraced asymmetry (McHarg 1992). This new visual aesthetic shifted away from the "classical" tradition (such as Versailles) and toward a foundation of design based on "applied ecology as the basis for function and aesthetics" (McHarg 1992, 73). The tradition would be continued by Andrew Jackson Downing, influencing Frederick Law Olmsted and shaping the trajectory of landscape design in America. This visual aesthetic would ultimately become the basis for landscape preferences in America today as well as the basis of scenic quality assessments (McHarg 1992, Parsons and Daniel 2002, Nassauer 1995b).

The Scenic Landscape and Conventional Aesthetics

Those who favor ecological aesthetics, or landscape appreciation based on the knowledge of beneficial ecological functions within the landscape, have questioned the value of the scenic aesthetic (Gobster et al. 2007, Mozingo 1997). While many perceive the scenic aesthetic as natural, it may not be ecologically healthy (McHarg 1992). Inspired by Andrew Downing and English landscape traditions, Frederick Law Olmsted brought the scenic aesthetic to America with his design of Central Park (McHarg 1992). And even though the scenic aesthetic does not always exhibit ecological health, it shapes landscape aesthetics and tastes in the United States today (McHarg 1992; Nassauer 1995b; Mozingo 1997) such as preferences for national parks and suburban design (Howett 1987; McHarg 1992). The scenic aesthetic consists of landscape preferences for "open areas with low ground cover, a water source directly (pond, stream) or indirectly (e.g. flowering plants, green vegetation) indicated, occasional clumps of trees and shrubs" (Parsons and Daniel 2002). Today's landscape conventions model this visual aesthetic through the preferences for the mown lawn lined with trees (Howett 1987; Nassauer 1995b; Mozingo 1997).

The Ecological Aesthetic

Because the scenic aesthetic does not always exhibit ecological health, those who favored ecological aesthetics, or an appreciation based on the knowledge of ecologically beneficial functions within the landscape, questioned it as the basis for landscape aesthetics and assessment (Gobster et al. 2007, Mozingo 1997). A strong correlation exists between scenic beauty and perceived naturalness (Gobster et al 2007). While the scenic aesthetic appears "natural", it may not be natural at all or ecologically healthy and people use this perceived "natural" aesthetic to

inform what to preserve, excluding the healthy landscapes that may not conform to the scenic aesthetic like bioretention practices (Gobster et al. 2007).

While some assert that ecological aesthetics should be the most important criteria for preserving landscapes, Gobster argues that knowledge alone may not be sufficient for preserving landscapes with such as a constructed wetland (Gobster et al. 2007). A constructed wetland exemplifies a landscape that does not conform to the scenic aesthetic, but is ecologically healthy. However, a wetland could be planted with a visible pattern and still provide ecological benefits. People acknowledge patterns such as groupings of plants as design or care (Nassauer 1995b). Care acts as a cultural language and communicates that people are stewarding the land (Nassauer 2011). Therefore, the implementation of a pattern has the potential to make a site more appealing and visible to a lay person, connecting people to an ecological designs without knowledge of its function. (Gobster et al. 2007)

Design Interventions for Ecological Landscapes

The scenic aesthetic most frequently influences the preservation of large scale landscapes, but it is important to find an appreciation and preservation of nature that we experience in our daily lives such as the green space in our cities (Howett 1987; Nassauer 1995b). The sustainability movement encourages the preservation of "green space", not just the "unbuilt" such as our national parks (Howett 1987; Nassauer 1988; McHarg 1992). It is through the perceptible realm, or the space where people interact with nature daily such as their front yard or landscape at work, that people make decisions impacting landscape management (Gobster et al. 2007). For example, one might decide to mow the "messy" grassy space on their property, when it actually serves to manage the stormwater (Nassauer 1995b).

The intersection of ecological design and traditional visual aesthetics may lead to a solution that better connects people to ecologically beneficial practices. Ecological designs within our "daily paths" such as bioretention and daylit creeks need to become "iconic" (Mozingo 1997). The concept of hypernature, a theory that sustainable design should draw attention itself over the daily concerns and over-stimulation in today's world, represents the opposite of the often passive experience of a bioretention practice (Meyer 2008). Mozingo posits that ecological designs are a “hard read” as opposed to an agricultural landscape that people readily understand as a “cared for” landscape. She introduces several concepts for designers to consider for ecological designs: visibility, temporality, reiterated forms, expression and metaphor. Visibility coincides with Meyer’s expression of hypernature. Without a design intervention to evoke visual signs of care, an ecological design, such as bioretention, may not be “perceivably visible” to the lay person. If landscape designers use "cues to care" (e.g., turf verge, orderly plantings or flowering plants), then ecological designs might be better understood because they exhibit familiar human intentions.

Researchers have called for exploring a new visual aesthetic for ecological design and responses leading to design concepts for ecological designs to better fit conventional aesthetics (Howett 1987, Nassauer 1995b; Parsons and Daniel 2002). Nassauer found evidence in several studies that landscapes exhibiting a human intention, or a “cue to care”, such as a clean edge, will be more likely to receive appreciation (Nassauer 1995b, 1988, 1997; Nassauer, Wang, and Dayrell 2009). Emblems of care can change between people because care emerges from a person's familiarity, past experience, and activity within the place (Gobster et al. 2007). Both the landscape context (physical characteristics, ownership and cultural history) and situational context shape a person's understanding and connection to place (Gobster et al. 2007).

Often shaped by context, "cues to care" embody human intention within the landscape. Farmers appreciate pastoral landscapes with rows of crops because of their deep background of knowledge about the care and understanding needed to achieve a beautiful crop (Nassauer 1995b), as opposed to a suburban resident who appreciates a mown lawn or a potted plant as an emblem of care (Nassauer 1995b). Both examples indicate care, but cultural languages and context shape perception and value of each indication (Nassauer 1995b).

Because bioretention practices may consist of messy vegetation, they are often misunderstood and perceived as neglected, leading to improper management (Nassauer 2009). While one of Nassauer's studies found the importance of scenic conventions, neatness was equally important and identified as a "cue to care" (Nassauer 1988). She found that messy characteristics are perceived as "too much nature" (Nassauer 1995b, 163). People become uncomfortable when landscapes exhibit messy characteristics outside of cultural norms (Nassauer 1995b). She also found that respondents associated the appearance of landscapes to stewardship. Those with “orderly” landscapes are considered good stewards, while neighbors with “messy” landscapes are perceived as bad neighbors, lazy workers or poor stewards (Nassauer 1995a). She suggests that "too much nature" becomes more acceptable if it has an element or neatness, an orderly frame or a human intention (Nassauer 1995b). Perhaps if a bioretention area was paired with mowing, flowering plants, bold patterns, trimmed shrubs or plantings in rows, they might be more acceptable (Nassauer 1995b).

In furthering her studies about neighborly considerations, Nassauer found evidence for landscape preferences based on cultural norms established by neighborhoods. In a photo-based landscape survey asking respondents to rank residential yard types, Nassauer found situational context to be extremely influential on preference. The survey asked residents to select a yard

type for their house with the context of an image to represent their neighbor's yard. The images included a range of landscape aesthetics from a conventional mown lawn to an unconventional landscape with tall grassy plants. Respondents were more likely to choose an unconventional residential landscape if their neighbor also chose an unconventional landscape. This study reveals the relationship between decisions about design within a social context; residents care about how their choice will be received by their neighbors. (Nassauer, Wang and Dayrell 2009)

Another of Nassauer's papers reflects on her studies about care, she discusses the links between care and stewardship (Nassauer 2011). She acknowledges care as an aesthetic response evoking stewardship. While exhibits of care can vary with culture and landscape context, some cues to care could include: neatness, order, crisp edges, fences, trimmed vegetation, mown turf, colorful flowers and physical signs describing ecosystem function (Nassauer 2011, 322). Any of these interventions can be used to make "invisible" landscapes such as bioretention systems, into visible landscapes. These interventions extend beyond a physical aesthetic, they represent a cultural language communicating human stewardship (Nassauer 2011). The connection between the familiarity of the interventions and preferences suggests that if applied to bioretention systems, they might become more visually appealing. (Nassauer 2011)

The movement towards a new ecological aesthetic begins with considering what will be accepted by culture and ultimately establishing a new cultural language (Eaton 1980, Howett 1987, Nassauer 1996, Mozingo 1997). The scenic aesthetic can shape efforts to protect landscapes. However, the perceived naturalness, often associated with this visual aesthetic, does not always equate to ecological health. Sustainable practices that are not familiar to the lay person may not be readily visible, therefore researchers advocate for such landscapes to visually draw attention to themselves through design interventions that use familiar characteristics such

as acts of care (Howett 1987, Mozingo 1997). Nassauer posits the social aspect of sustainability where people may respond best to a social gesture or neighborly considerations (Nassauer, Wang and Dayrell 2009, Gobster et al. 2007). Emblems of care and considerations of community identity could lead to greater environmental stewardship (Nassauer 2011). All of which challenge landscape professionals to re-envision the visual aesthetics of ecological designs in order to improve the stewardship of them. We wonder if applying intentional seasonal planting design could contribute to a new landscape visual aesthetic.

Seasonality

Seasonality embodies both vegetative changes (flowering and leaves change color) and cultural actions (raking leaves and pulling weeds) (Nassauer 1988, Kuper 2013, Purs 2013, Tveit, Ode, and Fry 2006). In 2006, Tveit, Ode and Fry identified nine key concepts for evaluating visual quality (Tveit, Ode, and Fry 2006). One concept includes "ephemera", defined as "elements and land-cover types changing with season and weather" (Tveit, Ode and Fry 2006, 264). The concept addresses not only natural changes, but a human dimension (Tveit, Ode and Fry 2006). The human aspect comes from a list of attributes under "ephemera" including land use and plowing (Tveit, Ode and Fry 2006). Researchers recommend using these concepts as a framework for establishing visual indicators that can "help us to quantify, measure and compare landscapes and the effects of landscape change on visual character" (Tveit, Ode and Fry 2006, 264).

To further define qualities within seasonality, another study conducted a literature review about seasonal landscapes to classify the concept of seasonality into subcategories (Purs 2013, Palang, Sooväli-Sepping, and Printsmann 2007). Purs found five thematic categories within seasonality: time, human, space, architecture and phenomenon. Several subcategories

accentuated physical vegetative characteristics, but the "human" category revealed several cultural aspects of seasonality such as perception, symbolism, players, use, influence, meaning, identity and reflection. Influence relates to how seasons impact the daily lives of humans and identity represents how a town could perceive an aspect of seasonality as a part of their identity like harvesting a regional crop or the beauty of fall color. (Purs 2013)

Several studies explore seasonality in an agricultural context. "Phenology of Landscape: The Role of Organic Agriculture" compares the seasonality of organic and conventional agriculture and whether or not it adds to the visual quality of the region (Stobbelaar, Hendriks, and Stortelder 2004). Researchers photographed the farms throughout the year to track the seasonal development, or observable seasonal aspects related to particular times of year. The study used a reference image, identified by observations of quality and wishes expressed by local stakeholders, as a basis to compare the seasonal development of the conventional and organic farms. After comparison, results reveal that organic farms exhibited more seasonal development than conventional farms. They found that seasonality was critical to the region's identity and that organic farms had more seasonal interest in color and variety than conventional farms.

In another agricultural study conducted in Kane County, Illinois, farmers looked at landscapes throughout the seasons (Nassauer 1988). The study presented farmers with photos of farms across the seasons. While they reacted positively to "openness, straight rows, even green color [and] for being weed free" (vegetative changes), they also reacted positively to the minimum tillage (an influence and a cue to care) in the fall photos (Nassauer 1995b). Photos depicting messy farms received mixed and negative reactions (Nassauer 1995b). Because of the cyclical nature of farming practices, farmers have their own cultural norms and expectations throughout the seasons such as which crops to plant and harvest at certain times of the year and

how to care for them. Their knowledge and experience shape their perception of the seasonal photos. While the lay audience may not be familiar with farming practices, they may be familiar with their region's seasonal harvest. And while the lay person may not appreciate tilling a farm, they may appreciate a raked lawn in the fall (Nassauer 1997).

Using a postal questionnaire and follow-up interviews, a recent study reveals seasonal preferences in an urban context. The study explores the aesthetic experience woodland ecosystems' impact "issues of residential (aesthetic) satisfaction, perceived personal security, restorative experiences and place identity" (Jorgensen, Hitchmough and Dunnett 2007, 280). Results revealed the community's strong values for interventions of care in residential neighborhoods such as the private gardens, overtly decorative plantings and landscape maintenance. They also revealed negative reactions toward a perceived lack of management. While results predominantly reveal a strong correlation between care and preference, secondary findings suggest positive reactions and awareness of seasonal change. Respondents described emotional responses to seasonal change such as a "sense of well-being" or "cheer[ing] you up" (Jorgensen, Hitchmough and Dunnett 2007). Several responses in the interview portion, communicate a connection to nature through the natural cycles of seasonal change (Jorgensen, Hitchmough and Dunnett 2007). Interviews also reveal reflections of places as they relate to the seasons. One participant expressed memories from summer as a child (Jorgensen, Hitchmough and Dunnett 2007, 282). The study's conclusion suggests interventions of care, including the use of "urban prairies or meadows" that exhibit "colourful, high impact urban plantings" (Jorgensen, Hitchmough and Dunnett 2007, 283). Perhaps this is one example where seasonality can be used in conjunction with care to make "messy" grassy ecosystems more iconic or intentional. (Jorgensen, Hitchmough and Dunnett 2007)

Studies about seasonality reveal the important seasonal qualities that make landscapes visible and sometimes even valuable (Nassauer 1988; Stobbelaar, Hendriks, and Stortelder 2004; Jorgensen, Hitchmough and Dunnett 2007; Hoyle, Hitchmough and Jorgensen 2017). Another study explored landscape aesthetics, restorative effect and perceived biodiversity in public and urban contexts and found evidence of preferences for flower coverage. Participants responded to landscape change because researchers conducted the study across the seasons (spring, summer and autumn). Participants walked through eight locations in England that consisted of a variety of vegetative communities (woodland, shrub and herbaceous). Researchers conducted site interviews asking participants to respond to the vegetation's aesthetics, restorative effects and perceived biodiversity. Results reveal significant preferences for landscapes with large flower coverage and the restorative effects of greenery during non-flowering times (Hoyle, Hitchmough and Jorgensen 2017). While it is not a surprise that respondents find more flower coverage more colorful and attractive, the value of greenery suggests special attention to design during low flowering months. All of the previously mentioned studies call for more research to improve understanding about perceptions of seasonal qualities (Nassauer 1995b; Stobbelaar, Hendriks, and Stortelder 2004; Kuper 2013). Perhaps a greater understanding of valuable seasonal qualities such as intentional flower coverage and greenery could be implemented as design interventions for ecological designs.

Seasonality in the Profession

Often landscape architects approximate a fixed vision, however landscapes are dynamic and change across the seasons (Oudolf and Kingsbury 2013). Recently, landscape architects who practice a "dynamic" approach to landscape design, now encourage both practitioners and gardeners to design for change (Rainer and West 2015; Oudolf and Kingsbury 2013). They

challenge the role of gardeners. Today garden design has the potential to provide solutions for a more sustainable future through reducing mown lawn, increasing biodiversity, reducing unnecessary trimming and improving the sustainability of management (Oudolf and Kingsbury 2013).

James Hitchmough and Nigel Dunnett at the University of Sheffield, UK developed the term "dynamic planting" (Oudolf and Kingsbury 2013). Unlike conventional landscape design that supports monocultural block planting, "dynamic planting" refers to a design process that understands the life cycles of perennials and embraces change and spontaneity. It refers to the controlling and editing of natural processes. Hitchmough, Dunnett, Oudolf and Kingsbury design for diversity, complexity, change coherence and distinction (Oudolf and Kingsbury 2013). They acknowledge that landscapes will grow and change. When using a diversity of species, they understand that some species will outcompete others and the site may need "restoration" back to the designers' initial vision.

This style grows out of the work of Gertrude Jekyll, a landscape designer during the 20th century arts and crafts movement. Instead of conventional 19th century landscapes that rarely used a complexity of plant material, she added multiple species in one planting bed. Unlike Gertrude Jekyll, Roberto Burle Marx was a modernist designer who rarely mixed plant species, and instead, planted bold color masses of monocultures in rhythmic shapes and patterns. While neither Jekyll or Marx designed naturalistic plantings, their use of color and rhythm influenced the "dynamic" designers. (Van Sweden and Thomas 2011)

As mentioned previously, research supports evidence for a correlation between perceived naturalness and preference (Gobster et al. 2007). English garden traditions centered around designing for perceived naturalness, however the garden itself was very planned and not natural

(Oudolf and Kingsbury 2013). Today this style might be categorized as "cottage gardens" in popular gardening magazines (Oudolf and Kingsbury 2013). The "dynamic" designers strive for a perceived naturalness with the complexity of Jekyll and the rhythm of Marx to achieve a planned spontaneity (Oudolf and Kingsbury 2013).

