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INTEGRATING SOCIAL AND ECOLOGICAL METHODS TO ASSESS AND
INFORM PARK MONITORING AND MANAGEMENT

by

Kelly A. Goonan

A dissertation submitted in partial fulfillment
of the requirements for the degree

of

DOCTOR OF PHILOSOPHY

in

Human Dimensions of Ecosystem Science and Management

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2017

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ABSTRACT

Integrating Social and Ecological Methods to Assess and
Inform Park Monitoring and Management

by

Kelly A. Goonan, Doctor of Philosophy

Utah State University, 2017

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Department: Environment and Society

Normative studies involving visitors and condition assessments of recreation resources like campsites are important to the overall approach to managing recreation in parks and protected areas. This dissertation examines these research approaches in novel ways to increase the utility of normative data and resource assessments for the purposes of decision-making and management.

An integrated study of national park visitors and campsite conditions was conducted to identify indicators and thresholds for social/experiential, resource, and managerial conditions, as well as document and evaluate current recreation resource conditions. The structural characteristics of reported norm curves were inspected and six distinct types of norms were identified. Thresholds for three target indicators were calculated based on respondent evaluations of conditions. Factor analysis and cluster analysis were used to classify campsites into four groups based on measured impacts.

A second study of multiple-impact campsite data from three national parks was conducted to assess the use of multivariate techniques to analyze campsite data. Factor analysis of the data was successful in identifying interpretable structures within each dataset, and cluster analysis resulted in unique typologies of site classifications for each study location based on the data measured in the field.

A third study examined the relationship between visitor characteristics and thresholds for recreation resource impacts. Established scales measured a variety of characteristics for visitors to two national parks, and thresholds were calculated for four recreation resource variables. Six distinct norm types were identified by examining the structural characteristics of respondent norm curves. Multiple regression analysis tested the relationship between the visitor characteristics and thresholds for resource conditions. One significant model was identified, and three significant predictor variables were identified.

Together the results of these studies improve our understanding of visitor norms, the applications of normative theory and methods to recreation research to evaluate the acceptability of conditions, and the advantages of alternative methods for analyzing multiple-indicator resource assessment datasets. This enhanced understanding will lead to more informed decision-making and constitutes an important aspect of adaptive recreation management.

PUBLIC ABSTRACT

Integrating Social and Ecological Methods to Assess and
Inform Park Monitoring and Management

Kelly A. Goonan

Managing outdoor recreation requires that managers do the following: (1) consider the user experience, environmental and cultural resources, and type and intensity of management actions; (2) specify desired conditions to be maintained, monitor conditions, and take appropriate action if unacceptable impacts occur; (3) adapt to new conditions and information; and (4) exercise good judgment based on their professional experience and the best information available to them. Social science studies of visitors and studies of significant recreation resources like campsites are important sources of information for managers and are commonly used in parks and protected areas to support planning and decision-making.

The studies presented here are designed to enhance our understanding of how visitors evaluate the acceptability of impacts to recreation resources and how we can more effectively analyze large campsite resource condition datasets to get meaningful results. A better understanding of impacts to cultural and environmental resources, the people who visit parks, and how they evaluate the acceptability of impacts will enable managers to make more informed decisions. This is an important part of the adaptive management of parks and protected areas.

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CHAPTER 1

INTRODUCTION

Introduction

Global trends in outdoor recreation suggest that public demand for nature-based recreation opportunities and appreciation of natural areas continues to grow (Cordell, 2012; Balmford et al., 2015). Public lands are highly important for the recreation opportunities they offer (Cordell, 2012), including national parks, which have experienced record-setting visitation numbers for the last two years (National Park Service Visitor Use Statistics, 2016; Olson 2016). Parks and other public lands serve as destinations for visitors seeking to engage in nature-based recreational activities. Such activities provide numerous benefits to participants and communities, including enhanced physical and mental health (Orsega-Smith et al., 2004; Pretty et al., 2005; Barton and Pretty, 2010; Lee and Maheswaran, 2010; Lee, 2011; Thompson Coon et al., 2011; Korpela et al., 2014), social and family bonding (Dorsch et al., 2016; Jirásek et al., 2017), fostering a sense of community (Moore et al., 1992; Dorsch et al., 2016), and economic benefits (Bennett et al., 1996; Outdoor Industry Association, 2017). However recreational use of these public lands also has the potential to impact biophysical resources, the quality of the recreation experience, and the kind and extent of management (Manning, 2011; Hammitt et al., 2015). Several frameworks have been developed to manage the impacts of recreation and help guide recreation planning and management (Stankey et al., 1985; Shelby and Heberlein, 1986; Graefe et al., 1990; National Park Service, 1997; Manning, 2001; Interagency Visitor Use Management

Council, 2016a). Management decisions require informed judgment on the part of park managers. The best available information is needed for managers to be efficient and effective in planning and management. While there is an established body of literature examining the biophysical (Leung and Marion, 2000; Monz et al., 2010; Hammitt et al., 2015) and social (Manning, 2011) aspects of outdoor recreation and their related management issues, there remains the opportunity to enhance our understanding of these often complex and multifaceted issues. Two topics common to outdoor recreation research with direct implications for managers are the use of visitor surveys in developing management indicators and thresholds and assessing the biophysical impacts of recreation activities on campsites. This dissertation, written in multiple-paper format, includes three studies examining these topics with the objective of increasing the utility of data collected in the field to park managers. These studies go beyond the traditional campsite condition studies and indicators-standards development studies to examine empirical relationships and integrate study findings in an effort to make the results more meaningful and useful to managers. A better understanding of park resources and the visitors who interact with them should lead to more informed and effective management of outdoor recreation in parks and other protected areas.

1. Outdoor recreation management

1.1 Recreation and public lands

Public land managers in the United States are challenged with the often-conflicting responsibilities of protecting important natural and cultural resources while also providing for high quality visitor experiences and opportunities. This is especially

true for managers of national park lands, who are governed by the “dual mandate” of the National Park Service Organic Act of 1916, which states that the purpose and mission of the Park Service is to “conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.” Such challenges extend beyond the U.S. to parks and protected areas around the world (Buckley, 2004; Pigram and Jenkins, 2006).

Recreational use of national parks is the primary means by which the public enjoys these lands. This use can result in numerous individual benefits (e.g., Lee, 2011; Orsega-Smith et al., 2004; Dorsch et al., 2016) as well as societal benefits (e.g., Moore et al., 1992; Budruk et al., 2009; Headwaters Economics, 2017; Outdoor Industry Association, 2017). These benefits include, but are not limited to, enhanced physical and mental health, community cohesion, and economic benefits. However, some level of change in condition is an inevitable consequence of repeated recreational use. Recreation in natural settings can impact several ecosystem components, including vegetation, soils, water, air quality, wildlife, and natural soundscapes (Leung and Marion, 2000; Hammitt et al., 2015). High levels of use can also have a negative impact on the visitor experience, as crowding (Shelby et al., 1989; Manning et al., 2000; Vaske and Donnelly, 2002) visitor conflict (Schuster et al., 2006; Mann and Absher, 2008), the type and intensity of management (Daniels and Marion, 2006), and degraded resource conditions (Leung and Marion, 2000; Manning et al., 2004) can detract from the quality of the recreation experience.

1.2 Recreation capacity

Managing the impacts associated with recreational use is generally conceptualized through the concept of capacity, often described as carrying capacity (Shelby and Heberlein, 1986; Stankey and Manning, 1986; Manning, 2011). In its most standard form, the concept of capacity refers to the ultimate limits to growth as constrained by biophysical factors (Manning, 2011). Carrying capacity is a widely recognized concept in the fields of wildlife ecology and range management, where it refers to the number of individuals of a given species that could be sustained within a given habitat (Dasmann, 1964). The concept was first applied to park and outdoor recreation planning and management in the 1960s (Wagar, 1964), and has since evolved into several frameworks meant to direct planning and management efforts. Within the context of outdoor recreation, capacity is defined as the amount (i.e., a number on a use-level scale that includes units of use, timing, and location components) and type of use that is compatible with the management prescription for an area (Whittaker et al., 2011) and is comprised of three components: social/experiential, resource/biophysical, and managerial (Manning, 2011).

The principal difficulty in applying capacity to parks and protected areas is in determining how much impact is too much, or what level of change in conditions is acceptable. Shelby and Heberlein (1984) identify two components involved in establishing capacities: a descriptive component and an evaluative component. The descriptive component defines the observable workings of recreation systems and involves management parameters, impact parameters, and the relationship between the two. The evaluative component integrates value judgments into determining capacity

based on the acceptability of impacts. Research has shown that recreation capacity can most effectively be defined, planned, and managed in the context of specific management objectives of individual parks and protected areas (Manning, 2004; Whittaker et al., 2011). Several management-by-objectives capacity frameworks have been developed, including Limits of Acceptable Change (LAC) developed by the U.S. Forest Service (Stankey et al., 1985), Visitor Experience and Resource Protection (VERP) developed by the National Park Service (National Park Service, 1997; Manning, 2001), and the new Visitor Use Management Framework (VUM) developed by an interagency council with representations from the Bureau of Land Management, U.S. Forest Service, National Oceanic and Atmospheric Administration, National Park Service, U.S. Army Corps of Engineers, and U.S. Fish and Wildlife Service (Interagency Visitor Use Management Council, 2016a).

1.3 Capacity frameworks

Frameworks designed to address the issue of capacity have proven to be useful planning tools for several diverse National Park Service (NPS) units and other protected areas (e.g., Manning et al., 1996a; Manning, 2007; USDA Forest Service, n.d.). The VERP framework became a formal part of the NPS general management planning process (National Park Service, 1997; Manning, 2001). However, following several lawsuits related to Yosemite National Park's Merced River Plan (Haas, 2004; Cathcart-Rake, 2009), the Ninth Circuit Court of Appeals ruled the VERP planning framework did not adequately address nor explicitly define "user capacity." The court also felt that VERP was not a proactive approach to planning, requiring management action only after

degradation had occurred. As such, the NPS was required to revise their use of the VERP framework.

In response to the lawsuits, researchers and agencies worked to examine the concept of visitor capacity and associated management frameworks. A Federal Interagency Task Force on Visitor Capacity on Public Lands was created to improve the capacity decision-making process among park and recreation professionals (Haas, 2002), and a state-of-knowledge review of capacity and its role in recreation resource planning and management (Whittaker et al., 2011) reached several consensus regarding the importance of specific goals and objectives stated in recreation plans, the use of indicators and associated thresholds and triggers, the importance of being proactive in addressing capacity, and the importance of monitoring in adaptive planning and management.