Piet Oudolf, Noel Kingsbury, James Hitchmough, Nigel Dunnett, Phyto Studio and Oehme, Van Sweden lead the profession in "dynamic" and "enhanced nature" design (Van Sweden and Thomas 2011; Rainer and West 2015; Oudolf and Kingsbury 2013). These designers also emphasize planning for the seasons. Piet Oudolf, a Dutch landscape designer who became famous in Europe, is known for his incredible gardens that look beautiful year-round (Van Sweden and Christopher 2011). Oudolf has a deep knowledge about plants and understands how plants change over time (Van Sweden and Christopher 2011; Oudolf and Kingsbury 2013). His knowledge goes beyond planning for seasonal color, but also seasonal structure and succession. Oudolf knows what his garden will look like all year round, from the choreographed flowering to the way light will hit the seed at heads of the grasses in the winter (Van Sweden and Christopher 2011). His design extends outside of conventional landscape aesthetics in his use of grasses. He even supports unconventional maintenance practices. He's known for telling his clients "not to cut back or tidy up the garden" (Van Sweden and Christopher 2011, 139). However, he implements "cues to care" such as a mown edge and repetitious plantings (Nassauer 1995b). Oehme, Van Sweden is a landscape architecture firm, founded by Wolfgang Oehme and James Van Sweden, in Washington, DC. The book, "The Artful Garden" consists of reflections by Van Sweden about the designers who influenced their style and design process (Van Sweden and Christopher 2011). One of the influences includes Piet Oudolf (Van Sweden and Christopher

2011). The firm mirrors Oudolf's perceivably natural design and prides itself on its emphasis on designing for change, not just for the season, but the time of day.

In 2015, the book "Planting in a Post-Wild World" emerged to give practical steps toward designing and planning for change. Authors Thomas Rainer and Claudia West, met under the mutual mentorship of Wolfgang Oehme and James van Sweden, and their style imitates that of Piet Oudolf and Oehme, van Sweden. The book promotes practical steps for planning for change, including a seasonal theme layer. The theme layer exhibits the plants that will be noticeable during different seasons. While all of these designers strive toward imitating nature, Rainer and West take it a step further by advocating for design with native plant communities. (Rainer and West 2015)

Nigel Dunnett, a professor of planting design and urban horticulture in the Department of Landscape at Sheffield University, previously mentioned for creating the term "dynamic" landscape design with James Hitchmough. Both Dunnett and Hitchmough contributed to research about the aforementioned style of “designed plant communities”. Dunnett also has experience applying this design to biofiltration systems such as bioswales and rain gardens. Dunnett developed a planting plan for the "UK's largest retro-fit SuDS (Sustainable Drainage System) project" for "Green Street", a street in Sheffield that he converted from all pavement into medians of rain gardens and bioswales using designed plant communities. The question arises about the implications of maintenance for such a large public application of this style such as a need for specialized plant knowledge to properly weed the site. For the first three years, a contract was given to Green Estate Ltd, a landscape management company that specializes in innovative management techniques. While the design requires specialized knowledge to remove

"weeds", other maintenance includes simply cutting back the grasses in the winter and removing clippings. ("Grey to Green" 2020)

It seems that this group of designers challenges the role of landscape architects and pushes toward new cultural norms. Their style calls for a deeper understanding of plants, to the point that designers know how their proposed design will look in months (seasonal change in vegetation) and even years after installation (successional stages of plants). This understanding leads to a longer lasting design. However, the design requires shifts in cultural norms and possibly even the structure of the profession. Clients must become more comfortable with reduced mown lawn and increased biodiversity (Oudolf and Kingsbury 2013). If more clients request this style, perhaps more people will be willing to copy their neighbors as suggested by Nassauer (Nassauer 2009). The more the style is accepted, the more there will be a need to shift either the role of the landscape architect, landscape managers or how the two interact, to accommodate the need for specialized management. In any case, several of the gardens designed by these professionals are award-winning and people travel to visit them.

Landscape Perception Research

Seasonality challenges typical methods for landscape perception research. Many studies base their methods on a theory developed by Rachel and Stephen Kaplan that people experience landscapes based on what they understand (legibility and coherence) and what they explore (mystery and complexity) (Kaplan and Kaplan 1995). One study specifically addresses the impacts of seasonality on Kaplans' theory, or how people experience the landscape. Kuper observes the Kaplan's theory (mystery, complexity, legibility, coherence) of expert perceptions in seasonal photos of landscapes (Kuper 2013). Kuper found that seasonal change impacts estimations of legibility, or an inferred understanding such as how one would navigate an

environment (Kuper 2013). Because of the variability in legibility estimations, this study supports other research questioning the reliability of using the Kaplans' theory for landscape perception research and research that does not address seasonal change (Stamps 2004, Tveit, Ode, and Fry 2006, Kuper 2013).

Landscape perception research grew in the 1960s as a response to the beginning of the green movement, addressing land-use and natural resource management (Gobster, Ribe and Palmer 2019). This body of research encompasses visual assessments and scenic quality assessments, measuring the visual or scenic value of landscapes based on their visual and physical characteristics (Gobster, Ribe and Palmer 2019). When these methods first developed, much debate occurred over whose opinion mattered most, the expert or the general public, and whether or not the assessments should be quantitative or qualitative (Shafer and Brush 1977; Carlson 1977; Ribe 1982; Carlson 1984; Ribe 1986). Today, landscape perception has evolved using several different methodologies to gain a deeper understanding of peoples' preferences for landscapes.

Early Methods for Landscape Perception Research

Elwood Shafer developed a model to predict the public's preference for landscapes "How to Measure Preferences for Photographs of Natural Landscapes"(Shafer and Brush 1977). He used a visual assessment methodology where he sent landscape photos to a random selection of recreationists. Using a grid over the photos, recreationists were asked to assess the zones outlined by Shafer (immediate, intermediate and distant), then rank the photos from most to least preferred. The zones represent three categories: the immediate, or individual trees and shrubs in the foreground, the intermediate, or forms or groups of trees and shrubs in the middle ground and distant, where individual trees and shrubs cannot be distinguished. Shafer then used the results to

create a linear regression model to predict the public's preference in order to promote land management. He hoped decision makers could use the model to "help plan and manage natural landscapes for an optimum range of scenic preferences, prepare environmental impact statements to the aesthetic quality and monitor trends of environmental quality" (Shafer and Brush 1977, 237). (Shafer and Brush 1977)

Shafer attempted to quantify landscape preference. In contrast, philosopher A. A. Carlson questions the usefulness of Shafer's model and articulates the complexity of aesthetics and perceptions. He argues that Shafer's visual assessment may not quantify what he intended rather it reveals the obvious, the "public's high preference for mountains and water, together with lower preferences for flatter land, is essentially common knowledge" (Carlson 1977). He composed an analogy with art criticism to address the idea of developing a trained authoritarian to assess aesthetic quality. In art, trained professionals and artists judge the quality of art and which works are worthy of preservation. However, unlike art, the landscape is composed of ecological and aesthetic qualities. Also, unlike art, most of the landscape Shafer was studying are federally-owned and subject to requirements of objective management. In response, Carlson proposes a need for an environmental critic, someone trained to judge the aesthetic quality of the natural environment.

Carlson identifies four themes or assumptions in Shafer's work: egalitarianism, formalism, objectivity and quantification that support his proposal of an environmental critic. He argues that Shafer quantified, but only to a certain degree. Shafer only "quantified public preference for certain formal aspects" (Carlson 1977, 162). Carlson suggest that there an assumed preference for formalism, or the "formal" visual aesthetic qualities such as line, shape, color and composition. Therefore, the assessment only measures how much a landscape

expresses “true aesthetic values” instead of preferences of the untrained public (Daniel 2001, 272). He also states that objectivity does not come from quantification alone. Instead, an environmental critic could provide an objective opinion as a trained professional within a qualitative assessment of visual aesthetic quality (Carlson 1977).

In response to Carlson, Ribe defends Shafer's attempt at the quantification of aesthetic quality with the belief that quantification can be used as evidence for objectivity of an assessment. Ribe states, "... empirical research and methods of aesthetic assessment have the capacity to... produce evidence of the validity and reliability of measures of scenic beauty" (Ribe 1982, 71). He agrees that there is a need to further identify and develop a landscape aesthetic quality theory to use as a baseline of measurement. Therefore, Shafer's study is important to further developing theory.

Theory Behind Landscape Perception

The debates between Carlson and Ribe are an example of how perception research delves into various theories about aesthetics, the human experience and quantifying value (Appleton 1996). It begins by defining the landscape. While there are several definitions of a landscape, in landscape perception it is typically a picture or a view of natural scenery, "a portion of territory that they can comprehend in a single view" (Daniel 2001). From here, one can begin to define what is meant by landscape quality and visual aesthetic quality (Daniel 2001). The scenic aesthetic, a visual aesthetic based on pleasure in landscapes that seem natural, became the basis of scenic quality assessments (Parsons and Daniel 2002, Nassauer 1995b). However, if landscapes are to measure a "degree of excellence" in ecological quality or values, then the scenic quality assessment alone, or simply evaluating pleasure from landscapes, would be inappropriate (Daniel 2001). And as discussed previously, what is "scenic" may not be natural or

even ecologically healthy (Gobster et al. 2007). Apparent naturalness can allude to a "landscape quality", but it may not mean what the assessment intended to understand (Daniel 2001).

In terms of "visual aesthetic quality", Lothian sheds light on the "objective-subjective" controversy. He states that if visual aesthetic quality is objective then it should be found within the "properties of the thing" and if it is subjective it is in the "mind of the human consumer". Along the same veins of consumerism, J.J. Gibson suggests in his theory of affordances, that people value landscapes for the benefits they are afforded, or provided (Gibson 2015). Again, this goes back to the debate between Carlson and Ribe about expert and perception-based valuation. Does the expert determine the objective qualities of which to measure? Or does preference depend solely on the viewer? In addition, landscape perception studies care about both visual and environmental quality. Daniel argues that there may be tradeoffs between the two. He argues for a balance between the expert and perception based approaches. The expert approach leans toward an objective approach to aesthetics, where the visual qualities are deemed valuable by a design professional. However, this method lacks validity, as two design professionals can come to different conclusions about valuable visual qualities in the same site. The perception based approach leans toward the subjective approach to aesthetics. (Daniel 2001)

Several theories strive to better understand how people's interactions with their environment impacts their preference. Psychophysical theory relates to a viewers' "perceptual factors (e.g. visual penetration, focality, complexity) and emotional responses (attention, stress-reduction)" to the environment (Daniel 2001, 273). Cognitive theories consist of the factors within the relationship between humans and the landscape (Daniel 2001). Such as the Appleton's prospect and refuge theory, where he suggests an underlying biological need to see (prospect) without being seen (refuge) within an environment (Appleton 1996, 66). He believes this can

lead to an "immediate source of aesthetic satisfaction" (Appleton 1996, 66). Daniel argues that more visual assessments need to integrate both expert and perception based approaches.

Visual Assessments and the Kaplans' Theory

Many visual assessments base their evaluations on Rachel and Stephen Kaplan's cognitive theory that people value landscapes based on what they offer in the way of understanding (legibility and coherence) and what they offer for exploration (mystery and complexity) (Kaplan and Kaplan 1995). For example, the Verde River Corridor Project (VRCP) conducted a visual assessment to engage the public and inform decision makers about the protection of the Verde river corridor (Whitmore, Cook, and Steiner 1995). Also an example of Daniel's request for an integrated approach, this visual assessment consisted of three sections to incorporate a gradient of expert and public perceptions: expert opinion, public valuation and public nomination. Adapted from an assessment approach developed by the U.S. Bureau of Land Management (BLM), the expert evaluation portion included environmental professionals documenting "scenic reaches" along the Verde river corridor with photos, descriptions, sketches and mapping. The photos generated by the experts were then ranked by the public by comparing physical characteristics. A third phase represented public nomination, where like the expert evaluation, the public nominates their favorite places in the Verde river corridor. It is through the public valuation phase that the assessment followed the Kaplan's perception theory that the public ranked the features in terms of legibility, complexity, coherence and mystery. Legibility measures how the viewer comprehends the landscape through visual elements, complexity refers to the intricacy of the landscape features, coherence refers to the arrangement of spatial elements and mystery refers to the viewers desire to know more (Whitmore, Cook, and Steiner 1995).

Direction of Landscape Perception Research

Many studies modeled their visual assessments after the Kaplan's perception study, but researchers now challenge the correlations between understanding and exploration with preference. Stamps conducted a meta-analysis evaluating the success of 61 visual assessments using Kaplan's theory (Stamps 2004). He found that these studies have not been reproducible and there is little correlation with preference; in fact he argues in favor of reevaluating the critical components relating public perception and preference (Stamps 2004).

Like the Verde River Corridor Study, landscape perception studies use a photo-based survey where respondents rate the photos based on their preferences (Shafer and Brush 1977, Nassauer et al. 2009, Jorgensen, Hitchmough and Calvert 2002). However, recent studies criticize the effectiveness of rating photos to reveal landscape preferences (Palmer 1995, Stamps 2004, Palmer and Hoffman 2001) because people typically do not view their preferences in terms of ratings (Palmer and Hoffman 2001). Recent research supports the use of the discrete choice experiment methodology because it imitates the decision-making process by presenting survey participants with a series of trade-offs rather than a rating (Johnson et al. 2013).

Discrete Choice Experiments

Stated preference (SP) survey methodologies imitate marketing assessments by providing respondents with a series of alternatives, each presenting a unique mix of attributes of varying levels (Louviere, Flynn and Carson 2010). A discrete choice experiment (DCE) is a SP choice-based method that extracts an understanding of attribute preference relationships from inter-linked choice behavior (Louviere, Flynn and Carson 2010). DCE emerged within research because it imitates the decision-making process by presenting survey participants with a series of trade-offs rather than a rating (Louviere, Flynn and Carson 2010; Johnson et al. 2013; Gobster, Ribe and Palmer 2019). It calculates the probability that a choice will be made through a

comparison of all alternatives (Louviere, Flynn and Carson 2010; Molin 2011). It is also desirable because it simplifies the rating process and in return has less respondent fatigue (Dillman 2014).

The process of developing a DCE involves determining attributes to measure, then assigning attribute levels, outputting attribute levels into a survey platform for the respondent to compare combinations of attributes and levels (Louviere, Flynn and Carson 2010). For a visual choice-based survey, the design of a DCE is coded within the photos. For example, each photo would represent a set of attributes (example A, B, C) and attribute levels (example 1, 2, 3) so a comparison would look like photo one representing A2 versus photo two representing C3. A part-worth utility is extracted in the analysis to determine how much "each attribute level contributes to the overall utility" to understand which attribute levels have the most impact on preferences (Molin 2011, 127).

Examples of DCE

While DCE methodology is cited in residential, healthcare and product research, calls have been made to better understand its potential for understanding indicators of preference for landscapes (Hurtubia, Guevara and Donoso 2015; Schirpke et al. 2018). Several studies used similar methodologies for landscape perception research, but often call for more research to improve the methodology (Hurtubia, Guevara and Donoso 2015; Schirpke et al. 2018).

One study uses a stated preference (SP) methodology to test the effectiveness of the method to extract preferences for qualitative attributes of public spaces (Hurtubia, Guevara and Donoso 2015). It explores the potential for SP to measure preferences for qualitative features, represented by design elements such as geometry, dimensions and design principles, such as safety, comfort and beauty (Hurtubia, Guevara and Donoso 2015). Researchers developed

images to represent varying levels of beauty, comfort and safety. They acknowledge the tradeoffs of using actual photos versus controlled manipulated photos. Actual photos offer a more realistic experience of the attributes, but may have additional uncontrollable factors such as lighting. Different lighting of the same object can elicit different responses (Hurtubia, Guevara and Donoso 2015). Manipulated photos provide a more controlled representation of attributes, but do not give as much of a realistic experience (Hurtubia, Guevara and Donoso 2015). This mainly explored the effectiveness of the method's use of photos over text and implications for using it in the field of landscape perception. They found that it was indeed effective and even comes with advantages, however they also suggest that the method comes with added complexities that should be carefully considered (Hurtubia, Guevara and Donoso 2015).