The recent challenges of defining recreation capacity and related recreation planning and management have led to the formation of the Interagency Visitor Use Management Council (IVUMC) consisting of representatives from the Bureau of Land Management, U.S. Forest Service, National Oceanic and Atmospheric Administration, National Park Service, U.S. Army Corps of Engineers, and U.S. Fish and Wildlife Service. The IVUMC's mission is "to provide guidance on visitor use management policies and to develop legally defensible and effective interagency implementation tools for visitor use management" (Interagency Visitor Use Management Council, 2016b). The IVUMC has made significant contributions to the task of informing outdoor recreation management and determining area capacities, including publishing a unified visitor use management framework (Interagency Visitor Use Management Council, 2016a) and

defining key terms related to visitor use management (Interagency Visitor Use Management Council, 2014). These are important steps in the future of recreation planning and management.

Outdoor recreation management decisions are ultimately value-based judgments about the acceptable levels of change in parks and protected areas (Shelby and Heberlein, 1984; Shelby et al., 1996; Manning and Lawson, 2002; Interagency Visitor Use Management Council, 2016a). Such decisions should be as informed as possible, and consider (a) the legal environment, including laws, policies, and regulations; (b) current resource and social conditions; (c) administrative feasibility; (d) public acceptability; (e) costs and benefits associated with planned management actions; (f) supply and demand of regional opportunities; (g) uniqueness of opportunities; (h) risk of irreversible change; (i) impacts on all resources; and (j) science-based information about the sensitivity of resources and recreation experiences, the relationships between visitor use and impacts, and public values and preferences (Whittaker et al., 2011). Scientific data regarding the biophysical and social/experiential components of a park or protected area are vital to helping managers determine what level of change is acceptable and establish thresholds for impacts. Research studies of the biophysical effects of recreational activities and of park visitors and their recreation experiences can provide managers with the necessary data to inform the formulation of impact thresholds and management decisions aimed at protecting the quality of park resources and the visitor experience.

2. Recreation resources

2.1 Biophysical impacts of outdoor recreation

Outdoor recreation activities in wildlands inevitably have some consequences on resource conditions. Recreation has the potential to impact a range of environmental resources and ecosystem components (Leung and Marion, 2000; Monz et al., 2013; Hammitt et al., 2015), including direct and indirect impacts to biotic and abiotic environmental components—such as vegetation, wildlife, soil, water, and soundscapes—or larger-scale changes in ecosystem structure or function, such as nutrient cycling, community composition, and air and water quality (see Monz and Leung, 2006). The field of recreation ecology has emerged in response to the concern of sustainably managing recreation activities in natural areas. Recreation ecology research uses scientific approaches and principles to address specific problems and issues of management concern, generally in the context of protected natural areas that have goals related to both ecological preservation/conservation and enjoyment and use by humans. Research in the field has examined the relationships between recreation activities and a variety of biophysical resources (Leung and Marion, 2000; Buckley, 2004; Monz et al., 2010; Steven et al., 2011; Newsome et al., 2012; Hammitt et al., 2015).

The relationship between recreational use and resource change can generally be characterized as curvilinear. That is, low levels of use cause a significant amount of initial impact, while further increases in use do not result in proportional increases in impact. While this relationship has been widely supported in the recreation ecology literature (Cole, 1995a; Leung and Marion, 2000; Cole, 2004; Hammitt et al., 2015), it has been criticized for being an oversimplification relying heavily on studies of

vegetation trampling and may not accurately reflect the response of other ecosystem components to recreation disturbance (Monz et al., 2013). Several factors influence the relationship between recreation use and resource change, including the amount and type of use, temporal and spatial distribution of use, and environmental durability (Cole, 1981; Hammitt et al., 2015).

2.2 Campsite studies

Campsites are often a focal point of studies and monitoring efforts aimed at examining biophysical impacts of recreation. Campsites serve as destinations and nodes of visitor use: they are locations where concentrated recreation activities impact biophysical resources, and where visitors interact with and observe those resources. While the impact of camping activities on ground cover vegetation and soils is well documented (Leung and Marion, 2000; Cole, 2004), camping also has the potential to impact other ecosystem components such as wildlife, water quality, and soundscapes (Hammitt et al., 2015). Visitors can also cause other impacts like damaging trees and shrubs, building campfires, and improperly disposing of trash and human waste (Leung and Marion, 2004). In addition to the resource concerns identified above, diminished resource quality can also negatively affect the visitor experience (Roggenbuck et al., 1993; Cole et al., 1997; Lynn and Brown, 2003; Manning et al., 2004). Therefore assessing and monitoring conditions at campsites is a valid objective for recreation resource managers.

Campsite studies can accomplish several useful goals and provide valuable information for resource planning and management. First, campsite studies can inventory

current resource conditions, providing a baseline that can serve as a foundation for future monitoring efforts (see Goonan et al., 2015). Second, they can track trends in resource conditions over time (see Boyers et al., 2000; Cole et al., 2008). Third, campsite studies can serve as a surrogate measure of visitor use patterns (see Cole et al., 2008). Fourth, they can evaluate the effectiveness of management actions (see Marion and Sober, 1987; Roggenbuck, 1992; Douchette and Cole, 1993; Leung and Marion, 2004). Finally, they can examine the spatial and temporal aspects of use and resource change (see Marion and Cole, 1996; Cole and Monz, 2004). Despite these capabilities, campsite studies cannot determine if observed conditions are ecologically sustainable or acceptable given management goals and objectives. Addressing the former question requires contributions from the fields of ecology, biology, and environmental science, while addressing the latter requires input from social science research, managers, and other stakeholders.

Methods for assessing and monitoring campsite conditions have been developed and applied over the past several decades. Early approaches measured various impact parameters such as changes in ground cover vegetation (Magill and Nord, 1963; Frissell and Duncan, 1965; LaPage, 1967; Magill, 1970; Settergren and Cole, 1970; Merriam et al., 1971), species composition (LaPage, 1967), health and condition of trees (Magill and Nord, 1963; Frissell and Duncan, 1965; Magill, 1970; Settergren and Cole, 1970; Merriam et al., 1971), organic material and litter cover (Magill and Nord, 1963; Frissell and Duncan, 1965; Legg and Schneider, 1976; Young and Gilmore, 1976), soil compaction (Frissell and Duncan, 1965; Settergren and Cole, 1970; Merriam et al., 1971; Legg and Schneider, 1976; Young and Gilmore, 1976), tree root exposure (Frissell and

Duncan, 1965), soil nutrients and pH (Young and Gilmore, 1976), and site area (Merriam et al., 1971).

In their update on the condition of newly created campsites in the Boundary Waters Canoe Area, Merriam and his colleagues (1971) suggested the potential to combine measured site characteristics to develop a “deterioration stage classification” (para. 20) that would be useful to managers. Some researchers attempted to develop a classification scale for campsites representing a continuum of impact. Willard and Marr (1970) described a scale based on vegetation cover loss, changes in plant vitality, soil exposure, and soil erosion. Merriam and colleagues (1973) developed a five-level impact stage classification based on measurements of the amount of bare soil, vegetation cover loss, soil compaction, dead trees, trees with exposed roots, and increase in site area. A campsite’s impact stage is calculated by assigning an ordinal stage value score of 1 through 5 to each measured variable (at least three) and taking the average (mean). The average stage value score determines the impact stage, with 1 being the lowest level of impact and 5 having the most change or impact (see Merriam et al., 1973, pp. 18-19). Following these early applications of a campsite impact classification scale, Frissell (1978) developed a condition classification system using visual criteria, or easily observable changes in site condition. This condition class scale represents a continuum of minimally- to highly-impacted campsites.

While this method is an easy way to classify sites and can be applied rapidly and efficiently in the field, it has three major shortcomings. First, rating assignment can suffer from observer bias (see Williams, 1994). Second, assigning a single impact rating can be difficult if co-variation of presumably related indicators does not occur. Finally, this

method provides little information regarding specific impacts of concern at individual sites. Multiple indicator methods have been developed to address some of the shortcomings outlined above (e.g., Cole, 1989; Marion, 1991; Marion, 1995; Newsome et al., 2012). These methodologies increase the sensitivity and precision of site assessments by measuring several indicators at each site. This yields a robust dataset with information about several specific impact parameters.

Despite the development of multiple-indicator methods for assessing campsite conditions, these methods often continue to assign an overall condition class rating to each individual campsite (e.g., Cole, 1993; Boyers et al., 2000; Monz et al., 2011; Goonan et al., 2012). Examining only the condition class ratings can obscure the information contained in the rest of the dataset. Using a multivariate approach to examine data from multiple indicator campsite studies can reveal meaningful patterns (Leung and Marion, 1999; Monz and Twardock, 2010). A study of backcountry campsites at Great Smoky Mountains National Park (Leung and Marion, 1999) resulted in a three-factor solution: campsite size, fire sites, and social trails loaded on one factor; exposed roots, groundcover loss, and exposed soil loaded on a second factor; and number of damaged trees and cut stumps loaded on a third. These three factors were termed *area disturbance*, *soil and groundcover damage*, and *tree-related damage*. Subsequent cluster analysis identified four distinct campsite types: low impact campsites (LIC), moderately-impacted campsites (MIC), intensively-impacted campsites (IIC), and extensively-impacted campsites (EIC). LIC sites had low mean scores on all factors, MIC sites had low to intermediate scores on all factors, IIC sites had intermediate area disturbance scores and

the highest levels of soil and groundcover damage, and EIC sites were characterized by high levels of area disturbance and tree-related damage.

Another study performed a similar analysis of data from a long-term monitoring effort of backcountry campsites in Prince William Sound (Monz and Twardock, 2010). Factor loadings of the ten measured variables identified a three-factor solution. Tree damage, root exposure, and trails loaded together in the first factor; vegetation cover loss, soil exposure, and area of observable impact loaded together on the second factor; and stumps, fire sites, camping trash, and human waste loaded on a third factor. These factors were termed “tree and vegetation damage,” “areal disturbance,” and “behavior-related disturbance,” respectively. A K-means cluster analysis of factor scores for each campsite identified three distinct campsite classes. *Minimally impacted sites* had low mean scores on all factors, *intensively impacted sites* had a high mean score for the areal disturbance factor, and *comprehensively impacted sites* scored high on the tree and vegetation damage factor and had positive mean scores for all other factors.

These studies illustrate how multivariate methods can be used to uncover meaningful patterns in campsite assessment data. They also demonstrate how the results of multivariate analyses can provide more meaningful information about specific impacts of concern at individual campsites and can inform the kinds of management actions needed for addressing different kinds of impacts. For example, the EIC sites identified at Great Smoky Mountains National Park were characterized by high levels of tree damage. Such impacts are indicative of depreciative visitor behavior, and specific management actions can be targeted to EIC sites to reduce these kinds of visitor impacts. This level of

understanding regarding the nature of impacts present at a given campsite is not possible with the traditional scalar condition class rating.

3. Normative theory and methods

Social science studies of park visitors and other stakeholders can be useful in identifying potential indicators of quality and informing the development of management standards. Normative theory and methods can be utilized to evaluate possible conditions of various social, resource, and managerial indicators and aid in the selection of standards or thresholds for acceptable conditions in parks and protected areas. Developed in sociology, the concept of norms has attracted considerable attention as a theoretical and empirical framework in outdoor recreation research and management (Heberlein, 1977; Shelby and Heberlein, 1986; Vaske et al., 1986; Whittaker and Shelby, 1988; Vaske et al., 1993; Shelby et al., 1996; Manning, 1999; Heywood et al., 2002). In the context of outdoor recreation, norms are generally defined as standards that individuals and groups use for evaluating behavior and social and environmental conditions (Vaske et al., 1986; Shelby and Vaske, 1991; Donnelly et al., 1992). In other words, norms address conditions that result from behavior and measure the degree to which selected conditions ‘ought’ to exist (Manning, 2011). If park visitors and other stakeholders possess norms for relevant aspects of recreation experiences, these norms can be measured and used as a basis for informing the development of management standards. Normative information can contribute to an empirically informed approach to outdoor recreation management and capacity decisions, especially when combined with other sources of information— including legal and administrative mandates, agency policy, historical precedents, public

acceptability, interest group politics, current resource and social conditions, management feasibility, resource characteristics, and scientific studies of ecological thresholds.

The application of the normative approach to formulating visitor-based standards in parks has relied on the work of Jackson's (1965) return-potential methodology to measuring norms. Such application is most fully described in Shelby and Heberlein (1986), Vaske et al. (1986), Shelby et al. (1996), Vaske and Whittaker (2004), and Manning (2011). Individual norms can be measured by asking visitors and stakeholders to evaluate the acceptability of a range of social, resource, or managerial conditions that could be found within a park or other natural area. These data are then aggregated and graphed to form a social norm curve. Norm curves can be tested for the existence of social norms and the degree to which norms are shared across groups. Normative research in outdoor recreation has been applied to several social, ecological, and managerial issues, including crowding (Heberlein et al., 1986; Williams et al., 1991; Inglis et al., 1999; Manning et al., 2000; Manning and Valliere, 2002; Vaske and Donnelly, 2002), ecological impacts on campsites (Shelby et al., 1988; Shelby and Shindler, 1992; Goonan et al., 2012), ecological impacts on trails (Kim and Shelby, 2006; Goonan et al. 2009), wildlife-management practices (Vaske and Donnelly, 1988; Zinn et al., 1998), fire management (Kneeshaw et al., 2004), and minimum stream flows (Shelby et al., 1992; Shelby and Whittaker, 1995a).

A hypothetical social norm curve (Fig. 1.1) illustrates the methodology described above. Respondents are asked to rate the relative acceptability of a range of conditions that could be present at a park or other recreation area, and responses are aggregated and

plotted on a graph. In this hypothetical case, the norm curve traces the average visitor-rated acceptability of the number of groups encountered per day along a trail. The norm curve's structural characteristics provide a great deal of information regarding the respondents' evaluations of potential conditions of the indicator being investigated. Detailed discussions of the structural characteristics of norms can be found in Vaske et al. (1993), Shelby et al. (1996), and Manning and Krymkowski (2010). The following summary of norm curve structure draws on those sources.

The highest point on the curve might be interpreted as the *preferred* or *optimal condition*. However, unless respondents are explicitly asked to specify their preference, it should be understood that interpreting preference from the norm curve is an assumption based on the average acceptability ratings of the various conditions. The point at which the norm curve crosses the zero point on the acceptability scale is the *minimum acceptable condition*, or *threshold*, for the indicator variable being investigated. The *range of acceptable conditions* includes all points on the curve above the zero point on the acceptability scale. The dispersion around the points defining the norm curve, or *crystallization*, reveals the level of consensus or agreement among responses. Finally, the amplitude of the curve, or the distance between the highest and lowest points on the curve, can indicate the *salience* or *intensity* of a particular indicator of quality. In other words, a large amplitude suggests that the indicator variable under study is important to visitors, while a smaller amplitude suggests that it is not a very important indicator of quality from the visitor perspective. The information provided by norm curves can be useful in selecting recreation-related indicators and informing the development of standards for recreation conditions.

Conceptually, norms can be categorized into one of three types: *no tolerance*, *single tolerance*, and *multiple tolerance*. All three types of norms were identified in a study of boaters on the Deschutes River in Oregon (Whittaker and Shelby, 1988). The tolerance for human waste represented a no-tolerance norm, with 80% of respondents reporting that it was never acceptable to see human waste. River encounters (time in sight of others) represented a single-tolerance norm, with nearly all visitors reporting thresholds greater than zero but unwilling to tolerate impacts beyond a certain level. Thresholds for fire ring impacts illustrated a multiple-tolerance norm: 40% of respondents favored zero impact, and the percentage reporting higher tolerances declined for the next three impact levels before turning upward at the highest impact level. Seventeen percent of visitors would tolerate a fire ring at every campsite. Understanding the type of norm can also provide useful information for recreation managers. No-tolerance norms are generally characterized by a mode at zero impact, high norm salience, and high crystallization; single-tolerance norms are generally characterized by a mode of some impact greater than zero with a sharp decline in the percentage of respondents who would tolerate impacts greater than the modal level; and multiple-tolerance norms may indicate the existence of at least two groups with different norms for this impact (Shelby et al., 1996). In other situations, multiple-tolerance norms might indicate a range of acceptable conditions between the minimum and maximum presented, resulting in an upside-down U shaped curve. For example, Shelby et al. (1992) found this pattern while investigating acceptable streamflow levels on the Colorado River.

Numerous studies have explored the application of normative theory and methods to parks and protected areas. These studies address theoretical and methodological issues

including norm prevalence, or the ability of respondents to report a norm for a given indicator variable (Kim and Shelby, 1998; Donnelly et al., 2000); norm salience (Donnelly et al., 2000); measuring norms (Manning et al., 1999; Manning, 2011); crystallization, or the level of consensus about a norm (Shelby et al., 1996; Krymkowski et al., 2009; Vaske et al., 2010); norm congruence (Manning et al., 1996c; Vaske et al., 1996); the relationship between visitor-based norms and the conditions experienced in parks (Laven et al., 2005); and the stability of norms over time (Bacon et al., 2001).

To measure norms, respondents are generally asked to evaluate the acceptability of a range of conditions that could be present in parks or recreation areas. The use of visual research methods in presenting possible conditions has emerged as a useful approach to measure norms (Manning and Freimund, 2004). Early studies using a visual approach used videotape (Shelby and Whittaker, 1995b; Vaske et al., 1995), slides (Shelby and Shindler, 1992; Basman et al., 1996) and photographs (Manning et al., 1996b) to present respondents with a range of social and ecological conditions. Visual research methods have a number of advantages over narrative/numerical techniques for measuring social norms. Visual methods can help standardize research on standards of quality by presenting a constant series of images to all respondents; they can be useful in studying standards of quality for indicator variables that are too technical or complex to communicate in a narrative format; and images can be manipulated to show a range of conditions, including conditions that currently exist or could potentially exist at a recreation area in the future.

4. Dissertation outline

4.1 Unifying theme and central principles

The research studies contained in this dissertation, outlined below, are unified by the common purpose of informing recreation resources management in national parks and other protected areas. The main objective of this dissertation is to increase the utility of data collected in the field to managers through enhanced understanding. The following principles of outdoor recreation resources management, drawn from the recreation literature (Wagar, 1964; Shelby and Heberlein, 1984; Leung and Marion, 2000; Leung and Marion, 2004; Pigram and Jenkins, 2006; Manning, 2011; Whittaker et al., 2011; Manning and Anderson, 2012; Hammitt et al., 2015; Interagency Visitor Use Management Council, 2016a), inform this objective:

Principle 1: Outdoor recreation should be considered within a three-component framework – social/experiential, resource/biophysical, and managerial. This principle speaks to the multidisciplinary nature of outdoor recreation. Holistic management should not only consider the three components, but also the potential interrelationships among them. For example, degraded resource conditions resulting from recreational use could detract from the quality of the visitor experience and require management intervention.

Principle 2: Outdoor recreation management should be guided by management objectives and associated indicators and thresholds. Management objectives are necessary to guide analysis and decision-making in outdoor recreation management. Objectives define the desired conditions to be maintained in parks and protected areas. Indicators are specific resource or experiential attributes that can be measured to track changes in conditions, and thresholds define the minimum acceptable condition of

indicator variables. Monitoring of indicator variables and comparison against established thresholds can provide managers with valuable information about changing conditions. Reflecting on management objectives can help guide decision-making regarding the necessity and appropriateness of various management actions.

Principle 3: Outdoor recreation management should be considered a form of adaptive management. Decisions in outdoor recreation management should be made based on the best available information, including science, staff expertise, and public input. As new information becomes available, management should be revised and refined as appropriate. Thus outdoor recreation management is an iterative process that allows for adaptation and integration of new information.

Principle 4: Outdoor recreation management decisions are based on scientific information as well as judgment. This is true for most decisions regarding outdoor recreation management: establishing management objectives, selecting appropriate indicators, setting condition thresholds, and choosing appropriate management actions requires balancing a great deal of information to fashion a plan. Scientific information, legal mandates, agency policy, biophysical considerations, social values, and norms are all important to consider in establishing outdoor recreation management policy. However, an element of judgment is necessary to find the appropriate balance and compose a holistic management plan. The results of outdoor recreation research studies do not dictate planning outcomes; rather they should be used in concert with other information to inform management decisions.