Another study uses a SP methodology to better understand how landscape indicators, or visual properties in the landscape, impact individual preferences for landscapes as well as observe groups of individuals who have similar preferences. All photos were taken during July and represent landscapes "such as alpine grassland, forest, agricultural landscapes and landscapes with anthropogenic elements". These photos were assigned attributes and attribute levels based on mapping and digital surface models. They were presented to randomly selected people who visit the sites such as locals, tourists or hikers. As a result, this study determined that the SP methodology was indeed effective at predicting landscape preferences. Especially for indicators that may be challenging for respondents to explain. For example, they found their results were in line with other studies that found a correlation between preference and open spaces with forest as a feature (like the scenic aesthetic). This study serves as an example of a SP using actual photos instead of photo manipulations to more accurately represent attribute levels. (Schirpke et al. 2018)

Both the study for understanding preferences for public space and the study for measuring landscape indicators exhibit how SP methodologies have the potential to be powerful tools for predicting landscape preferences (Hurtubia, Guevara and Donoso 2015; Schirpke et al. 2018). Both found that the method was successful in extracting information about individual preferences. They also found room for improvement as they gained a better understanding for the tradeoffs when using manipulated photos versus actual photos. Therefore, further research is needed to address the complexities associated with representing and measuring attributes in actual photographs.

New Ecological Paradigm Scale

In the 1970s, when environmental concerns about air and water pollution, loss of aesthetic values and resource conservation became more important public concerns, researchers began to look into ways to measure public attitudes towards "environmental concern" (Dunlap et al. 2000). The scale began as the New Environmental Paradigm (NEP) included several focuses: "beliefs about humanity's ability to upset the balance of nature, the existence of limits of growth for human societies, and humanity's right to rule over the rest of nature" (Dunlap et al. 2000). These focuses found in twelve questions and a high score would reveal pro-environmental beliefs (Dunlap et al. 2000).

After years of testing the scale (on a variety of populations, even other countries), creators modified the scale. The new scale, titled the New Ecological Paradigm, would better cover elements of the ecological worldview, improve the balance of a pro- and anti-NEP direction and remove sexist terminology (such as mankind to humankind) (Dunlap et al. 2000). The new scale comprises a series of fifteen questions within five facets of an ecological worldview: the reality of limits to growth (1, 6, 11), anti-anthropocentrism (2, 7, 12), the fragility

of nature's balance (3, 8, 13), rejection of exemptionalism (4, 9, 14) and the possibility of ecocrisis (5, 10, 15). Agreement with the eight odd numbered items and disagreement with the seven even-numbered indicates a pro-ecological worldview (Dunlap et al. 2000).

Table 1: Total Correlations for New Ecological Paradigm Scale Items

	Do you agree or disagree that:	**SA**	**MA**	**MD**	**SD**
1	We are approaching the limit of the number of people that the earth can support.	2	1	-1	-2
2	Humans have the right to modify the natural environment to suit their needs.	-2	-1	1	2
3	When humans interfere with nature it often produces disastrous consequences.	2	1	-1	-2
4	Human ingenuity will ensure that we do not make the earth unlivable.	-2	-1	1	2
5	Humans are severely abusing the environment.	2	1	-1	-2
6	The earth has plenty of natural resources if we just learn how to develop them.	-2	-1	1	2
7	Plants and animals have as much right as humans to exist.	2	1	-1	-2
8	The balance of nature is strong enough to cope with the impacts of modern industrial nations.	-2	-1	1	2
9	Despite our special abilities, humans are still subject to the laws of nature.	2	1	-1	-2
10	The so-called "ecological crisis" facing humankind has been greatly exaggerated.	-2	-1	1	2
11	The earth is like a spaceship with very limited room and resources.	2	1	-1	-2
12	Humans were meant to rule over the rest of nature.	-2	-1	1	2
13	The balance of nature is very delicate and easily upset.	2	1	-1	-2
14	Humans will eventually learn enough about how nature works to be able to control it.	-2	-1	1	2
15	If things continue on their present course, we will soon experience a major ecological catastrophe.	2	1	-1	-2

Questions in this section asked to what degree did the respondent agree or disagree with the statement. The respondent selects from the following SA = Strongly Agree, MA = Mildly Agree, U = Unsure, MD = Mildly Disagree, and SD = Strongly Disagree. Each question represents a value; Agreement with the eight odd-numbered items and disagreement with the seven even-

numbered items indicate pro-NEP responses. When added together, a higher score represents a pro-environmental worldview and a lower score indicates a lack of environmental concern.

NEP is still fairly new to landscape aesthetics research. It is included in this study as a potential link to stewardship. The literature suggests that a higher environmental concern score is associated with pro-environmental behavior (that could be a form of stewardship) (Steg and Vlek 2008). While this correlation is not strong, it's enough to be discussed in the literature and explored in further research (Steg and Vlek 2008). The literature also suggests a correlation between higher NEP scores and education (Bjerke 2006). It could be that those who are more educated and engaged in environmental concerns are more aware of practices such as bioretention (Bjerke 2006). And, as ecological aesthetics suggests, perhaps someone who is more familiar with the function of ecological designs, would be more likely to appreciate them even if they lack visual aesthetics.

CHAPTER 3

METHODS

This thesis consists of a landscape perception study evaluating seasonality in Southeastern coastal bioretention practices. The following section outlines methods used to evaluate perceptions and provides descriptions for site selection, photo collection, survey design and analysis methods.

Site Selection

This project focuses on bioretention practices in an urban coastal context. I designed this thesis project in partnership with UGA Marine Extension and Georgia Sea Grant (MAREX-SG). While bioretention practices suffer from improper management in many environments, MAREX-SG helps design and monitor several sites in Georgia's coastal plain.

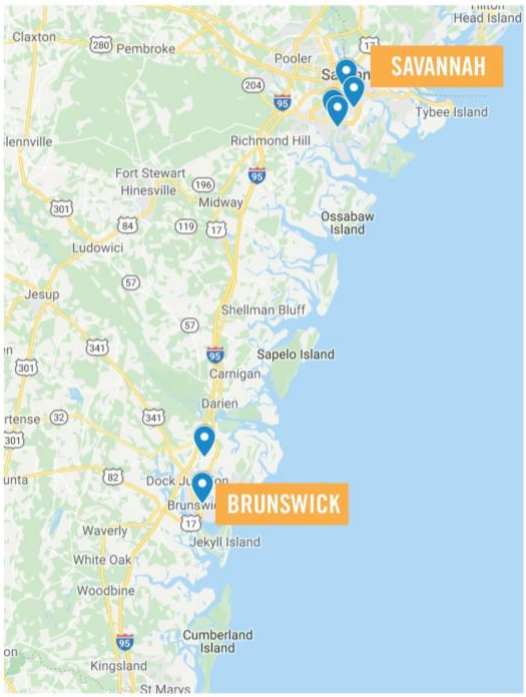


Figure 2: Map of Sites

Map of project sites, by Broich, Kelsey. “Map of Bioretention Sites.” 2019. jpeg.

Jessica Brown, stormwater specialist for UGA Marine Extension and Georgia Sea Grant, and I selected six sites using the 2017 Coastal Low Impact Development Best Management Practices inventory ("Coastal" 2017). Each site represents a bioretention practice (the second most commonly used practice within the inventory) in Georgia's Coastal Plain. They also represent a public space and a well-functioning bioretention practice at the time of selection. The selection includes bioretention practices located at a public park, an airport, a restaurant, a school, a hospital and a hospice facility. All sites are located in the municipalities of Brunswick and Savannah, Georgia.

Photo Collection

This study uses actual photos instead of photo manipulations to more accurately represent attribute levels (winter, fall, spring. etc.). I photographed six sites during five site visits

throughout the year between December 2018 and September 2019. Visits occurred approximately every other month. In the end, I completed five visits across December, February, April, June and September. During each site visit, I used both an iPad and Canon EOS 60d camera to capture site images.

I used Stop Motion Studio, a stop motion movie app, on an iPad to ensure consistent photos across the seasons ("Stop Motion Studio"). The app overlays the last photo over the camera's viewfinder to align the next image with the last (see Figure 3). This results in a consistent alignment and view from the previous visit. Once I found the last position of the camera with the iPad, an additional photo was taken with a DSLR camera for higher quality images. During each visit, I documented almost five different vantage points for each site. A total of 641 photos were captured with the DSLR camera. While almost five different vantage points were captured at each site, upon review of the quality of the photos across the seasons, three was determined to be the maximum number of consistently aligned photos across the seasons. For example, one site may have had a photo in one season that was noticeably misaligned compared to the other photos of the same vantage point.

Photos were then sorted and edited to correct shadows and exposures. After evaluating and correcting the white balance, shadows and exposure for all of the photos, I collected 15 photos from each site (see example above in figure 4) and used 90 photos for the pilot survey. I decided to remove one site based on the results of the pilot survey. The final survey displayed 75 photos.

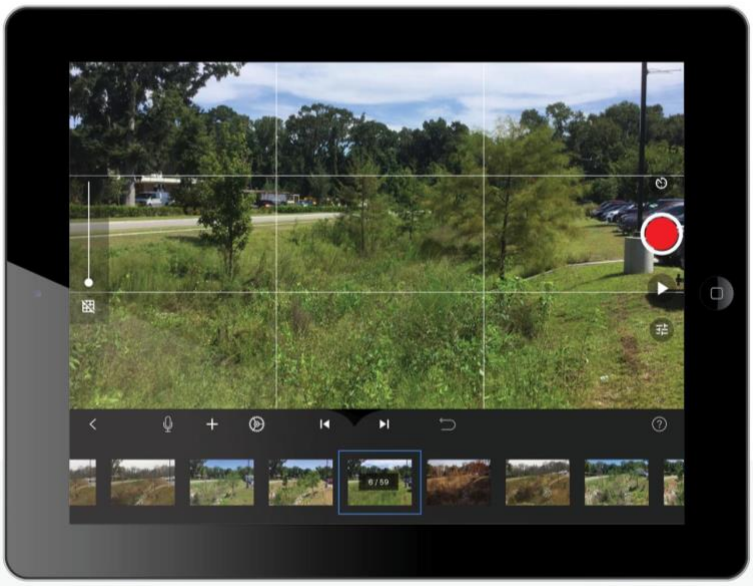


Figure 3: Screenshot of Stop Motion Studio iPad App

Screenshot of Stop Motion Studio camera viewer, by Broich, Kelsey. “Screenshot Stop Motion Studio.” 2019. jpeg.

Figure 4: Example of Photos Collected at One Site

Example of photos collected at one site, by Broich, Kelsey. “Hospital Site photos.” 2019. jpeg.

Survey Design

I created the DCE, the section of the survey asking participants to select a preference between two seasonal photos of bioretention systems, in Sawtooth Software's Choice-based Conjoint Survey and distributed it online ("Sawtooth Software"). Sawtooth Software provides a platform to easily create a DCE survey. Through Sawtooth, I implemented attributes (seasons, site and view), decided which would be tested (in the pilot, seasons and site, and in the final survey, seasons) and added a photo for each attribute combination (example winter, site 2, view b). Other design selections include how many photos the respondent sees at one time, how many comparisons will be completed, if the comparisons are random or controlled and the inclusion of a “none” option. My survey presented respondents with two photos and a none option and completed 20 randomly selected comparisons. ("Sawtooth Software")

Sampling Population and Population Strategy

The target population, or all of the individuals needed to generalize results (Dillman 2014), includes anyone who has the potential to make decisions that will alter landscapes. For example, anyone who is 18 or older could impact the management of landscapes such as mowing the lawn for a personal residence or making landscaping plans for a business. Because the location of all the sites are within the coastal plain, I limited the sampling to zip codes within the Coastal Plain ("Ecoregions" 2016). Respondents within the Coastal Plain will better represent the context of our sites because they will have familiarity with coastal context and vegetation.

In order to represent the identified target population, I extracted the sampling frame (the list of acceptable respondents for this sample) through mapping (Dillman 2014). Using the Environmental Protection Agency's (EPA) Ecoregions Level III of North America map, I extracted zip codes within the two ecoregions ("Ecoregions" 2016).

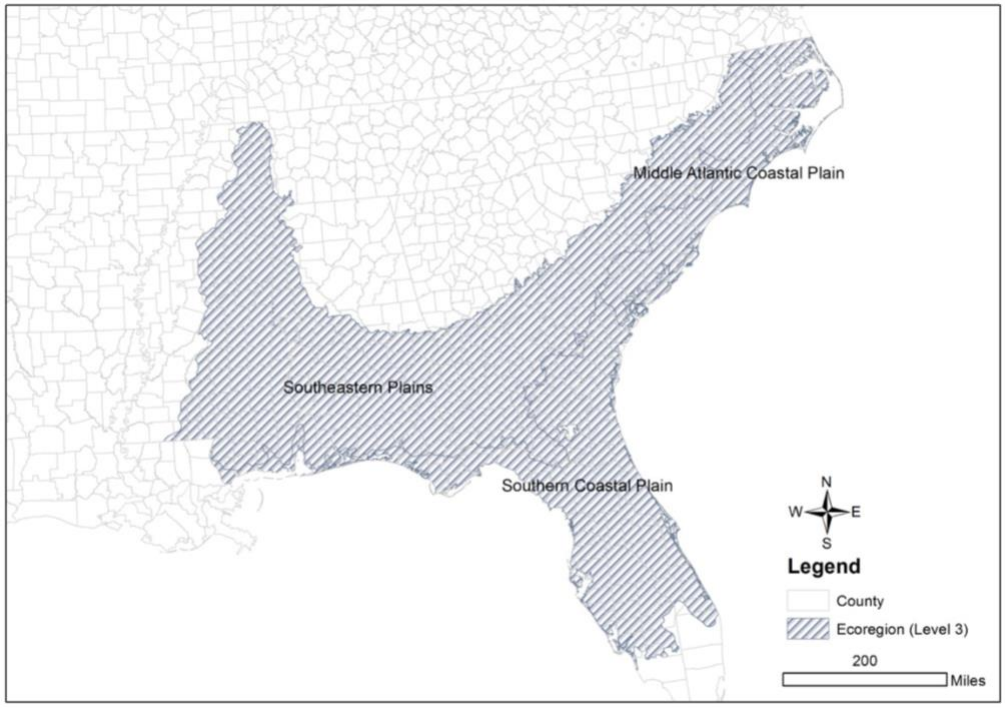


Figure 5: Sampling Region using the Coastal Plain Ecoregions Level III of North America Map (2006)

The regions most appropriate for the study were 8.5.3 Southern Coastal Plain and 8.3.5 Southeastern Plains as identified on the Ecoregion Level III North America Map (2006) and within the North American Terrestrial Ecoregions – Level III descriptions (Wiken, Nava and Griffith 2011). The Southern Coastal Plain represents the ecoregion encompasses the location of the project's bioretention sites. I included the Southeastern Plains, an "interior coastal plain", because the description of the physical characteristics such as vegetation were very similar to the Southern Coastal Plain. In addition, while still predominantly Florida, this decision broadened the scope of the project to include more Georgia residents. In addition, broadening the target population helps ensure a larger sample size in the time frame of the survey (Dillman 2014).

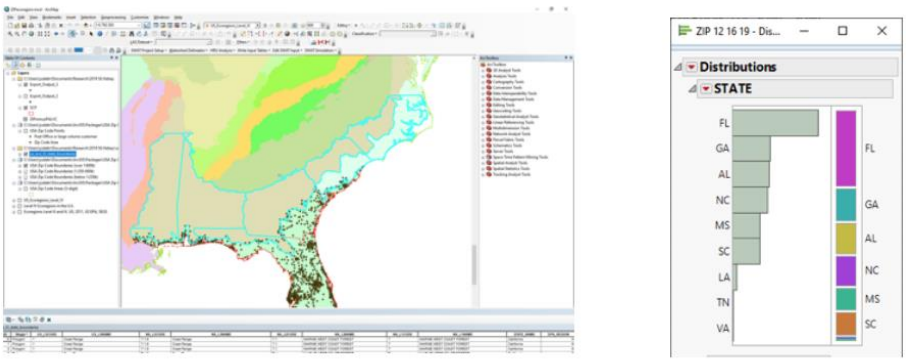


Figure 6: GIS Map of Coastal Plains and Southeastern Plains Ecoregions

Both the Ecoregion Level III North America and USA zip code maps were imported into GIS as layers. These layers were used to extract zip codes specifically within the two identified ecoregions by selecting features (or zip codes) by location (or Ecoregions). Zip codes for PO boxes were removed by filtering for zip code addresses only. I removed PO Box zip codes because they do not represent physical addresses.