4.2 Dissertation chapters and objective

This dissertation contains three chapters prepared for publication that address three topics common to research in outdoor recreation: an assessment of biophysical conditions at campsites, biophysical and social science research designed to identify indicators and thresholds to inform a program of monitoring, and an exploration of characteristics of visitors to national parks and their evaluations of recreation resource conditions.

Chapter 2 examines an integrated social/ecological approach to backcountry planning, management, and monitoring in Kenai Fjords National Park (KEFJ). Two phases of social science research were completed to identify potential indicators for backcountry experiential and resource conditions and formulate thresholds for selected indicators. This research complements an assessment of backcountry campsite conditions. Normative results of the visitor survey were analyzed to examine structural characteristics of respondent norms. Six types of norms were identified. Campsite data were analyzed using traditional and multivariate approaches. Campsite conditions are evaluated in the context of visitor thresholds and norms. Implications for managers and future research are discussed.

Chapter 2 Objectives:

1. Identify visitor-based indicators for backcountry experiential and recreation resource conditions
2. Formulate visitor thresholds for conditions of selected indicator variables
3. Examine the structure of visitor norms as applied to indicators of interest

4. Examine current backcountry campsite conditions in the context of visitor thresholds and norms

The study presented in Chapter 2 identified six distinct norm types based on structural characteristics, calculated thresholds for selected indicators, identified four classes of campsites based on measured variables, and integrated social science and resource assessment results to evaluate current park conditions. The analysis of varying norm structures highlight the potential problems with considering only average or aggregate results of social science and resource assessments. The classification of campsites based on measured values of multiple indicators demonstrates the advantages of this approach over traditional scalar methods as it highlights specific impacts of concern and may suggest appropriate management action. The results have implications for the application of normative methods in recreation social science, as well as the analysis of resource monitoring data. The integration of these approaches can also produce more useful results that can inform management decisions. This study has been prepared for publication in *Northwest Science*.

Chapter 3 examines campsite assessment data from three independent studies at national parks using a multivariate approach to determine whether underlying patterns in the data can be identified. These results are compared to traditional condition class ratings to examine the relative advantages and disadvantages of each approach. Sites included in the study are Isle Royale National Park, Michigan; Zion National Park, Utah; and Kenai Fjords National Park, Alaska. Management and research implications are discussed.

Chapter 3 Objectives:

1. Examine the application of a multivariate statistical approach to analyzing multiple-indicator campsite data
2. Determine whether interpretable structures can be found within multiple-indicator campsite data
3. Determine whether campsites can be classified based on the empirical measures collected
4. Compare results with traditional scalar condition class ratings if an empirically-based classification is possible
5. Examine the advantages and disadvantages of using a multivariate approach to analyzing campsite condition data within the context of recreation resources management in parks and protected areas

The research presented in Chapter 3 revealed interpretable structures within the data from all study locations, and was able to classify campsites based on the empirical measures collected in the field. The multivariate approach examined demonstrated the ability to identify meaningful patterns and associations of variables in campsite data from assessments conducted at sites representing a range of geographic locations, climates, and ecosystems. This approach is an improvement over the traditional scalar condition class rating based on visual criteria as it provides more detailed information about specific impacts of concern. This study has been prepared for publication in *Journal of Environmental Management*.

Chapter 4 examines the relationship of selected visitor characteristics to visitors' tolerances for recreation resource impacts. Visitors to Kenai Fjords National Park and

Denali National Park and Preserve were given a survey that measured a suite of characteristics, including low impact knowledge, prior experience, ecological knowledge, motivations, place attachment, environmental orientation, and demographics. Visitors were also asked to evaluate a range of conditions for six recreation resource variables: visitor-created trails; informal visitor sites; trail condition; and small, medium, and large campsites with varying levels of vegetation cover loss. Respondent norm curves were visually inspected to examine structural characteristics. Six types of norms were identified. Multiple linear regression models were constructed to examine the relationship of selected visitor characteristics on respondents' tolerance of impacts to recreation resources. Implications for management, normative approaches in recreation research, and future research are discussed.

Chapter 4 Objectives:

1. Measure a variety of characteristics for visitors to national parks in Alaska
2. Measure visitor thresholds for a suite of resource conditions that could be found at a national park in Alaska
3. Examine the structure of visitor norms as applied to resource indicators of interest
4. Explore the influence of visitor characteristics on thresholds for recreation resource conditions

The study in Chapter 4 illustrates a first attempt to examine the relationship between visitor characteristics and thresholds for recreation resource conditions. A multiple regression model examining the relationship between visitor characteristics and condition thresholds explained 5.8% of the variability in visitor-created trail thresholds.

Ecological concern and respondents' rate of participation in organized park activities emerged as significant variables in regression models for visitor-created trails and trail condition thresholds. This research also expanded the classification of norms based on structural characteristics, identifying six norm types based on the structural characteristics of respondents' norm curves for condition acceptability ratings. This study provides support for the use of normative methods to assess park visitors' tolerance of recreation resource conditions. The expanded norm typology can provide important insight into visitors' evaluations of the acceptability of impacts that will provide managers with valuable information to enhance park planning and decision-making. This study has been prepared for publication in *Leisure Sciences*.

Together, these research studies advance theory and practice in outdoor recreation management through enhanced understanding of these topics and a reflection on practical management implications. An improved understanding of the biophysical impacts associated with recreation activities and the visitors utilizing and interacting with those resources should increase the utility of recreation ecology and social science study results to managers, leading to more informed and efficient management of outdoor recreation.

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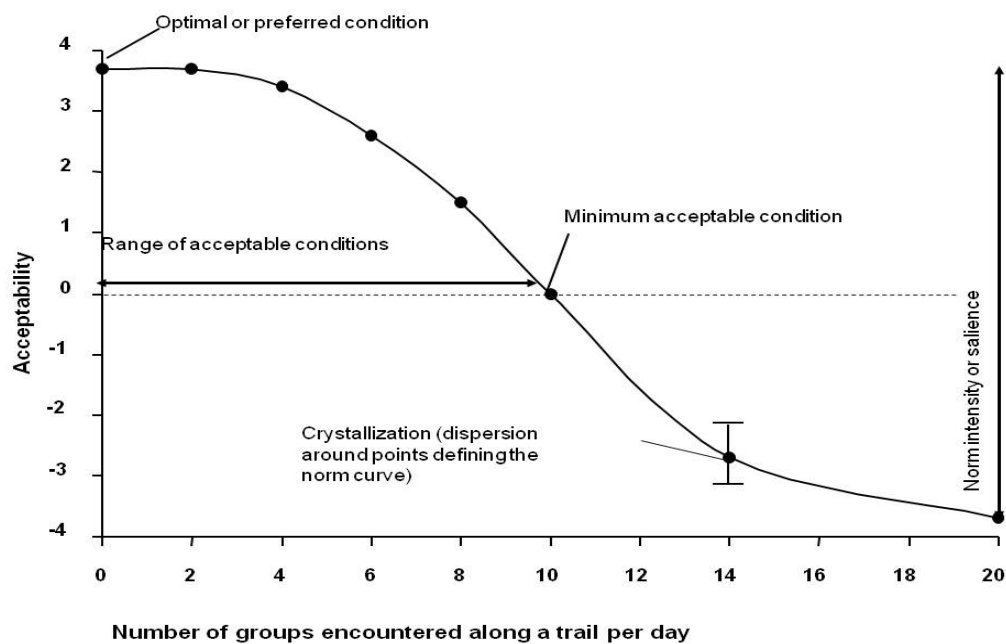


Fig. 1.1. Hypothetical social norm curve.

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CHAPTER 2
AN INTEGRATED APPROACH TO RECREATION MANAGEMENT
AND MONITORING: AN EXAMPLE FROM KENAI FJORDS
NATIONAL PARK, ALASKA

Abstract

This study combined social science techniques to measure visitor evaluations of the acceptability of selected experiential and resource conditions with measures of campsite impacts in Kenai Fjords National Park, AK. Visitors returning from a backcountry trip to the coast completed a self-administered on-site survey incorporating normative methods to determine acceptability thresholds. Structural characteristics of resulting norms were examined identifying six structural types, and acceptability thresholds for indicators were calculated. Backcountry campsites were assessed using established protocols. Factor analysis and cluster analysis were used to classify campsites based on measured impacts. Thresholds were identified for encounters with other kayak groups and the number and type of boats seen; respondents judged all campsite conditions as being acceptable. The multivariate analyses of campsite assessment data succeeded in identifying four campsite types based on empirical measurements of condition indicators. Results suggest that overall visitors to the park are encountering acceptable social and resource conditions in the coastal backcountry. The analysis of varying norm structures highlight the potential problems with considering only average or aggregate results of social science and resource assessments. The classification of campsites based on measured values of multiple indicators demonstrates the advantages

of this approach over traditional scalar methods as it highlights specific impacts of concern and may suggest appropriate management action. The results have implications for the application of normative methods in recreation social science, as well as the analysis of resource monitoring data. The integration of these approaches can also produce more useful results that can inform management decisions.

Introduction

Recreation in United States National Parks

National parks and other protected areas are highly valued for the recreation opportunities they offer, and trends in outdoor recreation in the United States (Cordell 2012) and worldwide (Pigram and Jenkins 2006, Balmford et al. 2015) suggest continued growth in public demand for recreation opportunities and appreciation of parks and other natural areas. The U.S. national park system has experienced record visitation in 2014 and 2015 (Olson 2016), and has experienced a system-wide increase of 4.54% from August 2015 to August 2016 (National Park Service Visitor Use Statistics 2016a). Outdoor recreation produces numerous individual benefits (e.g., Orsega-Smith et al. 2004, Lee 2011, Dorsch et al. 2016) as well as societal benefits (e.g., Moore et al. 1992, Budruk et al. 2009, Headwaters Economics 2017, Outdoor Industry Association 2017). These benefits include, but are not limited to, enhanced physical and mental health, community cohesion, and economic benefits. However recreational use of these public lands also has the potential to impact park resources, the quality of the recreation experience, and the kind and extent of management (Manning 2011, Hammitt et al. 2015). Managers of national parks are charged with not only providing for use and

enjoyment by the public, but they are also entrusted to protect significant natural and cultural resources. Balancing these competing responsibilities is often challenging; however, managing protected areas used for outdoor recreation in a deliberate, proactive, adaptable manner can help find the balance. Utilizing a management framework built on stated desired conditions, indicators, thresholds, and a program of continued monitoring can provide managers with the tools and information necessary to achieve both goals of protecting significant resources and providing for use and enjoyment by the public.

Managing Outdoor Recreation

Managing the impacts associated with recreational use is generally conceptualized through the concept of capacity (Shelby and Heberlein 1986, Stankey and Manning 1986, Manning 2011; Interagency Visitor Use Management Council 2016). Agencies in the U.S. are required to plan for visitor use management, which is defined as the proactive and adaptive process for managing characteristics of visitor use and the natural and managerial setting (Interagency Visitor Use Management Council 2016). In this context, visitor capacity, a component of visitor use management, is the maximum amounts and types of use that can be accommodated by an area while achieving and maintaining desired conditions (resource conditions and recreation experiences) that are consistent with the purposes for which the area was established. In other words, capacity can be understood as the type and level of recreation use that can be accommodated while maintaining acceptable desired social/experiential, resource/biophysical, and managerial conditions within a park or other natural area (Manning 2011, Interagency Visitor Use Management Council 2016).

A principal difficulty in applying capacity to parks and protected areas is in determining how much impact is too much, or what level of change is acceptable. Shelby and Heberlein (1984) identify two components involved in establishing capacities: a descriptive component and an evaluative component. The descriptive component defines the observable workings of recreation systems and involves management parameters, impact parameters, and the relationship between the two. The evaluative component integrates value judgments into determining capacity based on the acceptability of impacts. Recreation capacity can most effectively be defined, planned, and managed in the context of specific management objectives or statements of desired conditions, supported by a system of monitoring indicators and associated thresholds (Whittaker et al. 2011, Interagency Visitor Use Management Council 2016). Indicators are defined as specific resource or experiential attributes that can be measured to track changes in conditions. Thresholds are minimally acceptable conditions associated with each indicator. A trigger is a point that reflects a condition of concern for an indicator that is enough to prompt a management response. A system of ongoing monitoring is essential to achieve and maintain desired conditions in parks and other natural areas and is key to the adaptive nature of most park planning frameworks (Interagency Visitor Use Management Council 2016).

Ultimately, decisions regarding outdoor recreation management are value-based judgments about the acceptable levels of change in parks and protected areas (Shelby and Heberlein 1984, Manning and Lawson 2002, Interagency Visitor Use Management Council 2016). Such decisions should be as informed as possible and consider a variety of information sources (Whittaker et al. 2011, Interagency Visitor Use Management

Council 2016). Scientific data regarding the biophysical and social/experiential components of a park or protected area are vital to helping managers determine what level of change is acceptable and establish thresholds for impacts. Research studies of the biophysical effects of recreational activities and of park visitors and their recreation experiences can provide managers with the necessary data to inform the formulation of impact thresholds and management decisions aimed at protecting the quality of park resources and the visitor experience

Normative Methods

Normative theory and methods can be utilized to evaluate possible conditions of various social/experiential, resource, and managerial indicators and aid in the selection of thresholds for acceptable conditions in parks and protected areas. Visitor studies incorporating normative methods can provide valuable information regarding the evaluative component of capacity.

Developed in sociology, the concept of norms has attracted considerable attention as a theoretical and empirical framework in outdoor recreation research and management (Heberlein 1977, Shelby and Heberlein 1986, Vaske et al. 1986, Whittaker and Shelby 1988, Vaske et al. 1993, Shelby et al. 1996, Manning 1999, Heywood et al. 2002). The application of the normative approach to formulating visitor-based standards in parks has relied on the work of Jackson's (1965) return-potential methodology to measuring norms. Such application is most fully described in Shelby and Heberlein (1986), Vaske et al. (1986), Shelby et al. (1996), Vaske and Whittaker (2004), and Manning (2011).

In the context of outdoor recreation, norms are generally defined as standards that individuals and groups use for evaluating behavior and social and environmental conditions (Vaske et al. 1986, Shelby and Vaske 1991, Donnelly et al. 1992). In other words, norms address conditions that result from behavior and measure the degree to which selected conditions ‘ought’ to exist (Manning 2011). Norms have been applied to several social, ecological, and managerial issues (Shelby et al. 1988, Williams et al. 1991, Shelby and Whittaker 1995, Zinn et al. 1998, Manning et al. 2000, Kneeshaw et al. 2004, Kim and Shelby 2006, Goonan et al. 2012). If park visitors and other stakeholders possess norms for relevant aspects of recreation experiences, these norms can be measured and used as a basis for informing the development of management standards. Normative information can contribute to an empirically informed approach to outdoor recreation management and capacity decisions, especially when combined with other sources of information.

In the methodology described above, respondents are asked to rate the relative acceptability of a range of conditions that could be present at a park or other recreation area, and responses are aggregated and plotted on a graph. In a hypothetical case, the norm curve would trace the average visitor-rated acceptability of the number of groups encountered per day along a trail. The norm curve’s structural characteristics provide a great deal of information regarding the respondents’ evaluations of potential conditions of the indicator being investigated. Detailed discussions of the structural characteristics of norms can be found in Vaske et al. (1993), Shelby et al. (1996), and Manning and Krymkowski (2010). For the purposes of this study, we are primarily interested in two structural characteristics: the *threshold* or *minimum acceptable condition*, or the point at

which the norm curve crosses the zero point on the acceptability scale; and the *range of acceptable conditions*, or all points on the curve above the zero point on the acceptability scale. These characteristics, among others, can be useful in selecting recreation-related indicators and informing the development of thresholds for recreation conditions.

In past studies, norms have been categorized into one of three types: *no tolerance*, *single tolerance*, and *multiple tolerance* (Whittaker and Shelby 1988, Shelby et al. 1992, Shelby et al. 1996). No-tolerance norms are characterized by an acceptable rating for the “no impact” condition and an immediate unacceptable rating for any level of impact, or a mode at zero impact; single tolerance norms are characterized by a threshold greater than 0 but an unwillingness to tolerate impacts beyond a certain level; and multiple tolerance norms cross the x -axis more than once, often with a range of acceptable conditions between the minimum and maximum presented (Shelby et al. 1996).

Campsite Studies

Campsites are often a focal point of studies and monitoring efforts aimed at examining biophysical impacts of recreation. Campsites serve as destinations and nodes of visitor use: they are locations where concentrated recreation activities impact biophysical resources, and where visitors interact with and observe those resources. In some cases, certain impacts like bare soil (e.g., Knudson and Curry 1981, Martin et al. 1989, Shelby and Shindler 1992, Farrell et al. 2001) fire rings (Shelby and Shindler 1992), and large areas (Lucas 1990), may be desirable to visitors as these impacts are perceived as enhancing the functionality of the location as a campsite (Brown and

Shomaker 1974, Heberlein and Dunwiddie 1979, Shelby et al. 1988). In other words, some impacts might be perceived as being amenity attributes that enhance the desirability of a campsite. In other situations, diminished resource quality can negatively affect the visitor experience (Roggenbuck et al. 1993, Cole et al. 1997, Lynn and Brown 2003, Manning et al. 2004). While the impact of camping activities on ground cover vegetation and soils is well documented (Leung and Marion 2000, Cole 2004), camping also has the potential to impact other ecosystem components such as wildlife, water quality, and soundscapes (Hammit et al. 2015). Visitors can also cause other impacts like damaging trees and shrubs, building campfires, and improperly disposing of trash and human waste (Leung and Marion 2004). The dual nature of campsites as recreation resources and important elements of the visitor experience makes assessing and monitoring conditions at campsites a valid objective for park and protected area managers.

Methods for assessing and monitoring campsite conditions have been developed and applied over the past several decades (Frissell 1978, Cole 1989, Marion 1991, Marion 1995, Newsome et al. 2012). Contemporary assessment protocols often use a multiple-indicator approach in which several campsite condition variables are measured. However, multiple-indicator methods often also assign an overall condition class rating based on the visual approach (e.g., Frissell 1978) to each individual site in order to classify campsites based on a continuum of impact. Examining only the condition class ratings in a multiple-indicator dataset can obscure important information about the nature of observed campsite impacts.

Multiple-indicator campsite studies are well suited to multivariate analyses that may reveal meaningful patterns within the data (Leung and Marion 1999, Monz and

Twardock 2010). Unlike the traditional scalar condition class rating, a holistic examination of multiple resource condition indicators can give managers a better understanding of specific impacts of concern at individual campsites and more efficiently direct management actions.

Campsite studies can accomplish several useful goals and provide valuable information for resource planning and management. First, campsite studies can inventory current resource conditions, providing a baseline that can serve as a foundation for future monitoring efforts (see Goonan et al. 2015). Second, they can track trends in resource conditions over time (see Boyers et al. 2000, Cole et al. 2008). Third, campsite studies can serve as a surrogate measure of visitor use patterns (see Cole et al. 2008). Fourth, they can evaluate the effectiveness of management actions (see Marion and Sober 1987, Roggenbuck 1992, Douchette and Cole 1993, Leung and Marion 2004). Finally, they can examine the spatial and temporal aspects of use and resource change (see Marion and Cole 1996, Cole and Monz 2004). Despite these capabilities, campsite studies cannot determine if observed conditions are ecologically sustainable or acceptable given management goals and objectives. Addressing the former question requires contributions from the fields of ecology, biology, and environmental science, while addressing the latter requires input from social science research, managers, and other stakeholders.

Integrated Studies

Empirical studies of the effects of recreation and tourism activities on conditions are invaluable to management and capacity decisions. While management frameworks recognize the three-dimensional nature of recreation capacity as including social,

resource, and management components, park managers have historically relied on solitary biophysical and social science studies to inform management decisions. There is a growing awareness that recreation ecology studies and social science research can both benefit from being conducted in concert (Newman et al. 2001, Moore et al. 2003, Manning et al. 2005, Monz et al. 2010, Marzano and Dandy 2012). Human values and ecological science are both necessary in determining what constitutes impairment of protected area ecosystems and in establishing visitor use capacities. However, only a limited number of studies have worked to incorporate field-based biophysical assessments and social science methodologies into individual study designs (Merriam et al. 1973, Cole et al. 1997, Manning et al. 2004, Smith and Newsome 2010, Goonan et al. 2012, Moore et al. 2012, D'Antonio et al. 2013). The research presented here uses approaches similar to Smith and Newsome (2010), Goonan et al. (2012), and D'Antonio et al. (2013) to integrate objective field-based measurements and social science methods to examine the acceptability of recreation resource impacts from the visitor perspective. This type of approach is an advancement of other approaches that simply ask respondents to evaluate a range of hypothetical conditions as it allows for a direct integration of measured biophysical indicators into social science instruments, and the ability to compare the results of social science research to objective resource conditions.