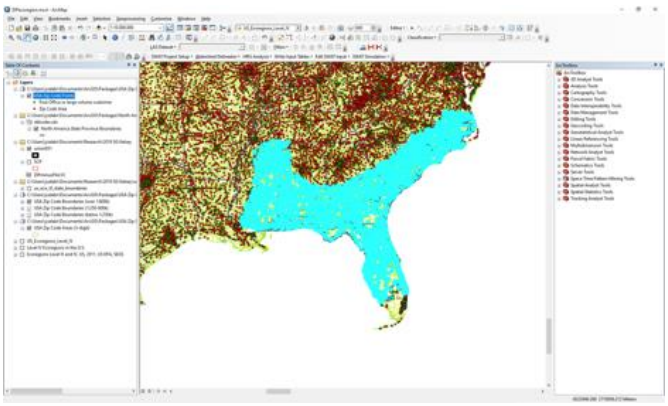


Figure 7: GIS Map After Extracting All Zip Codes

Lack of General Population Internet Frame

Because of the use of an online survey, it is difficult to fully represent the general population (Dillman 2014). Web surveys typically use self-selected panels of respondents or intercepting people while they are online and asking them to complete surveys (Dillman 2014).

Because this is a form of non-probability sampling, web surveyors often rely on a large sampling size and quota sampling using a survey panel (Dillman 2014). Quota sampling, a non-probability method, identifies sample characteristic targets such as 51% female (Dillman 2014). The target population identifies characteristics such as a general public demographic breakdown, coastal zip codes and age requirements. A simple random sampling method reduces coverage error (Dillman 2014). I used quota sampling and simple random sampling through a Qualtrics panel and a series of screening questions.

Survey Overview

I conducted an online survey ("Sawtooth Software" 2019, "Qualtrics" 2019). Qualtrics calculated the survey's sample size (n=985) and used screening questions to meet the demographic distribution and quotas. Respondents start in the Qualtrics portion answering a series of demographic questions. Then they complete the Sawtooth portion, a discrete choice experiment (DCE) exercise, including 20 photo comparisons in randomized order. By request of the IRB (Institutional Review Board), I included a "none" option to serve as a "non-response" (Dillman 2014). After the DCE portion, respondents answered a series of questions from the New Ecological Paradigm (NEP) to reveal their environmental worldview or level of concern for the environment (Dunlap et al. 2000). Finally, they respond to an open-ended question about any of their experiences with bioretention systems, gardening and maintenance.

Discrete Choice Experiment

I chose Discrete Choice Experiment (DCE) as the survey approach for its potential to better understand predictors of preference and their weightings in determining response. Research suggests that it better represents the decision making process because it represents the tradeoffs behind responses instead of a single rating (Louviere, Flynn and Carson 2010). I

created the DCE portion of the survey in Sawtooth Software. This software allows surveyors to create a choice-based conjoint exercise. The surveyor adds attributes and attribute levels to create a design of comparisons that will be seen on the survey. My survey outputs 20 randomized photo-pairs enabling comparison between two concepts (or photos) and a none option.

Attributes Selection

I selected attributes and attribute levels to represent each photo within the survey. For example, Sawtooth Software's Choice-based Conjoint survey format presents survey participants with two "concepts" at a time, in this case two photos and a series of related attributes. Each concept represents a combination of attributes and levels (as illustrated in Figure 8), but in this case are only revealed through the photos shown to the survey participant. While conjoint analysis can be used for complex analysis with six or more attributes (Hurtubia, Guevara and Donoso 2015; Schirpke et al. 2018), my thesis tests primarily for seasonality. I used seasonality, site and view as attributes to represent each photo within the survey. However, we only tested for seasonality. The view, or vantage point, were not explicitly similar between sites. The site and view served as organizational tools to input all photos into the survey.

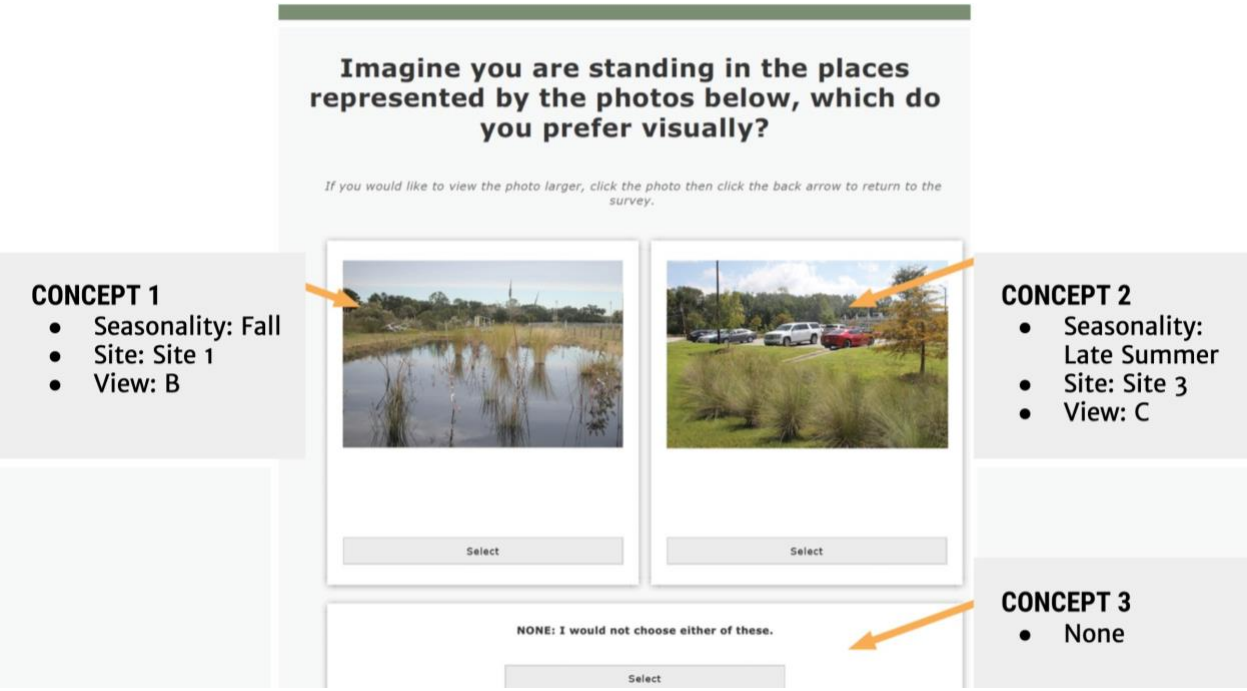


Figure 8: Example Survey Question and Concepts with Attributes

An example of a survey question with coded attributes and attribute levels as viewed by the respondent. Image by Broich, Kelsey. "Sample Survey Question." 2019. jpeg.

New Ecological Paradigm Scale

Respondents were asked how much they agreed or disagreed with a series of statements from the New Ecological Paradigm (NEP) to better understand their environmental worldview (Dunlap et al. 2000). The NEP scale is analyzed by taking a sum of all of the answers to produce a score: high scores (1 to 30) indicate a pro-NEP while low scores (-1 to -30) represent a lack of environmental concern (Dunlap et al. 2000). The scores were divided into increments: -30 to -11 very anti-environmental, -10 to -1 moderately anti-environmental, 0 neutral, 1 to 10 moderately pro-environmental and 11 to 30 very pro-environmental.

Analysis

I used Hierarchical Bayesian (HB) analysis to estimate utilities, or values revealing which attributes carry the most weight on chosen preferences and are based on a series of comparisons (Louviere, Flynn and Carson 2010). HB balances between two "hierarchies": an upper that represents whether two levels are typically preferred together and a lower representing the fit of an individual's part worth utilities with the level of fit within the population sample. Sawtooth conducts 10,000 iterations using the utilities from the two hierarchies. It estimates a summarized utility score and these utilities represent the importance of a level (such as fall, winter, spring, summer).

Counts analysis calculates the portion that attribute level (fall, winter, spring, summer, late summer) was chosen based on the number of times it occurred in the survey. The results reveal the seasons and photos that were most and least preferred. I compare most and least preferred photos to an anecdotal list of additional factors to explore any other factors that could influence preference such as a red car, open water, flower plants etc. I compare demographic data to preferences to explore any correlations between groups of similar demographics (Creswell 2014). I also compare preferences to the New Ecological Paradigm to see if environmental attitudes drive preference (Dunlap et al. 2000).

CHAPTER 4

PILOT SURVEY, RESULTS AND DISCUSSION

Overview

I presented the results of the following pilot study findings at the 2019 Visual Resource Stewardship Conference (Broich et al. 2019). In the fall of 2019, I distributed an online pilot survey (n=53) to the University of Georgia's College of Environment and Design's student email lists (including both graduate and undergraduate students). Our sample consisted of students with backgrounds in landscape architecture or similar fields such as urban planning and historic preservation. The pilot survey presented participants with 20 random pairs of photos and asked to select which they preferred visually. Additional questions asked for demographic information and open-ended questions about experience with management.

Landscape designs often promote a static vision, yet landscapes change over time, both physically in vegetation and culturally in how people respond to them. Recent calls advocate for designing for dynamic landscapes, yet few studies have been conducted measuring perceptions of seasonal qualities. Stormwater management practices such as bioretention areas are used as examples of landscapes with important ecological functions, but poor landscape aesthetics. If their function is not visible or if they are not aesthetically pleasing they are at risk of being managed improperly. We wonder if year-round seasonal interest will increase appreciation and therefore promote better management of bioretention cells. This study evaluates the public's perception of bioretention cells across the seasons. We conducted a pilot survey comparing seasonal photos of six bioretention practices in the Coastal Plain of Georgia, USA. The results of

the pilot survey revealed the significance of seasonality and a preference for late summer. Further analysis and the next iteration of the survey have potential to more deeply understand what factors of late summer contributed to their preference.

Results

The box and whisker plot below reveals each seasonal attribute's utility score, or the amount the attribute level contributed to a person's choice. The results reveal a significant difference between winter and the other seasons (X_2 (4, N=53) = 33.255, p < 0.01).

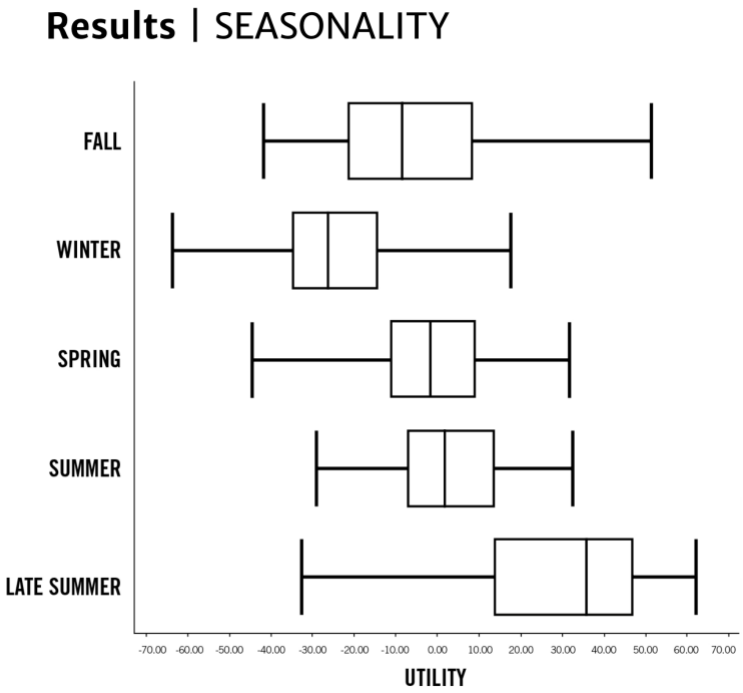


Figure 9: Seasonality Box and Whisker Plot

The box and whisker plot was generated using Hierarchical Bayesian (HB) analysis. Utility numbers were given to each attribute level based on how much the attribute contributed to a person's choice. Seasonality was significant (X_2 (4, N=53) = 33.255, p < 0.01). Late summer was most preferred and winter was less preferred compared to spring, summer, late summer and fall. Sawtooth Software. “Box and whisker plot of conjoint analysis for seasonality.” 2019. jpeg.

Counts analysis reveals that winter was the least preferred and was chosen 33.8% of the time it occurred in the survey (X_2 (4, N=53) = 33.255, $p < 0.01$). Late summer was the most preferred and was selected 59.8% of the time it occurred (X_2 (4, N=53) = 33.255, $p < 0.01$). Respondents selected late summer almost 20% more than fall, spring and summer, and about 25% more than winter.

The pilot study also revealed that additional factors influenced preference. Differences between sites overwhelmed differences attributed to seasonality. Photos from one particular site that had trees, shade, open water and less grassy vegetation and were selected more than other photographs, suggesting that the specific qualities of that site were driving preferences. Out of the top five most selected photos, four were from this site.

Discussion for further research

The pilot survey was conducted to test the survey methodology and make improvements for a survey with a larger sample size. The questionnaire asked respondents about demographics, experience with management and questions to determine a participant's attitude toward environmental concerns, but the sample was too small to analyze these components. With a larger sample, researchers can draw conclusions about the general population's perceptions of bioretention areas and seasonality by segmenting demographics, experience and environmental attitudes.

The discrete choice experiment proved to be an effective method for extracting preferences. As revealed in the pilot survey, by presenting a series of tradeoffs we can better understand the attributes that weigh the most on participants' preferences. However, further research is needed to understand specific qualities within the preferred attribute levels.

While seasonality was the focus of the study and was significantly different (X_2 (4, N=53) = 33.255, $p < 0.01$), further research was needed to determine what qualities within seasonality contribute to preference such as fall color or flowering. This could be done through further comparison of the sites, as well as documenting additional factors in each photo (such as photos with prominent cars, open water, flowering plants etc). The site with open water was overwhelmingly preferred, so it was removed in the later survey to help focus the test on seasonality, since gaining a better understanding of significant indicators of preference could lead to design recommendations.

CHAPTER 5

SURVEY, RESULTS AND DISCUSSION

Overview

In January of 2020, I distributed an online survey to a Qualtrics panel. The panel sampled from residents within the Southern Coastal Plain and Southeastern Plains (8.5.3 Southern Coastal Plain and 8.3.5 Southeastern Plains as identified on the Ecoregion Level III North America map (2006)). The survey consisted of demographic questions (through Qualtrics), 20 comparisons of seasonal photos, questions about experience with management and questions from the New Ecological Paradigm that gauges respondents' attitudes toward environmental concern.

Within the comparisons, human subjects considerations would not allow me require a response. A "none" option was provided, but was tracked to avoid straight-lining or low responses where panel responses rush to complete the task without serious participation. When collecting data 24% of respondents selected the "none" option, leading to inconclusive findings. Respondents who selected "none" for more than half of the comparisons were excluded to reduce nonresponse bias and to avoid straight-lining (Dillman 2014). Other screening criteria included: an age restriction (> 18 years), residence within the Southern Coastal Plain and Southeastern Plains. Demographic quotas were set to best represent the sampling frame for the study.

Qualtrics set an initial sample size (n=500) and successfully collected that amount (n=511). However, code to prevent over-quotas malfunctioned and 484 additional valid responses were collected (n=995). The smaller sample (n=511) closely resembles the general

population, but analysis comparing the smaller and larger samples (n=995) revealed similar conclusions. Therefore, results presented are based on the larger sample (n=995).

Results

Table 2: Survey Demographics Compared to U.S. and Georgia "U.S. Census Bureau QuickFacts" (2020) and the "2010 Census – Block Maps" (2019)

	U.S.*	Georgia*	Georgia's Coastal Plain	Survey
Population	328,239,523	10,617,423	2,688,012	985
Sex				
Female	50.80%	51.40%	50.96%	65.77%
Male	49.20%	48.60%	49.04%	34.23%
Race and Hispanic Origin				
White	76.50%	60.50%	58.56%	72.62%
Black or African American	13.40%	32.40%	33.93%	18.36%
American Indian and Alaska Native	1.30%	0.50%	0.31%	1.10%
Asian	5.90%	4.30%	0.96%	2.71%
Native Hawaiian and Other Pacific Islander	0.20%	0.10%	0.08%	0.20%
Other | Two or More Races	2.70%	2.20%	6.16%	*5.01%*

*QuickFacts provides statistics for all states and counties, and for cities and towns with a population of 5,000 or more.

Demographic Results

Although gender was not balanced in the larger sample, the results for seasonal preferences were similar to the smaller sample. For example, instead of 49% male and 51% female ("U.S. Census Bureau QuickFacts" 2020), the larger sample was 65% female and 35% male. Aside from the imbalance in gender, many of the categories were representative of the U.S. Census's demographic estimates. For race and ethnicity, the survey participants were representative of 2019 U.S. Census estimates that predicted three largest categories to be 76.5% White, 13.4% Black or African American and 18.3% Hispanic or Latino. However, compared to

the demographic distribution of Georgia's Coastal Plain, there was underrepresentation for blacks of African Americans. The sample was slightly higher than U.S. estimates for education. The 2014-2018 estimates suggested 87.7% of the population having a high school degree or higher education and 31.5% having a bachelor's degree or higher. The survey 95% of survey respondents have a high school degree or higher education and 53% have received higher education.

One of the benefits of reporting on the larger sample is the state distribution. Because I set the parameters of sampling the population within the Coastal Plain and Southeastern Plains, I expected most of the sample (33%) to come from Florida, where many residents are retirees. I added the Southeastern Plains that increased the sampling area for Georgia from 10% to 15% and reduced Florida from 75% to 33%. Results from the larger sample increased Georgia's representation, making up 25.5% of the state distributions.

Table 3: Survey Demographic Distribution

AGE	% of Total
18-34	34.80%
35-54	40.42%
55 or older	24.77%

GENDER	% of Total
Female	65.06%
Male	34.64%
Other	0.10%
Prefer not to say	0.20%

EMPLOYMENT	% of Total
Employed full-time	36.85%
Employed part-time	13.15%
Retired	18.27%
Student	6.33%
Unable to work	7.83%
Unemployed	17.57%

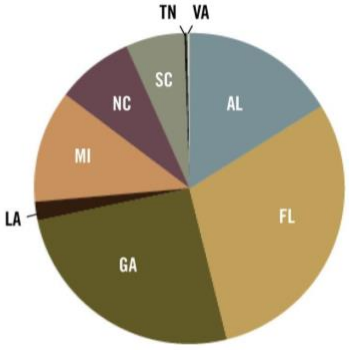
INCOME	% of Total
<$30,000	33.13%
$30,000-60,000	34.65%
$60,000-100,000	18.03%
>$100,000	14.18

ETHNICITY	% of Total
American Indian or Alaska Native	1.10%
Asian	2.71%
Black or African American	18.36%
Hispanic, Latino, or Spanish	3.61%
Middle Eastern or North African	0.20%
Native Hawaiian or Other Pacific Islander	0.20%
Some other race or ethnicity	1.20%
White	72.62%

EDUCATION	% of Total
Some high school	5.37%
High school degree or equivalent	41.95%
Bachelor's degree	26.95%
Master's degree	11.85%
Doctorate	3.24%
Other	10.64%

MARITAL STATUS	% of Total
Divorced	9.02%
Married or in a domestic partnership	53.81%
Single (never married)	33.07%
Widowed	4.11%

STATE	% of Total
Alabama	16.27%
Florida	29.92%
Georgia	25.50%
Louisiana	2.11%
Mississippi	11.65%
North Carolina	7.93%
South Carolina	6.33%
Tennessee	0.20%
Virginia	0.10%



The graphic above illustrates the demographic distribution of the respondents who answered the survey (n=995).

New Ecological Paradigm (NEP)

Results reveal that 80% of respondents had low NEP scores indicating a lack of environmental concern. I conducted a one-way Analysis of Variance (ANOVA) to better understand the relationships between demographics and NEP. I found a significant difference between NEP scores and gender ((F(319, 597) = 1.1235, p < 0.0001). A chi-square test also revealed a significant difference in mean NEP scores between genders (F(319, 597)= 1.1235, p < 0.001). Men were more likely than women to be pro-environmental (X_2 (4, N=964) = 30.646, p = 0.0001). When looking at individual relationships, a chi-square test also revealed a significant relationship between age and the NEP scores (X_2 (8, N=963) = 27.835, p < 0.0005). Those who were 55 or older were more likely to be pro-environmental than those who were 18-34 or 35-54 (X_2 (8, N=963) = 27.835, p < 0.0005).

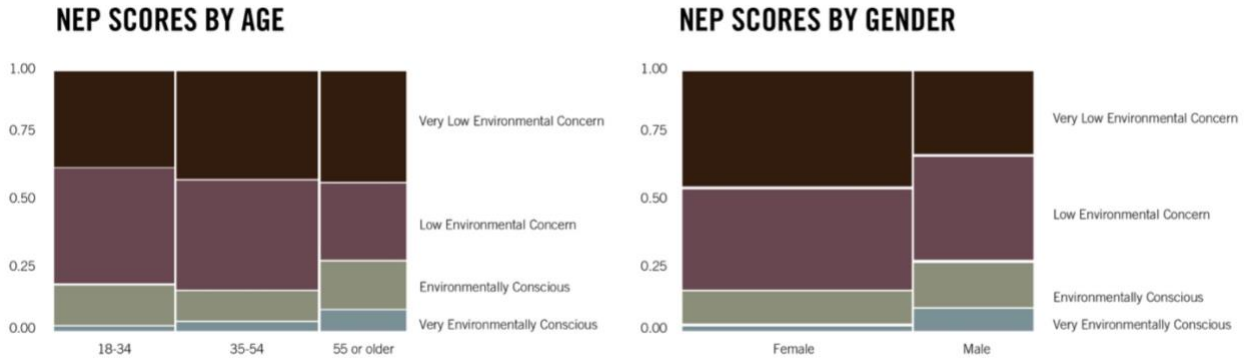


Figure 10: Mosaic Graphs of Correlations between NEP scores and Age and NEP scores and Gender

Preferences for Seasonality

Hierarchical Bayesian Analysis

The box and whisker plot (Figure 12) generated by HB analysis, reveals the importance of seasonality. Again, the growing seasons (spring, summer and late summer) are more preferred than the dormant seasons (winter and fall) (X_2 (4, n = 985) = 928.490, p =0.01). However, even with a large sample, the explanation of variance resulted in a low adjusted R_2 value (F(4, 943)= 2.0899, p=0.0802). I conducted an ANOVA test to understand relationships between demographics and seasonal preferences, but found no significant difference (F(8, 26)= 1.0165, p = 0.4483). Another ANOVA test also found no significant differences between NEP scores and seasonal preferences (F(4, 943)= 2.0899, p = 0.0802).

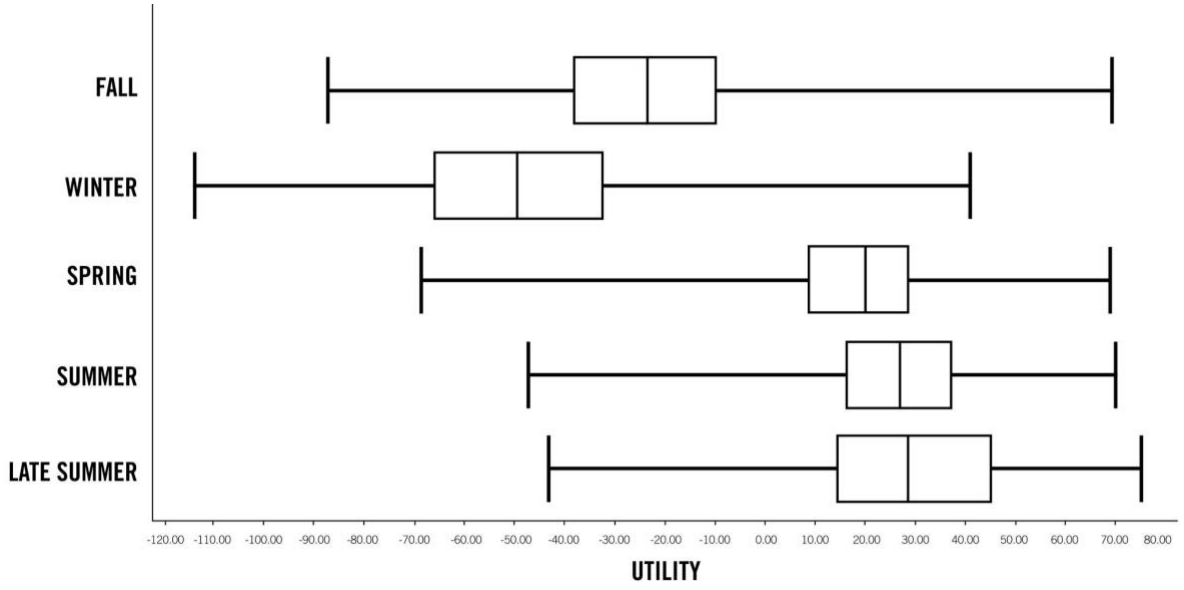


Figure 11: Seasonality Box and Whisker Plot (n=985)

Table 4: Average Utility Values Zero-Centered Differences

Average Utility Values Zero-Centered Differences

SEASONS	*Average Utilities*	*Std Deviation*	*Lower 95% CI*	*Upper 95% CI*
Fall	-25.01	22.34	-26.41	-23.62
Winter	-52.69	17.87	-53.81	-51.57
Spring	20.46	19.05	19.27	21.65
Summer	29.24	15.17	28.30	30.19
Late Summer	28.00	20.45	26.72	29.28

Total Respondents: 985

Counts Analysis

Counts analysis calculates the proportion a level (fall, winter, spring, summer, late summer) was chosen based on the number of times it appeared in the survey. Spring, summer and later summer were selected around 50% of the time they occurred, while fall and winter were chosen less than 50% of the time they occurred with fall at 35% and winter at 27.9% (X^2 (4, n = 995) = 925.990, $p < 0.01$).

Table 5: Counts Analysis for Seasons

Counts Results

SEASONS	% Chosen*	
Fall	35.2%	Total Respondents: 995
Winter	27.9%	Within Att. Chi-Square:
Spring	49.7%	925.990
Summer	52.0%	D.F. 4
Late Summer	52.5%	Significance p < 0.01

** Percent chosen based on times it occurred*

SEASON	SITE	% Chosen*
Late Summer	Site 3	64.1%
Spring	Site 2	63.1%
Summer	Site 2	58.5%
Late Summer	Site 2	57.0%
Summer	Site 5	54.1%
Spring	Site 3	52.9%
Summer	Site 3	52.5%
Late Summer	Site 4	49.5%
Late Summer	Site 5	48.5%
Summer	Site 1	48.4%
Spring	Site 4	47.2%
Spring	Site 5	47.2%
Fall	Site 5	47.1%
Summer	Site 4	46.7%
Late Summer	Site 1	43.9%
Spring	Site 1	38.4%
Fall	Site 1	36.8%
Winter	Site 3	35.3%
Fall	Site 3	33.6%
Fall	Site 2	30.1%
Winter	Site 2	30.0%
Winter	Site 5	29.3%
Fall	Site 4	27.8%
Winter	Site 1	22.2%
Winter	Site 4	21.9%

** Percent chosen based on times it occurred*

Most Preferred

LATE SUMMER SITE 3 | SPRING SITE 2 | SUMMER SITE 2

Least Preferred

WINTER SITE 4 | WINTER SITE 1 | FALL SITE 4

Figure 12: Photo Comparison of Most and Least Preferred

Table 6: Counts Analysis Individually by Gender

Counts Results | Female

SEASONS	% Chosen*	
Fall	34.6%	Total Respondents: 644
Winter	26.2%	Within Att. Chi-Square: 699.682
Spring	50.7%	D.F. 4
Summer	52.3%	Significance p < 0.01
Late Summer	52.4%	

** Percent chosen based on times it occurred*

Counts Results | Male

SEASONS	% Chosen*	
Fall	36.2%	Total Respondents: 341
Winter	30.8%	Within Att. Chi-Square: 242.467
Spring	47.9%	D.F. 4
Summer	51.7%	Significance p < 0.01
Late Summer	52.9%	

** Percent chosen based on times it occurred*

When looking at the seasonal preferences by gender, there was no difference ($F(8, 26)= 1.0165$, $p = 0.4483$). Interestingly, when each gender was evaluated individually with counts analysis, women chose winter less than men by choosing it 26.2% (X_2 (4, n = 644) = 699.682, $p < 0.01$) as opposed to men who chose winter 30.8% of the time it occurred (X_2 (4, n = 341) = 242.467, $p < 0.01$). The late summer season was selected 64.1% of the times they occurred. The next three

most popular site photos were from the Site 2 for spring (63.1%), summer (58.5%) and late summer (57%) (X_2 (16, n = 985) = 208.891, $p < 0.01$). The least popular group from Site 4 in winter was chosen 21.9% of the time it occurred (X_2 (16, n = 985) = 208.891, $p < 0.01$). The second least popular group from the Site 1 in winter was chosen 22.2% of the time it occurred (X_2 (16, n = 985) = 208.891, $p < 0.01$).

Comparing Photos to Additional Factors

After identifying the most and least preferred photos, I compared groups of photos from the rankings to explore any commonalities. The least preferred photos included Site 4 in winter, Site 1 in winter and Site 4 in fall (X_2(16, n = 985) = 208.891, $p<0.01$). The most preferred photos include the Site 3 in late summer, the Site 2 in spring and the Site 2 in summer (X_2(16, n = 985) = 208.891, $p<0.01$). I used a website that takes a jpeg and runs a javascript to compute the average color for each image ("Get Average Color of Image"). Though anecdotal, all the least preferred images had average colors that were either brown or grey and the most preferred photos were mostly blue or green. This may indicate a reaction to color, perhaps respondents were immediately drawn to green photos over brown.

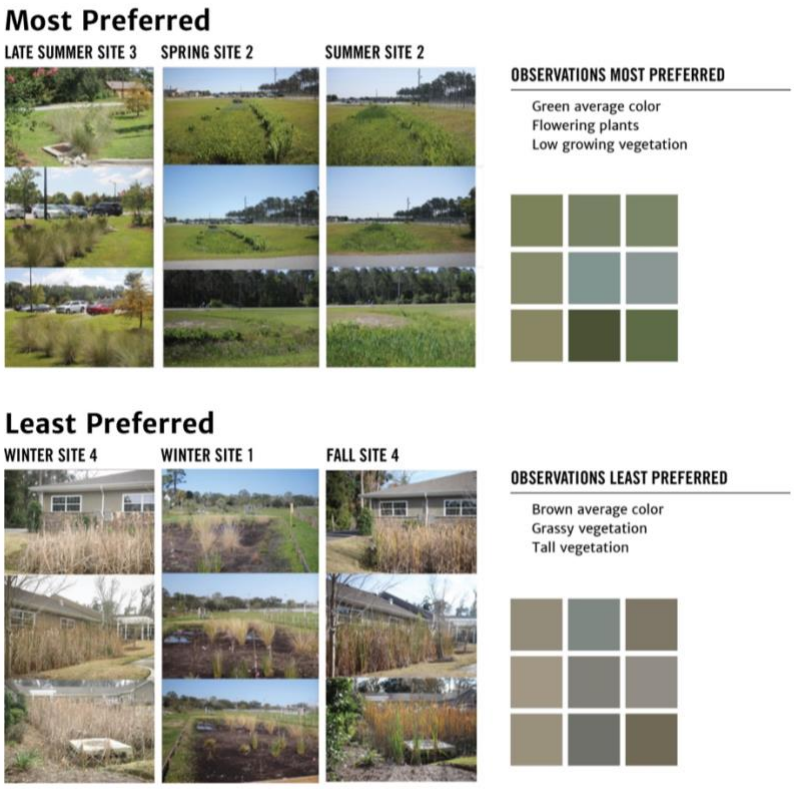


Figure 13: Most and Least Preferred Photo Comparison and Additional Factors

Vegetation is another difference between the groups. The least preferred groups have brown grasses that could be perceived as tall and dormant ($X_2(16, n = 985) = 208.891, p<0.01$). The literature suggests a preference for flowering plants and that flowering plants can be viewed as emblems of care (Nassauer 1995b; Hoyle, Hitchmough and Jorgensen 2017). Correspondingly, I found that the most preferred photos have green vegetation that is relatively low growing and flowering ($X_2(16, n = 985) = 208.891, p<0.01$). The vegetation comparisons reveal several additional factors that could influence preference. Respondents may express preferences for living over dormant. Or the grasses in the least preferred photos may look tall because of how much space they take up in the photo, compared to the preferred photos where the background is visible beyond the vegetation. Like other ecological designs, bioretention typically reduces mown lawn, increases biodiversity and does not require as much trimming (Oudolf and

Kingsbury 2013). However, the literature supports these observations about preference because Nassauer found evidence that people prefer the following qualities in "cues to care": neatness, order, crisp edges, fences, trimmed vegetation, mown turf, colorful flowers and physical signs describing ecosystem function (Nassauer 2011). These sites may lack preference because they lack these qualities, but further research is needed to make that conclusion.