Methods

Study Area

Kenai Fjords National Park (officially abbreviated by the National Park Service as KEFJ) is located at approximately 59°55'N 149°59'W in southern Alaska. Established in

1980, KEFJ protects nearly 670,000 acres of glaciers, alpine habitat, spruce-hemlock coniferous forest, deciduous forest, and fjord estuaries. In 1964, a powerful earthquake caused areas of the shoreline to subside several feet, causing salt water to infiltrate the water table and kill stands of trees near the coast. These standing “ghost trees” are an important testimony to the dynamic nature of the area and are considered protected cultural resources by the NPS. Although there is no designated wilderness in KEFJ, most of the park is remote backcountry and nearly 85% is considered eligible wilderness. With approximately 400 miles of coastline, the park offers excellent opportunities for sea kayaking. A system of campsites located along the coast supports overnight visitor activities in the backcountry. All overnight backcountry visitors are encouraged to complete a voluntary backcountry registration with the NPS, but only guided groups are required to register.

Visitor Surveys

Survey work was conducted in two phases: an indicator elicitation survey in 2010 (USU IRB Protocol #2623; OMB Control Number 1024-0224), and a study in 2012 designed to develop numerical thresholds (USU IRB Protocol #2946; OMB Control Number 1024-0224). In 2010, adult visitors who had participated in a trip to the coastal backcountry of KEFJ were contacted and asked to complete an on-site self-administered survey (Appendix A). Contacts took place in the field and at local kayak shops following a trip to the coast from July 15 to August 30. Open-ended questions asked respondents what they enjoyed most about their visit, what they enjoyed least, what they would ask park managers to change, what they valued most about KEFJ, and what they considered

to be the most important qualities of KEFJ. Responses were coded to identify potential indicator variables relevant to the visitor experience. Close-ended questions asked respondents to rate the importance of several potential issues or problems they perceived within the park's backcountry areas. Items included in the survey were derived from indicators monitored in the campsite assessment protocol and discussion with park managers concerning potential indicators of interest. Visitors were able to respond that the issue was "Not a problem (1)," a "Small problem (2)," a "Big problem (3)," or that they did not know. Visitor demographics and trip information were also collected.

A second phase of research was conducted August 1 to August 15, 2012 to develop numerical thresholds (Appendix B) for selected indicators, incorporating results from Phase 1. Adult visitors returning from a backcountry trip were contacted at local kayak outfitters and asked to participate in the study. Visitors were asked to indicate reasons for visiting the park, rate the extent to which they perceived several items to be problems, and evaluate the acceptability of various resource and social conditions that could be encountered in the coastal backcountry. Visual simulations and narrative/numerical formats were used to determine respondents' tolerance to the number of other kayak groups seen per day during a trip, the number and kind of boats seen at one time, and the condition of backcountry campsites (Appendix C), and norm curves were plotted for each variable. Visual simulations of number/kind of boats and backcountry campsites were presented to respondents in a random order. Respondents were also asked to indicate their condition preference, the point at which they would discontinue visiting the coastal backcountry, and the condition for which the NPS should manage. Trip information and visitor demographics were also collected.

Contacting visitors to participate in the study was difficult given the manner of access to the coast. Most visitors access the coast via private water taxis owned or hired by private outfitting and guide service providers. Time constraints and physical conditions make contacting visitors in the field during a trip difficult. In 2010, attempts were made to administer surveys via kayak shops and on water taxis at the conclusion of a trip when visitors traveled back to Seward. This approach yielded very few completed surveys. In 2012, a letter was sent to local kayak shops informing them of the study and asking permission for research staff to contact visitors at the shops after they had returned from a trip to the coast. Of the six outfitters contacted, two agreed to allow researchers to contact visitors.

Visitor Norms

Visitor ratings of the acceptability of the number of other kayak groups seen per day during a trip, the number and kind of boats seen at one time, and the condition of backcountry campsites were graphed and visually inspected to identify their structure. Responses were coded to indicate norm type based on the structure identified. Thresholds for resource conditions were calculated for appropriate norm types using linear interpolation.

Campsite Assessment

Complete assessments were conducted on campsites in August 2010 using an updated monitoring protocol developed for KEFJ (Monz et al. 2011). Campsite condition measurements followed standard campsite assessment protocols (Marion 1995, Monz 2000) with minor modifications to adapt methodologies to the environment of coastal

Alaska. Vegetation cover and soil exposure measurements followed the ocular measurement approach suggested by Marion (1995). An undisturbed area adjacent to each campsite was selected as a control for vegetation loss calculations. Campsite size was measured using the variable radial transect method. Condition class measurements followed a standard scale (Marion 1995) of 1 through 5, with higher condition class ratings representing higher levels of impact. In some cases a condition class rating of 0 was assigned to an area where camping is possible but no clear ground impact was present to define as a campsite and confirm recent use. Other site attributes were assessed as suggested in Marion (1995) and Twardock et al. (2010). A summary of variables measured is presented in Table 2.1.

Data Analysis

Responses to open-ended questions in the phase 1 and 2 surveys were coded to identify key themes and potential indicator variables relevant to the visitor experience. Vegetation cover loss on campsites was calculated using the following formula:

$$\text{Cover loss} = 1 - \frac{\% \text{ cover in campsite}}{\% \text{ cover in control plots}} \times 100$$

Campsite areas were calculated geometrically from the radial transect data using a custom computer program (Dr. J. Marion, Virginia, USA, 2008).

Data from the visitor surveys and the campsite assessments were summarized and synthetic variables were calculated using SPSS (v. 19, SPSS Inc., Chicago, IL USA). Statistical tests were conducted in SPSS following standard procedures as suggested by Vaske (2008).

A multivariate analysis was conducted on the campsite assessment data in an attempt to gain a greater understanding of the nature and patterns of impacts present on the coast. The analysis used exploratory factor analysis using principal components extraction, and factors with Eigenvalues greater than 1.0 were retained. A varimax rotation was used and factor loadings less than 0.4 were suppressed for ease of interpretation. Agglomerative (hierarchical) cluster analysis using Ward's Method (interval = squared Euclidean distance) was conducted on the factor scores to classify campsites according to impact characteristics. These methods are examined in greater detail in Chapter 3.

Results

Visitors to Kenai Fjords National Park

Thirteen surveys were completed in 2010, and 46 surveys were collected in 2012. Demographic characteristics were compared for 2010 and 2012 respondents and no significant differences were identified. Overall the majority of respondents were male (54%), identified as white (93%), and the average age was 36 years. Visitors to KEFJ tend to be well educated, with nearly 78% holding a college or graduate degree. About 74% of respondents lived in the United States, while international visitors came primarily from Canada (60%) and Germany (13%). The vast majority of respondents (89.8%) were first-time visitors to KEFJ, and approximately 80% of respondents visited the coast as part of a commercial tour or with a guided group. Visits were primarily day trips (62.7%), and multi-day trips ranged from 2 to 19 days in length with an average duration of 4 days. Sea kayak (64.4%), chartered water taxi (57.6%), and helicopter (20.3%) were the most

popular methods used to access the coast. Most respondents who spent the night in the backcountry were unable to name specific sites at which they camped, however eight groups reported camping in Northwestern Fjord and eight reported camping in Aialik Bay.

Phase 1: Identifying Indicators

Visitors who participated in the 2010 survey (n = 13) were asked to respond to open-ended questions asking what they enjoyed most about their visit, what they enjoyed least, and what they would ask the National Park Service to change about how KEFJ is managed. They were also asked what they valued most about KEFJ and what they considered to be the most important qualities of KEFJ. Wildlife, scenery, and solitude were considered by many respondents to be important; bad weather was the largest complaint, though noise from tour boats was also mentioned; and most respondents would not ask the NPS to change anything about the way it manages the park (Table 2.2).

Respondents were also asked to evaluate several issues and report how much of a problem they perceived each to be at KEFJ (Table 2.3). The only issue considered by visitors to be a “small problem” was noise from tour boats. None of the issues were considered by respondents to be a “big problem.” Respondent ratings also indicate the speed and presence of tour boats may be emerging problems from a kayaker’s perspective.

Results of Phase 1 indicate that opportunity for experiencing solitude, the scenic quality of the natural environment, wildlife-viewing opportunities, kayak/tour boat

interactions, and natural soundscapes are important to the quality of the visitor experience.

Phase 2: Reasons for Visiting and Perceived Problems

Indicators from the campsite monitoring protocol and indicators identified from the 2010 survey results were incorporated into a second visitor survey administered in 2012. A total of 46 surveys were collected. Respondents were presented with a list of possible reasons for visiting KEFJ and asked to indicate how important each was to them. While most of the potential reasons for visiting that were presented received a rating of “moderately important” or higher, the three most important reasons for visiting KEFJ were to view the natural scenery, to view glaciers, and to view wildlife (Table 2.4).

Respondents were also asked to indicate their level of agreement with a number of statements regarding conditions in the KEFJ coastal backcountry. Respondents were also given the option to indicate that they did not know or that the item did not apply to their experience. Overall respondents did not indicate any problems with social or resource conditions that they encountered while participating in a trip to the KEFJ coastal backcountry (Table 2.5).

Phase 2: Identifying Thresholds

The final section of the survey asked respondents to indicate the acceptability of various social and biophysical conditions that could be observed in the coastal backcountry. Respondents were first asked to evaluate how acceptable it would be to see certain numbers of kayak groups per day during their trip. Aggregate responses were plotted in a norm curve (Figure 2.1). Respondents indicated that it was acceptable to see a

maximum of 6 other kayak groups per day without causing them to feel too crowded. Respondents preferred to see an average of 1.41 other kayak groups per day, and the mean maximum number of other kayak groups respondents indicated they could see before they would no longer visit the coast was 10.84. However, 41.3% of respondents indicated that they would continue to visit the backcountry regardless of the number of other kayak groups seen. Respondents also indicated that the mean maximum number of other kayak groups seen per day that the NPS should allow on the coast was 9.76, with 32.6% of respondents indicating that the number of kayak groups allowed to access the coast should not be restricted. On average, respondents reported seeing 1.73 other kayak groups per day during their trip.