Discussion for further research

The DCE survey methodology was effective for showing evidence for preferences for the growing season (spring, summer and late summer) over the non-growing season (winter and fall) (X_2 (4, n = 985) = 928.490, p =0.01). However, even with significant findings in a large sample, the model results only account for 0.88% of variance. A lack of identifying specific demographic segments does not present actionable findings such as making decisions to reach a specific segment of people to determine their preference. However, the study points to new directions in research to further understanding about seasonal change, stewardship, environmental value, environmental behavior, ecological aesthetics, maintenance and management.

Replications of the study may consider comparing results to the DCE methodology to intercept surveys and focus groups. Research supports the use of photo surveys to extract information about perceptions, but there are still limitations such as failing to address the other senses (Daniel and Vining 1983; Hurtubia, Guevara and Donoso 2015). Incorporating in-person interactions or extracting preferences while visiting the site may address these other senses. Again, the study did not present actionable findings toward any one group of people. If another researcher replicated the study with a different sample (outside of the Southeast), it would be interesting to see if the results are similar.

While survey results revealed a preference for growing seasons, further studies can investigate specific qualities of plants during seasonal change. Though anecdotal, analysis of additional factors in the most and least preferred photos suggest that respondents may be reacting to different qualities of the vegetation such as color or height. Future studies can look at one quality and how it changes over time. For example, one study found preferences for green vegetation during non-flowering seasons (Jorgensen, Hitchmough and Calvert 2002, 149). Additional vegetative qualities to be explored as they relate to seasonal change include plant health, age of a design, comparing native and invasive species, ponding and preconceptions of plant maintenance. Perhaps understanding reactions to such qualities across the seasons can inform design recommendations.

Bioretention practices typically reduce mown lawn, increase biodiversity and do not require as much trimming (Oudolf and Kingsbury 2013) and may not exhibit "cues to care" (Nassauer 1995b). However, the literature indicates that people prefer the following qualities in “cues to care”: neatness, order, crisp edges, fences, trimmed vegetation, mown turf, colorful flowers, physical signs describing ecosystem function and education (Nassauer 2011). The least preferred sites may lack preference because they lack these qualities, but further research is needed to make that conclusion. “Cues to care” could be explored from a seasonal change perspective to understand human activities associated with changing season or specific times of year. Better defining these qualities could lead to specific design recommendations such as a plant palette that flowers multiple times of the year or choosing plants that look "neat" or "orderly" in the winter. Piet Oudolf considers how a site will look in the winter and incorporates plants with winter interest like ones that are upright, have structure or seed pods (Oudolf and Kingsbury 2013). While this study found evidence for the importance of seasonal change, further

research is needed to test whether or not intentional year-round seasonal visual appeal improves stewardship.

The results revealed a lack of preference for dormant seasons. Further studies could address interventions and their impact on preferences specifically for dormant seasons. This could be testing of intentional seasonal interest versus an unintentional design. Other studies could explore the role of education in preferences for landscapes across seasons. Perhaps a comparison between those educated before the winter and their ability to identify or value a winter bioretention practice. Educational signage or other structures (like art) may bring visibility to ecological function and could be seen as an indication of care (Nassauer 2011). Other studies may consider exploring how preferences change over time with more exposure to the “messy” naturalistic planting design using demonstration projects (Hoyle, Hitchmough and Jorgensen 2017). Long-term studies may have greater potential to see cultural change and explore whether or not people see ecological function as an act of care.

Landscape designers and managers may consider these qualities as design interventions. However, movement toward “naturalistic planting design” and intentional year-round seasonal interest could lead to new implications for maintenance and management. More intentional winter design and a promotion of biodiversity may result in a need for maintenance professionals with more plant knowledge and the ability to discern which plants are "weeds". In a streetscape design incorporating intentional seasonality and bioretention practices, the designer hired a specialized maintenance company to manage the design for three years (“Grey to Green” 2020). Perhaps this indicates opportunities for training maintenance professionals to enhance plant knowledge to support this visual aesthetic.

It is important to continue the body of research to understand human engagement with landscape change. While many studies extract information about preference, new directions should further understanding interactions between preference, environmental value and "environmental behavior" (Steg and Vlek 2008). Other areas of research can address the practicalities of this design intervention (cost, longevity, maintenance) and opportunities for policy and education to enhance the sustainability of bioretention practices.

CHAPTER 6

CONCLUSION

This thesis primarily tested preferences for preferences for the seasons and found evidence that people prefer growing seasons over dormant seasons. The lack of preference for dormant seasons suggests that ecological designs may be at most risk of removal during dormant seasons. Preferences for the growing seasons suggest reactions to vegetative qualities within a particular time of year. Though inconclusive and not actionable to any particular group of people, findings provide several important and new directions in research such as preferences for vegetative qualities of seasonal change, potential interventions of intentional year-round seasonal interest, relationships between preference and behavior, and considerations for maintenance.

Again, survey results reveal a preference for the growing seasons, but what specific qualities in the vegetation drive preference for spring, summer and late summer? Anecdotal observations of additional factors in the most and least preferred photos suggest that respondents may be reacting to different qualities such as color or height. Identifying specific qualities within seasonal change could lead to recommendations for design interventions. Perhaps people are reacting to greenery or flowering plants. Identifying these qualities could lead to design recommendations such as plants that flower in multiple seasons or plants that look "neat" or "orderly" in the winter (Nassauer 1997).

The lack of preference for dormant seasons introduces new considerations for researching the dormant season specifically. If landscape designers intentionally select plants that exhibit "cues to care" or look "neat" during the winter, will the interventions change perceptions of

dormant landscapes? Will they be seen as cared for and gain more appreciation? Though anecdotal, Trenthan Gardens, one of the most visited gardens in England, uses the proposed design intervention of intentional year-round seasonal interest ("A Winter Walk: Nature Sparkles at Trentham Gardens" 2018). Both Piet Oudolf and Nigel Dunnett, landscape designers known for this style of planting design, contributed to Trentham Gardens' celebrated winter gardens. The gardens incorporate flowers that bloom during late winter and early spring. They also use winter interest such as perennial grasses that are "left standing from autumn to mid January", rather than cutting them down to tidy up for the spring.

It is important to understand how a style of year-round seasonal interest impacts management. These designs support biodiversity and reduce mown lawn (Oudolf and Kingsbury 2013). Not only do they require more plant knowledge to discern weeds from intentional plantings, but they promote unconventional maintenance such as not cutting back the garden in the fall (Oudolf and Kingsbury 2013). Another celebrated garden, Lurie Garden in Chicago, Illinois, prides itself on this new aesthetic and management (Stewart 2016). In an article describing the benefits of the garden's winter design, the writer states, "Not cutting down the garden in the fall is a part of Lurie Garden's management philosophy to both present the beauty of the garden in all four seasons and promote urban biodiversity year-round" (Stewart 2016). It further describes how this form of management not only provides visual aesthetic appeal, but it also supports wildlife by providing winter habitat and food for birds, insects and animals (Stewart 2016).

However, unconventional maintenance may lead to resistance from the lay person. Nassauer suggests that, people are sensitive to how their landscape conveys their level of stewardship (Nassauer 1995a). Promoting unconventional practices may take time to work

against preconceptions such as associating not cutting back grasses with a lacks of care. As suggested by Hoyle, Hitchmough and Jorgensen, creating more opportunities to expose people to this new aesthetic and management philosophy may encourage greater acceptance of ecological design (Hoyle, Hitchmough and Jorgensen 2017). Perhaps policy and demonstration gardens could be used to create more exposure to bioretention practices. Again, these interventions need further research to truly influence human engagement with the landscape or stewardship.

Landscape design has the potential to provide solutions for a more sustainable future. Better understanding of preferences for seasonal change and improving appreciation of bioretention practices supports ecological designs that reduce mown lawn, increase biodiversity, reduce unnecessary trimming and improve the sustainability of management (Oudolf and Kingsbury 2013). While this study found that people do prefer the growing season over the dormant seasons, further research is needed to link intentional seasonal planting design with stewardship. As well as identifying specific qualities of the seasons to support design recommendations for a "new ecological aesthetic". Design interventions have the potential to form a "new ecological aesthetic" that connects people to nature and supports the development of sustainable cities (Howett 1982; Gobster et al. 2007). Many green infrastructure practices such as bioretention suffer from improper management because of their unconventional design (Mozingo 1997; Nassauer 1997; Gobster et al. 2007). Previous research supports that people are more likely to engage with landscapes they find "iconic", beautiful or exhibit care (Howett 1982; Mozingo 1997; Nassauer 1997). Finally, this study further supports the need to design for change (Van Sweden and Thomas 2011; Oudolf and Kingsbury 2013; Rainer 2015). Perhaps planning for winter when sites lack preference, iconicism and exhibits of care, have the potential to enhance appreciation for bioretention practices.

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APPENDICES

A IRB Approval Letter

UNIVERSITY OF GEORGIA

Tucker Hall, Room 212
310 E. Campus Rd.
Athens, Georgia 30602
TEL 706-542-3199 | FAX 706-542-5638
IRB@uga.edu
http://research.uga.edu/hso/irb/

Human Research Protection Program

EXEMPT DETERMINATION

October 14, 2019

Dear Jon Calabria:

On 10/14/2019, the Human Subjects Office reviewed the following submission:

Title of Study:	Evaluating Public Perceptions of Bioretention Areas Across the Seasons
Investigator:	Jon Calabria
Co-Investigator:	Kelsey Broich
IRB ID:	PROJECT00000711
Review Category:	DHHS Exempt 2i

We have approved the protocol from 10/14/2019 to 10/13/2024.

Since this study was determined to be "exempt", please be aware that not all future modifications will require review by the IRB. For more information, please see Appendix C of the Exempt Research Policy: *https://research.uga.edu/docs/policies/compliance/hso/IRBExempt-Review.pdf* As noted in Section C.2, you can simply notify us of modifications that will not require review by using the "Add Public Comment" button on the main study page.

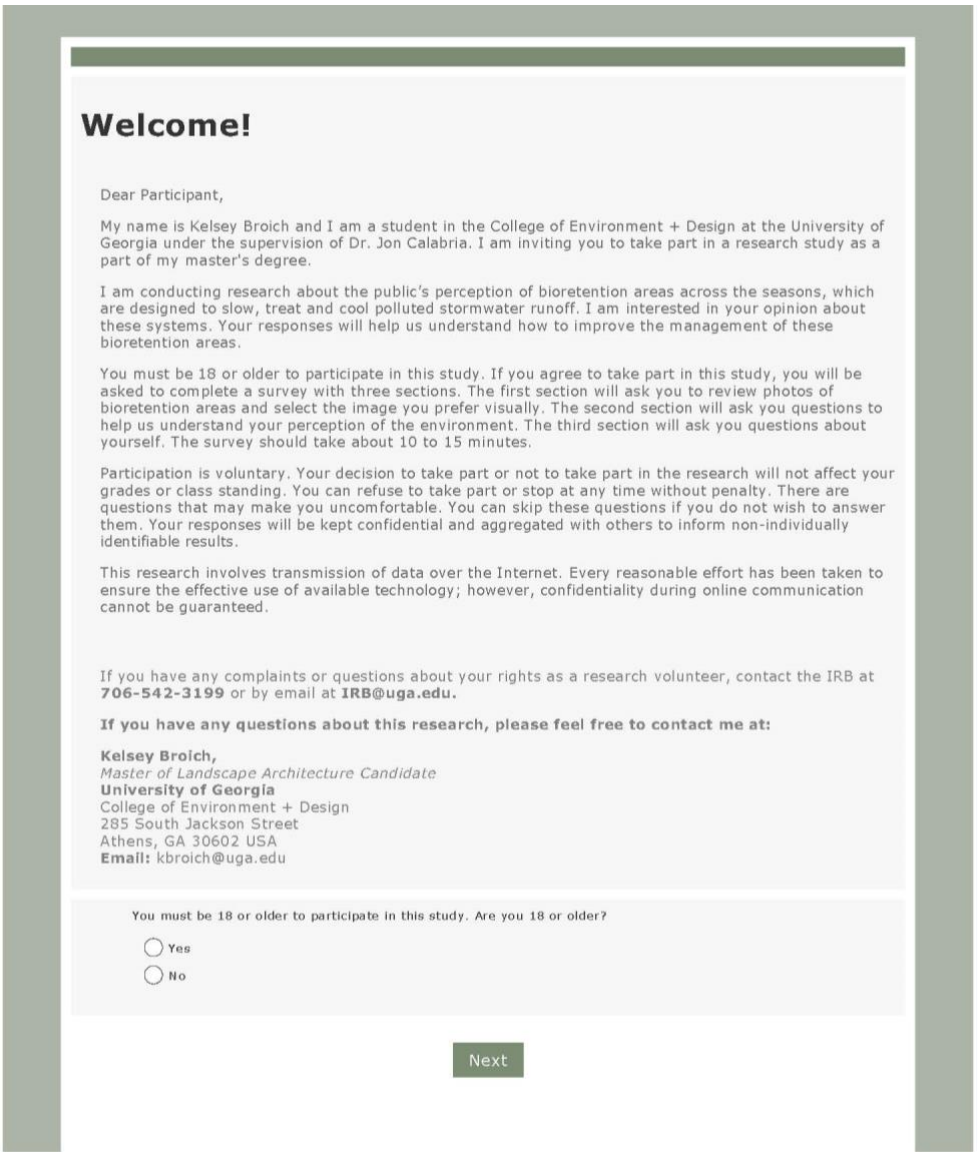
Please close this study when it is complete.

In conducting this study, you are required to follow the requirements listed in the Investigator Manual (HRP-103).

Sincerely,

Jennifer Freeman, IRB Analyst
Human Subjects Office, University of Georgia

B Pilot Survey



Welcome!

Dear Participant,

My name is Kelsey Broich and I am a student in the College of Environment + Design at the University of Georgia under the supervision of Dr. Jon Calabria. I am inviting you to take part in a research study as a part of my master's degree.

I am conducting research about the public's perception of bioretention areas across the seasons, which are designed to slow, treat and cool polluted stormwater runoff. I am interested in your opinion about these systems. Your responses will help us understand how to improve the management of these bioretention areas.

You must be 18 or older to participate in this study. If you agree to take part in this study, you will be asked to complete a survey with three sections. The first section will ask you to review photos of bioretention areas and select the image you prefer visually. The second section will ask you questions to help us understand your perception of the environment. The third section will ask you questions about yourself. The survey should take about 10 to 15 minutes.

Participation is voluntary. Your decision to take part or not to take part in the research will not affect your grades or class standing. You can refuse to take part or stop at any time without penalty. There are questions that may make you uncomfortable. You can skip these questions if you do not wish to answer them. Your responses will be kept confidential and aggregated with others to inform non-individually identifiable results.

This research involves transmission of data over the Internet. Every reasonable effort has been taken to ensure the effective use of available technology; however, confidentiality during online communication cannot be guaranteed.

If you have any complaints or questions about your rights as a research volunteer, contact the IRB at **706-542-3199** or by email at **IRB@uga.edu.**

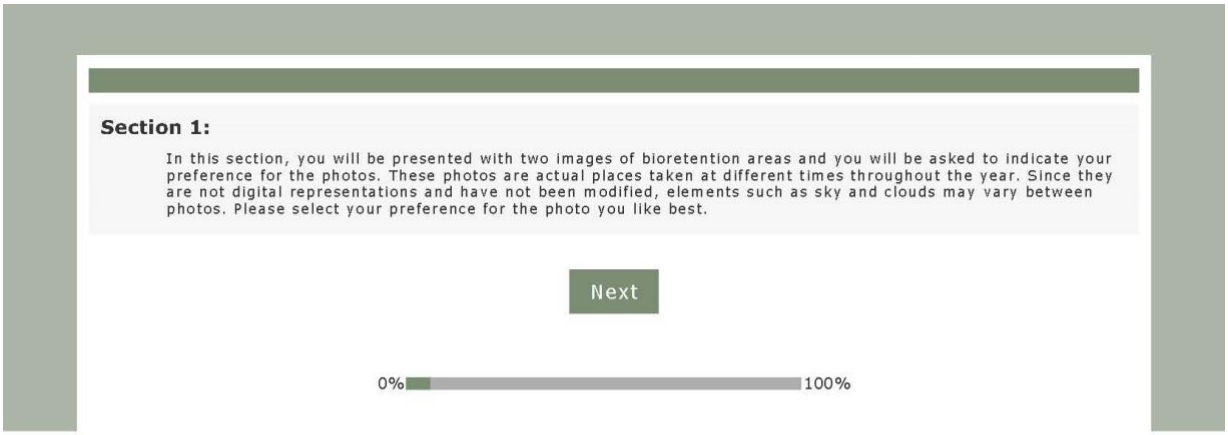
If you have any questions about this research, please feel free to contact me at:

Kelsey Broich,
Master of Landscape Architecture Candidate
University of Georgia
College of Environment + Design
285 South Jackson Street
Athens, GA 30602 USA
Email: kbroich@uga.edu

You must be 18 or older to participate in this study. Are you 18 or older?

- ◯ Yes
- ◯ No

Next


Section 1:
In this section, you will be presented with two images of bioretention areas and you will be asked to indicate your preference for the photos. These photos are actual places taken at different times throughout the year. Since they are not digital representations and have not been modified, elements such as sky and clouds may vary between photos. Please select your preference for the photo you like best.
Next
0%
100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

Select

Select

NONE: I would not choose either of these.

Select

Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

Select

Select

NONE: I would not choose either of these.

Select

Next

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Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

Select

Select

NONE: I would not choose either of these.

Select

Next

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Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

Select

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NONE: I would not choose either of these.

Select

Next

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Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

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NONE: I would not choose either of these.

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If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

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NONE: I would not choose either of these.

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Next

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If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

Select

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NONE: I would not choose either of these.

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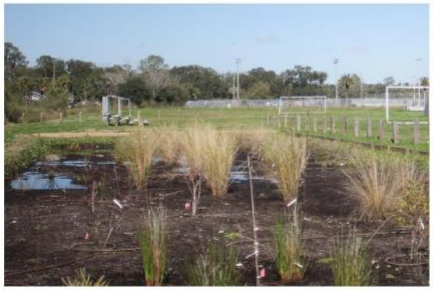
Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

Select



Select

NONE: I would not choose either of these.

Select

Next

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Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

Select

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NONE: I would not choose either of these.

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If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

Select

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NONE: I would not choose either of these.

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If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

Select

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NONE: I would not choose either of these.

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If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

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If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

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NONE: I would not choose either of these.

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If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

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NONE: I would not choose either of these.

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If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

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If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

Select

Select

NONE: I would not choose either of these.

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Next

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If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

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NONE: I would not choose either of these.

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Select

Select

NONE: I would not choose either of these.

Select

Next

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If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

Select

Select

NONE: I would not choose either of these.

Select

Next

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If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

Select

Select

NONE: I would not choose either of these.

Select

Next

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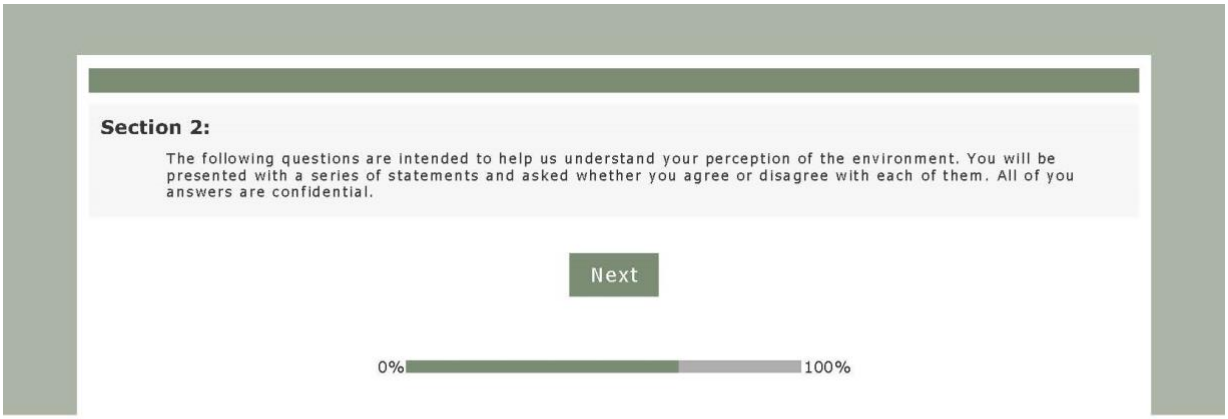
Section 2:
The following questions are intended to help us understand your perception of the environment. You will be presented with a series of statements and asked whether you agree or disagree with each of them. All of you answers are confidential.
Next
0%
100%

Please indicate the degree to which you agree or disagree with the following statement:

We are approaching the limit of the number of people the earth can support

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

Humans have the right to modify the natural environment to suit their needs

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

When humans interfere with nature it often produces disastrous consequences

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Next

0% 100%

Please indicate the degree to which you agree or disagree with the following statement:

Human ingenuity will insure that we do NOT make the earth unlivable

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

Humans are severely abusing the environment

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

The earth has plenty of natural resources if we just learn how to develop them

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Next

0% 100%

Please indicate the degree to which you agree or disagree with the following statement:

Plants and animals have as much right as humans to exist

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

The balance of nature is strong enough to cope with the impacts of modern industrial nations

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

Despite our special abilities humans are still subject to the laws of nature

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Next

0% 100%

Please indicate the degree to which you agree or disagree with the following statement:

The so-called "ecological crisis" facing humankind has been greatly exaggerated

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

The earth is like a spaceship with very limited room and resources

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

Humans were meant to rule over the rest of nature

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Next

0% 100%

Please indicate the degree to which you agree or disagree with the following statement:

The balance of nature is very delicate and easily upset

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

Humans will eventually learn enough about how nature works to be able to control it

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

If things continue on their present course, we will soon experience a major ecological catastrophe

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Next

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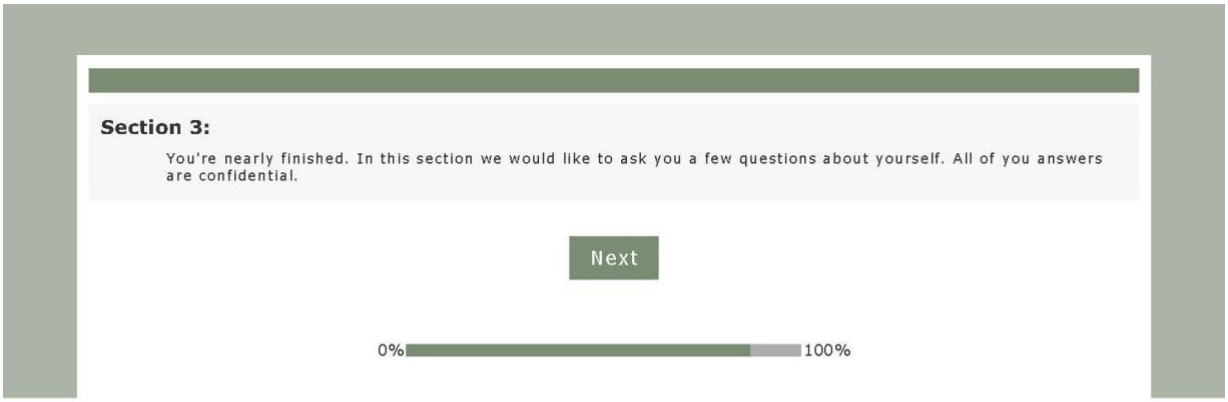
Section 3:
You're nearly finished. In this section we would like to ask you a few questions about yourself. All of you answers are confidential.
Next
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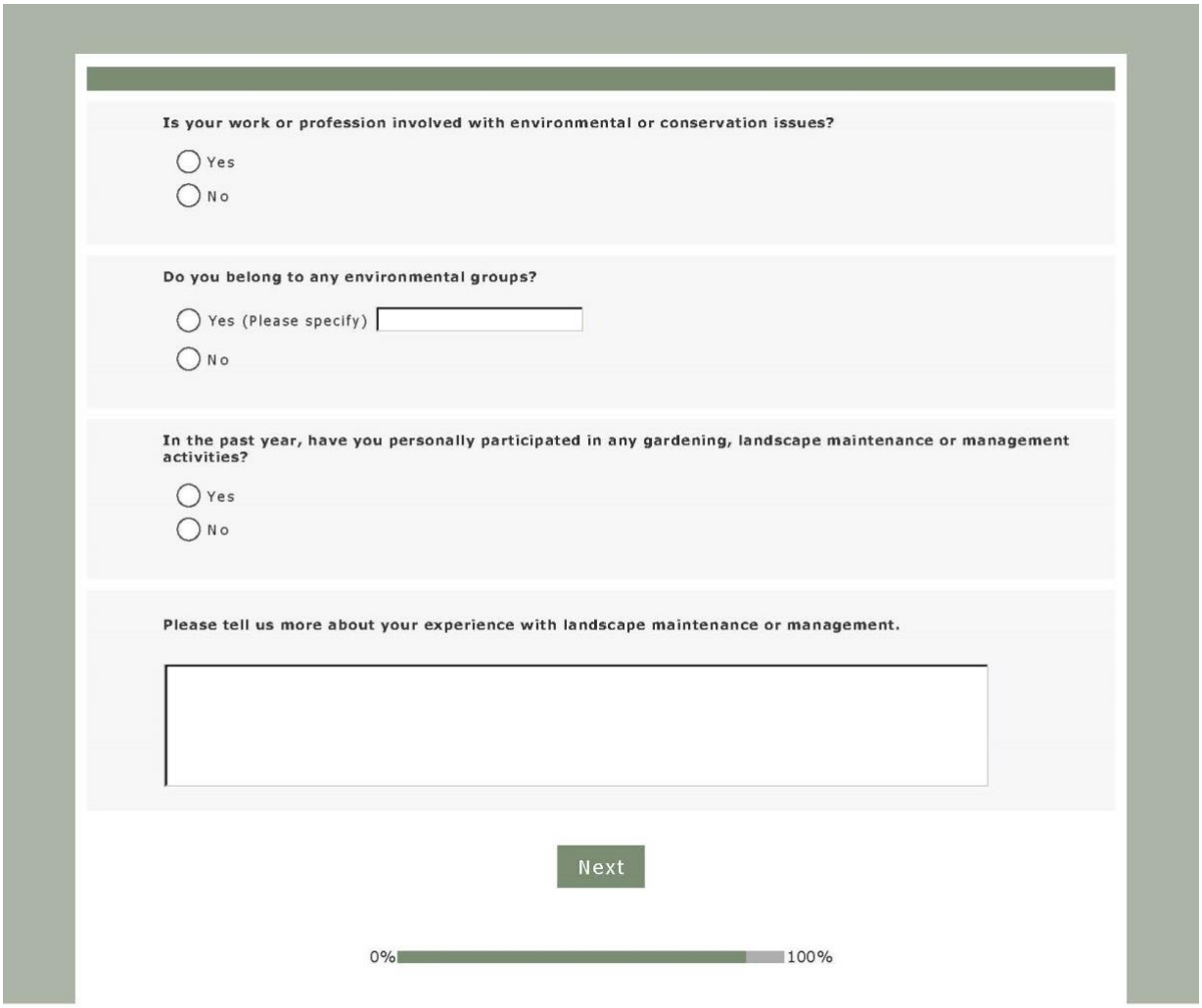
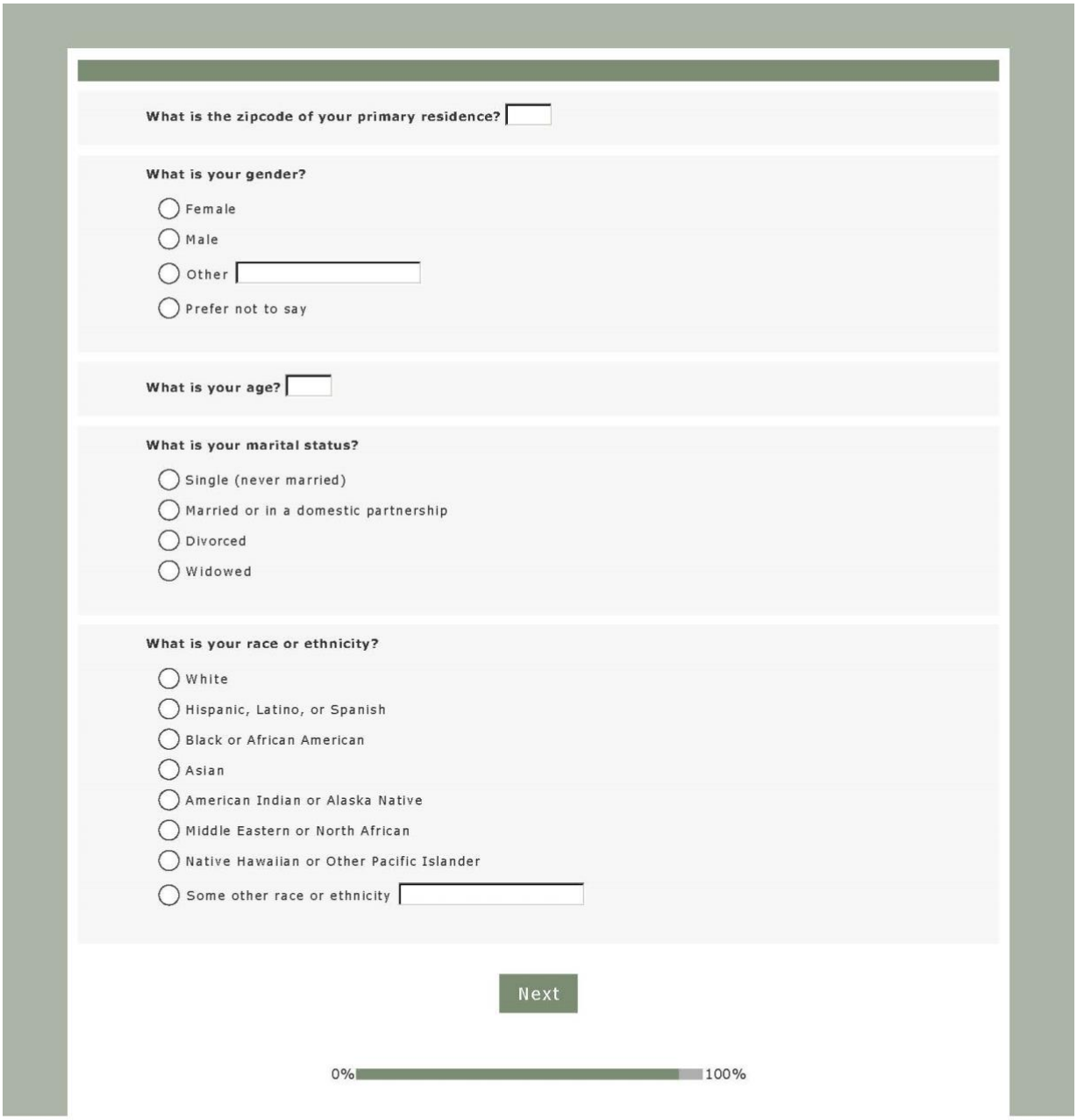
100%


Is your work or profession involved with environmental or conservation issues?
Yes
No
Do you belong to any environmental groups?
Yes (Please specify)
No
In the past year, have you personally participated in any gardening, landscape maintenance or management activities?
Yes
No
Please tell us more about your experience with landscape maintenance or management.
Next
0%
100%


What is the zipcode of your primary residence?
What is your gender?
Female
Male
Other
Prefer not to say
What is your age?
What is your marital status?
Single (never married)
Married or in a domestic partnership
Divorced
Widowed
What is your race or ethnicity?
White
Hispanic, Latino, or Spanish
Black or African American
Asian
American Indian or Alaska Native
Middle Eastern or North African
Native Hawaiian or Other Pacific Islander
Some other race or ethnicity
Next
0%
100%

What is your current employment status?

- ◯ Employed or self-employed full-time (40+ hours a week)
- ◯ Employed or self-employed part-time (less than 40 hours a week)
- ◯ Unemployed (currently looking for work)
- ◯ Unemployed (not currently looking for work)
- ◯ Student
- ◯ Retired
- ◯ Unable to work

What is the highest degree or level of school you have completed? If you're currently enrolled in school, please indicate the highest degree you have received.