Next, respondents were shown a series of photographs showing different numbers and combinations of kayaks and tour boats and asked to rate the acceptability of each. Aggregate responses were plotted in a norm curve (Figure 2.2). On average, respondents found a maximum of 12.09 kayaks, 1.95 tour boats, and 5.43 mixed kayaks and tour boats acceptable to see at any one time in the fjords. When asked what they would prefer to see, the majority (60.5%) of respondents selected the photo with 0 boats and 20.9% selected the photo showing 8 kayaks. When asked to indicate which photo showed the number and types of boats that was so unacceptable they would no longer visit the fjords, 37% of respondents selected the photo showing 6 tour boats, 23.9% selected the photo showing 15 mixed boats (12 kayaks and 3 tour boats), and 13% selected the photo showing 24 kayaks. Thirteen percent of respondents indicated that none of the photos was so unacceptable that they would no longer visit the fjords.

When asked which photo showed the condition at which management action should be taken to limit boats within the fjords, 26.1% of respondents selected the photo of 6 tour boats, 17.4% selected the photo of 12 kayaks and 3 tour boats, and 17.4% selected the photo of 24 kayaks. A small proportion of respondents indicated that none of the photos showed a condition at which boats should be restricted from accessing the fjords (4.3%) or that boat access to the fjords should not be limited (6.5%). Most respondents (46.2%) reported that they typically did not see any other boats during their backcountry trip, while 23.1% indicated seeing a few boats (4 kayaks and 1 tour boat), and 15.4% reported seeing a moderate number of other boats (8 kayaks and 2 tour boats).

When asked to indicate how crowded they felt during their trip to the fjords using a nine-point scale (1 = Not at all crowded; 9 = Extremely crowded), respondents indicated an average level of perceived crowding of 1.59 on the crowding scale ($n = 44$; $\text{min} = 1$, $\text{max} = 9$).

Finally, respondents were shown a series of photographs showing campsites of 13m^2 (3.6m by 3.6m), 36m^2 (6m by 6m), and 100m^2 (10m by 10m) with 12%, 55%, and 88% vegetation cover. None of the conditions were rated as being unacceptable to visitors (Figure 2.3).

When asked which campsite conditions they would prefer to see, 32% of respondents selected the small campsite with the most vegetation (13m^2 , 88% vegetation cover), and 17.6% selected the medium campsite with the most vegetation cover (36m^2 , 88% vegetation cover). A majority (67.4%) responded that none of the conditions pictured were so bad as to cause them to stop camping at backcountry campsites in the fjords, while 8.7% indicated they would no longer camp at backcountry campsites if

conditions reached the highest level of impact examined (100m², 12% vegetation cover).

Respondents were also asked to indicate which photograph showed a condition at which management action should be taken to limit impacts to backcountry campsites. Thirteen percent of respondents indicated the photo of the 100m² campsite with 12% vegetation cover, while 39% responded that none of the photos showed a high enough level of environmental impact to justify management action. One respondent indicated that no management intervention should be taken at backcountry campsites. Finally, respondents were asked which photograph looked most like the conditions they typically encountered at backcountry campsites. Fourteen respondents indicated they had visited backcountry sites, and reported seeing a range of impact conditions (29% chose the 100m² campsite with 55% vegetation cover, 21% chose the 13m² campsite with 88% vegetation cover, 14% chose the 13m² campsite with 12% vegetation, and 14% chose the 36m² campsite with 88% vegetation cover).

Visitor Norms

Six distinct norm structures were identified based on visual inspection of individual respondent ratings of acceptability for the three indicators investigated: (i) threshold norms (T), which follow the typical norm curve pattern and indicate a clear threshold of tolerance for conditions; (ii) reverse norms (RN), in which lower impact conditions are rated as less favorable than higher impact conditions; (iii) neutral norms (N), in which all conditions were rated 0 on the acceptability scale; (iv) acceptable norms (A), in which all conditions received a positive rating or the curve made a positive *U*

shape without crossing into the unacceptable range; (v) unacceptable norms (UA), in which all conditions received a negative rating or the curve made a negative *U* shape without crossing into the acceptable range; and (vi) multiple-tolerance norms (MT) where the curve crossed the x-axis two or more times or multiple conditions were rated 0 on the acceptability scale. Norm type for each respondent was recorded for the kayak group (Figure 2.4), boat (Figure 2.5), and campsite condition (Figure 2.6) indicators. Most respondents indicated a clear threshold for the acceptable number of other kayak groups to see per day, the acceptable number of kayaks seen at one time, the acceptable number of tour boats to see at one time, and the acceptable number and type of “mixed” kayaks and tour boats to see at one time (Table 2.6). A substantial number of respondents rated all conditions with tour boats as being unacceptable (Table 2.6). The majority of respondents rated all campsite conditions as being acceptable. Approximately 20% of respondents indicated a reverse norm for medium and large campsites, and very few respondents indicated thresholds for campsite condition (Table 2.6).

Campsite Condition Assessments

Full assessments were conducted on a total of 80 backcountry coastal campsites in KEFJ in August 2010. Overall average conditions at KEFJ in 2010 compare favorably to other studies conducted in coastal Alaska (e.g., Twardock et al., 2010). Average campsite size is 26.5m² and average of amount of vegetation cover is approximately 44% (Table 2.7). Large campsites exceeding 50m² in size are uncommon. Multiple trailing is the most commonly observed resource change, occurring in approximately 74% of sites. Other

impacts are fairly minimal, with observations at fewer than 20% of sites measured (Table 2.8).

Exploratory factor analysis of standardized variables for the twelve measured resource indicators resulted in an interpretable four-factor solution that accounted for approximately 61% of the variation in the data (Table 2.9). Factor loadings for individual items less than 0.4 were eliminated from the results to aid interpretation. The trash and human waste variables had variance 0 and were excluded from the analysis. Factor 1 was interpreted as “areal disturbance” with root exposure, trails, tree damage, and site area loading on this factor; Factor 2 was interpreted as “ground-cover disturbance” with vegetation cover loss and mineral soil exposure loading on this factor; Factor 3 was interpreted as “ghost tree damage” with the ghost tree damage and ghost stumps variables loading on this factor; and Factor 4 was interpreted as “behavior-related disturbance” with stumps and fire sites loading on this final factor. Examining the full dendrogram (Appendix D) suggested a four-cluster solution. This solution was supported by examining the mean factor scores of the final cluster centers (Table 2.10) for the four distinct groupings: 1) *Intensively impacted sites* with moderate mean scores on the ghost tree damage and behavior-related disturbance factors; 2) *Extensively impacted sites* with a high mean score on the areal disturbance factor and negative mean scores for all other factors; 3) *Cultural resource concern sites* with a very high mean score on the ghost tree damage factor; and 4) *Behavior influence sites* with a very high mean score on the behavior-related disturbance factor. A total of 39 campsites were classified as intensively impacted, 31 sites were classified as extensively impacted, 4 were classified as cultural resource concern sites, and 6 were classified as behavior-related disturbance sites.

A comparison of the site attributes of the four campsite types illustrates how these types differ based on individual measures (Table 2.11, Table 2.12). Intensively impacted sites exhibit the highest levels of mineral soil exposure and vegetation cover loss, as well as a large mean campsite area. Extensively impacted sites show moderate levels of most measured impact parameters. Cultural resource concern sites have the most ghost tree stumps and the highest level of damage to ghost trees; behavior influence sites have the most cut stumps, trails, and the highest level of tree damage. Statistically significant differences were observed for all measured variables (ANOVA for continuous measures, Table 2.11; Chi-square for ordinal measures, Table 2.12) except amount of trash present (Pearson Chi-square = 1.065, $p = .786$), human waste (variance 0), and campsite area ($F = 1.032$, $p = .383$). Significant differences in mean condition class ratings were observed among campsite types ($F = 5.413$, $p = .002$), however the substantive differences were not very large, with mean condition class ratings ranging from 2.00 to 3.50 on a scale of 1 to 5.

Discussion

Quality of the Visitor Experience

Based on respondent ratings of social/experiential and environmental conditions, the current quality of the visitor experience in the KEFJ coastal backcountry overall appears to be quite high. Respondents to the 2010 and 2012 surveys did not indicate any “problem” conditions, and report encountering social and resource conditions that are well within what they consider to be acceptable. The one exception is that 15% of respondents did report typically seeing conditions that approximated eight kayaks and

two tour boats within sight at one time. This condition received a mean -1.71 acceptability rating, falling within the unacceptable range for visitors, and is approaching a level at which some visitors indicated they may be displaced from the fjords (12 kayaks and 3 tour boats seen at one time). Managers at KEFJ should monitor use and encounter levels in the fjords to ensure that conditions are acceptable based on desired experiential, resource, and managerial conditions.

Integrating Results of Social Science and Campsite Monitoring

Visitor-based indicators and thresholds data can be integrated with campsite monitoring data in a complementary manner that informs management and supports visitor experience and resource protection goals. While it is important to collect objective information about camping resource conditions in the field, it is also useful to explore how the people using those resources perceive the conditions they encounter. In this case, indicators from the revised campsite monitoring protocol were incorporated into the surveys administered to backcountry visitors. Survey results can be viewed alongside resource monitoring data to evaluate existing conditions from a visitor perspective.

Overall average campsite conditions compare favorably to other studies conducted in coastal Alaska (e.g., Twardock et al., 2010). Average campsite size is 28m², with an average relative vegetation cover of approximately 45%, and large sites exceeding 50m² in size are uncommon. Multiple trailing is the most commonly observed resource change, occurring at 73% of sites. However other impacts are fairly minimal, with observations at fewer than 20% of sites measured. The campsite monitoring data collected in the field generally support the survey results, in which respondents indicated

no problems or concerns related to backcountry resource conditions around camping areas. While none of the campsite conditions presented to respondents were judged to be unacceptable, campsite monitoring data suggest that current average campsite conditions are similar to those visitors would prefer to see: respondents most frequently chose photos depicting smaller campsites with moderately high levels of vegetation cover as what they would prefer to see (13m² with 88% vegetation cover and 36m² with 88% vegetation cover), and monitoring data show an average size of 28.27m² and 44.3% vegetation cover as the current conditions of KEFJ backcountry sites.