- ◯ Some high school
- ◯ High school degree or equivalent (e.g., GED)
- ◯ Bachelor's degree (e.g. BA, BS)
- ◯ Master's degree (e.g. MA, MS, MEd)
- ◯ Doctorate (e.g. PhD, EdD)
- ◯ Other (please specify) _____

What is your total household income?

- ◯ <$30,000
- ◯ $30,000-60,000
- ◯ $60,000-100,000
- ◯ >$100,000

What experience or understanding do you have of areas used for cleaning stormwater, such as bioretention areas and rain gardens?

Next

0% 100%

Thank you very much for your time!

This survey instrument was modeled closely on previously used and recognized examples from the literature. The first section is based on other landscape photo-based surveys such as the 2017 study by Veitch et al. (2017), the 2019 study by Schirpke et al. (2019) and the 2015 study by Hurtubia et al. (2015). The second section is based on the 2000 study by Dunlap et al. (2000) and the 2008 study by Thomson (2008). The third section is based on the 2006 study by Nassauer et al. (2006). All questions were modeled based on the work of Don Dillman (2014) and John Creswell (2014).

Powered by Sawtooth Software

C Survey

Default Question Block

Welcome!

Dear Participant,

My name is Kelsey Broich and I am a student in the College of Environment + Design at the University of Georgia under the supervision of Dr. Jon Calabria. I am inviting you to take part in a research study as a part of my master's degree.

I am conducting research about the public's perception of bioretention areas across the seasons, which are designed to slow, treat and cool polluted stormwater runoff. I am interested in your opinion about these systems. Your responses will help us understand how to improve the management of these bioretention areas.

You must be 18 or older to participate in this study. If you agree to take part in this study, you will be asked to complete a survey with three sections. The first section will ask you questions about yourself. The second section will ask you to review photos of bioretention areas and select the image you prefer visually. The third section will ask you questions to help us understand your perception of the environment. The survey should take about 10 to 15 minutes.

Participation is voluntary. You can refuse to take part or stop at any time without penalty. There are questions that may make you uncomfortable. You can skip these questions if you do not wish to answer them. Your responses will be kept confidential and aggregated

with others to inform non-individually identifiable results.

This research involves transmission of data over the Internet. Every reasonable effort has been taken to ensure the effective use of available technology; however, confidentiality during online communication cannot be guaranteed.

If you have any complaints or questions about your rights as a research volunteer, contact the IRB at **706-542-3199** or by email at **IRB@uga.edu**.

If you have any questions about this research, please feel free to contact me at:

Kelsey Broich,
Master of Landscape Architecture Candidate
University of Georgia
College of Environment + Design
285 South Jackson Street
Athens, GA 30602 USA
Email: kbroich@uga.edu

If you click the arrow button below, it is implied that you have read the information above about the research, your rights as a participant, and give your voluntary consent.

Block 1

In this section we would like to ask you a few questions about yourself. All of your answers are confidential.

What is your age?

Under 18
18-34
35-54
55 or older

Block 3

What is the zip code of your primary residence?

What is your gender?

Female
Male
Other
Prefer not to say

What is your marital status?

Single (never married)
Married or in a domestic partnership
Divorced
Widowed

What is your race or ethnicity?

White
Hispanic, Latino, or Spanish
Black or African American
Asian
American Indian or Alaska Native
Middle Eastern or North African
Native Hawaiian or Other Pacific Islander
Some other race or ethnicity

Block 4

What is your current employment status?

Employed or self-employed full-time (40+ hours a week)
Employed or self-employed part-time (less than 40 hours a week)
Unemployed (currently looking for work)
Unemployed (not currently looking for work)
Student
Retired
Unable to work

What is the highest degree or level of school you have completed? If you're currently enrolled in school, please indicate the highest degree you have received.

Some high school
High school degree or equivalent (e.g., GED)
Bachelor's degree (e.g. BA, BS)
Master's degree (e.g. MA, MS, MEd)
Doctorate (e.g. PhD, EdD)
Other (please specify)

What is your total household income?

<$30,000
$30,000-60,000
$60,000-100,000
>$100,000

Block 2

Is your work or profession involved with environmental or conservation issues?

Yes
No

Do you belong to any environmental groups?

Yes (Please specify)

No

In the past year, have you personally participated in any gardening, landscape maintenance or management activities?

Yes

No

Please tell us more about your experience with landscape maintenance or management.

Block 5

Not in flow
Testing block

P= ${e://Field/P}
ID1= ${e://Field/ID1}
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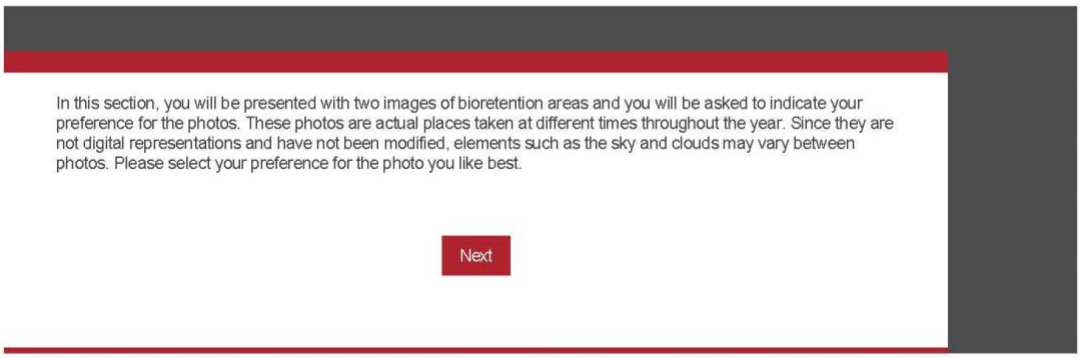
Powered by Qualtrics


In this section, you will be presented with two images of bioretention areas and you will be asked to indicate your preference for the photos. These photos are actual places taken at different times throughout the year. Since they are not digital representations and have not been modified, elements such as the sky and clouds may vary between photos. Please select your preference for the photo you like best.
Next

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(1 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(2 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(3 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(4 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(5 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(6 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(7 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

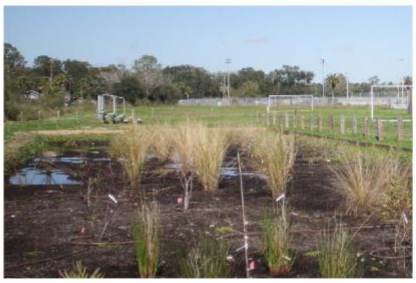
0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(8 of 20)

Select



Select

NONE: I would not choose any of these.

Select

Back Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(9 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(10 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(11 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(12 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(13 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(14 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(15 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(16 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(17 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(18 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(19 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

0% 100%

Imagine you are standing in the places represented by the photos below, which do you prefer visually?

If you would like to view the photo larger, click the photo then click the back arrow to return to the survey.

(20 of 20)

Select

Select

NONE: I would not choose any of these.

Select

Back Next

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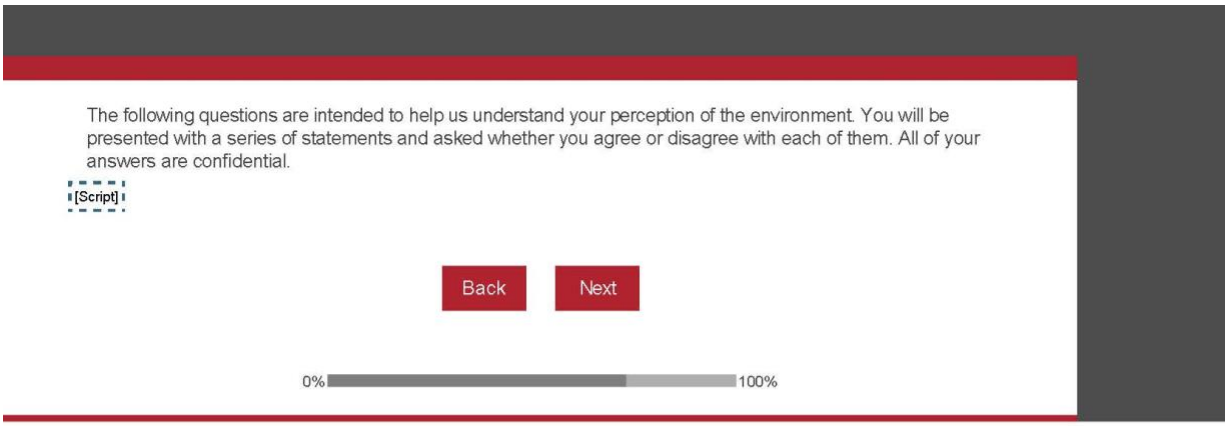
The following questions are intended to help us understand your perception of the environment. You will be presented with a series of statements and asked whether you agree or disagree with each of them. All of your answers are confidential.
[Script]
Back
Next
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Please indicate the degree to which you agree or disagree with the following statement:

We are approaching the limit of the number of people the earth can support

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

Humans have the right to modify the natural environment to suit their needs

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

When humans interfere with nature it often produces disastrous consequences

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Back Next

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Please indicate the degree to which you agree or disagree with the following statement:

Human ingenuity will insure that we do NOT make the earth unlivable

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

Humans are severely abusing the environment

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

The earth has plenty of natural resources if we just learn how to develop them

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Back Next

0% 100%

Please indicate the degree to which you agree or disagree with the following statement:

Plants and animals have as much right as humans to exist

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

The balance of nature is strong enough to cope with the impacts of modern industrial nations

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

Despite our special abilities humans are still subject to the laws of nature

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Back Next

0% 100%

Please indicate the degree to which you agree or disagree with the following statement:

The so-called "ecological crisis" facing humankind has been greatly exaggerated

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

The earth is like a spaceship with very limited room and resources

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

Humans were meant to rule over the rest of nature

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Back Next

0% 100%

Please indicate the degree to which you agree or disagree with the following statement:

The balance of nature is very delicate and easily upset

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

Humans will eventually learn enough about how nature works to be able to control it

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Please indicate the degree to which you agree or disagree with the following statement:

If things continue on their present course, we will soon experience a major ecological catastrophe

- ◯ Strongly Agree
- ◯ Mildly Agree
- ◯ Unsure
- ◯ Mildly Disagree
- ◯ Strongly Disagree

Back Next

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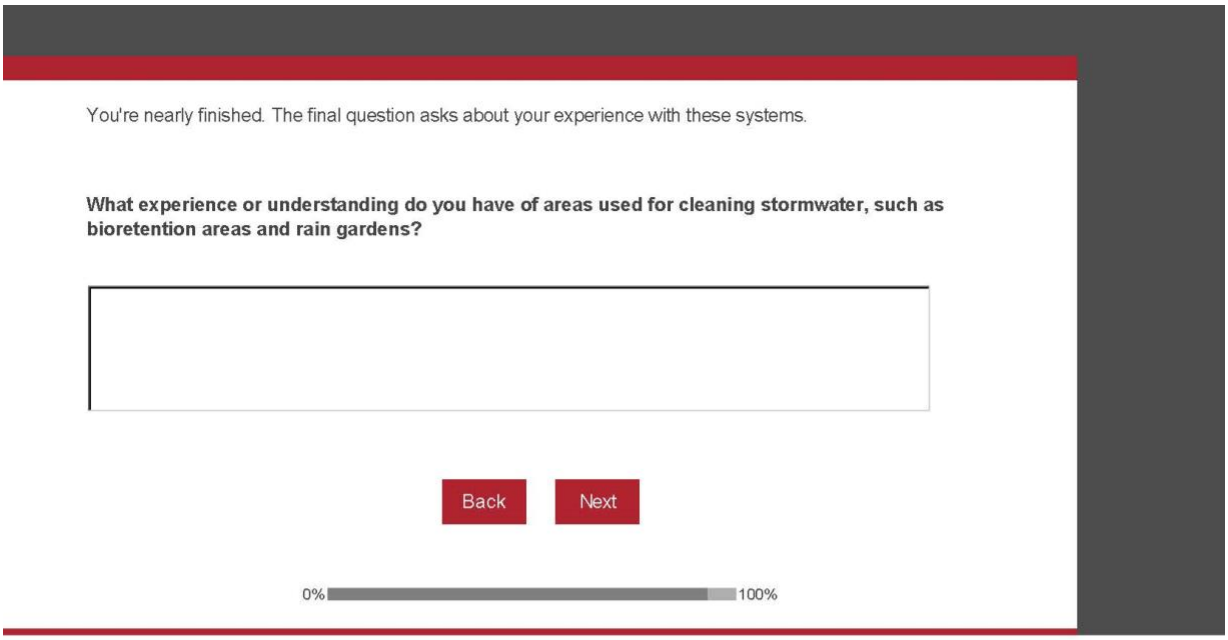
You're nearly finished. The final question asks about your experience with these systems.
What experience or understanding do you have of areas used for cleaning stormwater, such as bioretention areas and rain gardens?
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Note:

When respondents take the survey in regular mode this page will not be displayed. Respondents will be redirected to the link below:

https://ugeorgia.ca1.qualtrics.com/jfe/form/SV_9uC8olSqhjeUtqI?P=2&VID= [Script] &ID1= [Script] &ID2= [Script] &ID3= [Script] &Q1= [Script] &Q2= [Script] &Q3= [Script] &NON= [Script] &TIME= [Script]

Powered by Sawtooth Software

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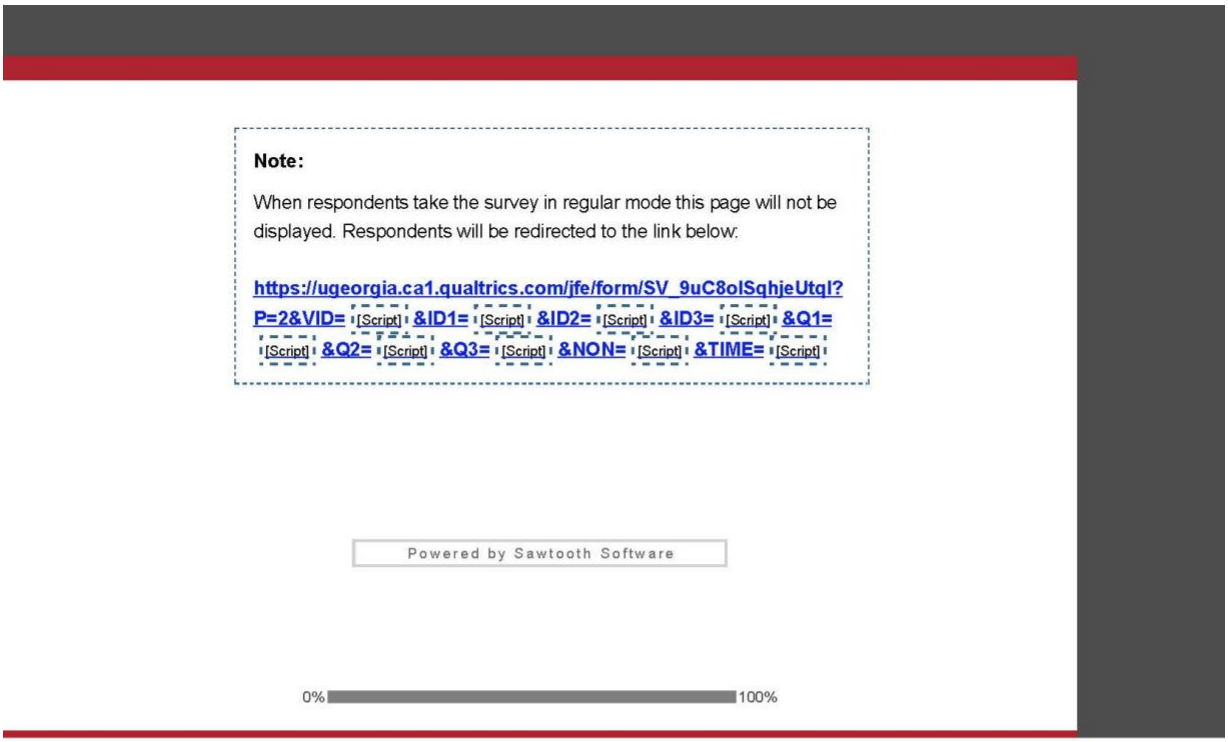
Note:
When respondents take the survey in regular mode this page will not be displayed. Respondents will be redirected to the link below:
https://ugeorgia.ca1.qualtrics.com/jfe/form/SV_9uC8olSqhjeUtqI?P=2&VID= [Script] &ID1= [Script] &ID2= [Script] &ID3= [Script] &Q1= [Script] &Q2= [Script] &Q3= [Script] &NON= [Script] &TIME= [Script]
Powered by Sawtooth Software
0%
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