Going beyond averages, however, to examine both visitor evaluations of potential conditions and the multi-parameter data collected during the campsite assessments reveals interesting patterns that managers should take into account when making capacity decisions or monitoring current conditions. Examining respondents' norm curves revealed six distinct structures of curve types (Table 2.6, Figures 2.4-2.6). Examining the different norm types for campsites shows that the majority of respondents found all conditions presented to be acceptable (A-type norm), however significant numbers of respondents found higher levels of impact to be more acceptable (RN-type norm) on medium and large campsites (thresholds of 30.4% and 36.3% *maximum* vegetation cover present, respectively), while a smaller but not inconsequential number found all large campsites to be unacceptable (UA-type norm). The large proportion of respondents reporting that all campsite conditions are acceptable, coupled with a visual inspection of the norm curves for campsite condition (Figure 2.3, Figure 2.6) suggest that visitors to KEFJ might consider higher levels of impact, measured as vegetation cover loss and campsite area, to be amenity values. In other words, more bare ground and space makes a

campsite more desirable, as these impacts enhance the perceived functionality of the area as a campsite. Similar findings have been reported in previous research (e.g., Brown and Shomaker 1974, Heberlein and Dunwiddie 1979, Knudson and Curry 1981, Martin et al. 1989, Shelby and Shindler 1992, Lucas 1990, Farrell et al. 2001, Shelby et al. 1988).

The multivariate analysis of the campsite data (Tables 2.11, 2.12) also highlights patterns that are obscured by simply examining the variable averages. The four campsite types identified by the factor analysis and cluster analysis reveal that certain sites are experiencing impacts that are much more severe than the average condition (Table 2.7). We also see that visitor-caused damage to ghost trees (e.g., cutting, carving, etc.) is a significant problem in some campsites, even though respondents to the survey did not report any impacts at backcountry sites as being a problem (Table 2.3). These results demonstrate the need for managers to conduct regular assessments at campsites and other areas used by recreationists and not rely on reports from visitors. Results of empirical studies of visitors, like the one discussed here, provide valuable information related to the evaluative component of capacity. Campsite assessments and other empirical studies of park resources provide valuable information related to the descriptive component of capacity.

Implications for Management and Future Research

This research identified new typologies for visitor norms and campsite classifications based on empirical measures made in the field. These results demonstrate that patterns may exist in data that would be obscured by only considering average or aggregate values for variables. Examining the full range of norm types and empirical

classification of campsites can provide managers with meaningful information that can enhance the efficiency and effectiveness of decision-making. For example, looking at the six different norm types in addition to the aggregate (mean) norm curve for a given variable highlights the differences between visitor evaluations of which conditions are acceptable and which are not. Rather than only examining the aggregate norm curve, viewing the full range provides managers with more options for establishing thresholds or triggers. Examining the full range of norm types may also give managers a better understanding of how their visitors perceive and evaluate various experiential, biophysical, and managerial conditions.

A similar lesson can be drawn from the multivariate analysis of the campsite data and resulting classification of site types. If only examining summary data for individual variables, we might conclude that the backcountry campsites in KEFJ are in overall good condition. However, when we examine the different site types, we observe significant differences in type and severity of impacts. We see that intensively impacted sites have the highest levels of vegetation cover loss and mineral soil exposure; extensively impacted sites display moderate levels of most impact; cultural resource concern sites have very high levels of impacts to ghost trees; and behavior influence sites have high levels of impacts resulting from undesirable behaviors such as fire rings and stumps. Only examining condition class ratings or average values would obscure those other impacts. A more detailed understanding of the nature and severity of specific impacts at sites of a different type can also inform the management actions that might be required to address impacts. For example, dealing with visitor-caused damage to ghost trees at

behavior-concern sites will likely require a different management action than addressing site expansion at intensively impacted sites.

Previous research had identified three distinct norm types: single tolerance, no tolerance, and multiple tolerance (Whittaker and Shelby 1988, Shelby et al. 1992, Shelby et al. 1996). However, in this study six distinct norm types were observed. As demonstrated here, these different norm types can vary drastically from the aggregate norm. Further research is needed to examine the generalizability of the norm types observed in this study other settings and other indicators.

The application of multivariate analysis and classification methods to multiple-indicator recreation resource data should be considered further. The advantages of this approach over traditional methods is supported and discussed in more detail in Chapter 3. As we saw here, the results of a multivariate approach better communicate the nature and severity of specific impacts of concern at campsites. The enhanced detail of the resulting classification can more effectively inform management actions targeting campsite impacts.

This study also demonstrates how a program of social-science research can complement a program of biophysical resource condition monitoring. The revised campsite monitoring protocol has established a condition “baseline” at KEFJ, and further monitoring will enable managers to view trends in conditions over time and evaluate the effectiveness of management actions aimed at minimizing recreation-related impacts to campsite resources. Results from surveys of backcountry visitors can tell managers if visitors are encountering conditions they find acceptable, if a particular issue is becoming

a problem from a visitors' perspective, and inform management strategies based on their acceptability to visitors.

Finally, although the temperate rainforest and fjord estuary ecosystems found at KEFJ are fairly rare globally (Alaback 1991, McLusky and Elliot 2004) and are susceptible to impacts from human activities, including recreation, little research has been conducted in these ecosystems in Alaska (the exception being an established program of research in Prince William Sound; see Twardock et al. (2010)). This lack of research should be addressed as the two key questions regarding the acceptability of resource impacts are, (a) do recreation impacts seriously threaten the ecological integrity and function of an area; and (b) do visitors consider impacts to be a serious problem (Cole et al. 1997). Future opportunities to explore the response of biophysical resources such as soils, vegetation, wildlife, and water quality to recreation disturbance; and examine interactions between recreationists and park resources using GPS tracking or similar methods (e.g., D'Antonio, 2013) in these unique ecosystems should be explored. This is especially important as tourism to coastal areas worldwide continues to grow (Honey and Krantz 2007).

Study Limitations

A limitation of this study is the small sample size of backcountry visitors who participated in the 2010 and 2012 visitor surveys (n = 13 and n = 46, respectively). Backcountry use in KEFJ was recorded as 75 visitors in July 2010, 238 visitors in August 2010, and 104 visitors in August 2012 (National Park Service Visitor Use Statistics 2016b). However, these numbers only reflect those visitors who stayed overnight at a

backcountry public use cabin, camped with a guided group, or filed a voluntary backcountry registration (Kenai Fjords National Park 2010). Day use in the fjords is not made available through the NPS Visitor Use Statistics database.

In 2010, attempts were made to administer surveys via kayak shops and on water taxis at the conclusion of a trip when visitors traveled back to Seward. This approach yielded very few completed surveys. Only two of the six outfitters contacted in 2012 agreed to allow researchers to contact visitors when they returned from a trip to the coast. This limited contact raises concerns over the ability to generalize study findings, as a representative sample of backcountry visitors may not have been achieved. According to park visitation statistics If KEFJ seeks to conduct a similar study of backcountry visitors in the future, alternative means of contacting visitors should be considered to ensure a larger and more representative sample of visitors. Other parks with highly permeable boundaries, multiple points of access, and limited control over access points should consider these challenges as well when planning social science research that requires input from visitors.

Despite the limited sample size, this research contributes to the knowledge of outdoor recreation and park visitors in that it identifies six different norm types a person can hold for recreation-related social and resource conditions. A larger sample size of national park visitors identified the same six norm types (see Chapter 4), indicating that the small sample size achieved in this study does not impact that finding. In addition, this study demonstrated the benefits of an integrated approach to research that can improve managers' understanding of park visitors and inform park management.

Conclusions

This study demonstrated the benefits of integrating social science and biophysical research to enhance managers' understanding of park visitors and their interactions with park resources. A survey of visitors to KEFJ measured perceived problems, norms for experiential and resource indicators, and determined thresholds for acceptable conditions of selected indicator variables. Six distinct norm types were identified based on structural characteristics, advancing our understanding of the ways in which park visitors might evaluate the social, resource, and managerial conditions they encounter or could encounter in parks. Data from campsite assessments were analyzed to quantify current resource conditions at coastal backcountry campsites, and a multivariate analysis identified four distinct campsite classifications based on measured impacts. The results of the campsite analyses were compared to the results of the visitor survey. Overall visitors are encountering acceptable conditions in the KEFJ backcountry. However, the survey results and campsite analyses suggest that managers should closely monitor visitor interactions in the fjords and specific impacts at campsites. Although we cannot identify where each respondent camped, it appears some may not have noticed or encountered certain impacts of concern at campsites, such as damage to ghost trees. This indicates that managers should not rely on visitor reports as proxies for objective assessment of campsite conditions.

Finally, the identification of six norm types and four campsite classifications based on the empirical data collected demonstrate how analysis methods can influence the results of social science and biophysical condition surveys. Managers should be cautious when examining averages or aggregate results, as important patterns in the data

may be obscured. This is extremely important when considering the value of social science and recreation ecology studies to informed decision-making for recreation management in parks and protected areas.

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TABLE 2.1. Site attributes, assessment methods and measurement scales for coastal backcountry campsites in Kenai Fjords National Park.

Site Attribute	Method Used	Measurement Scale
Campsite area	Radial transect	Square meters
Landing substrate	Observation	Bedrock, cobble, sand, soil, sand/cobble, soil/cobble
Camping site substrate	Observation	Bedrock, cobble, sand, soil, sand/cobble, soil/cobble
Tree canopy cover	Observation	Presence/absence
Vegetation cover on-site	Ocular estimation	Six level cover scale (0-5%, 6-25%, 26-50%, 51-75%, 76-95%, 96-100%)
Vegetation cover off-site	Ocular estimation	Six level cover scale (0-5%, 6-25%, 26-50%, 51-75%, 76-95%, 96-100%)
Mineral soil exposure	Ocular estimation	Six level cover scale (0-5%, 6-25%, 26-50%, 51-75%, 76-95%, 96-100%)
Tree damage	Observation	Three level damage scale (1 = None/slight; 2 = Moderate; 3 = Severe; 4 = Not applicable)
Ghost tree damage	Observation	Three level damage scale (1 = None/slight; 2 = Moderate; 3 = Severe; 4 = Not applicable)
Root exposure	Observation	Three level damage scale (1 = None/slight; 2 = Moderate; 3 = Severe; 4 = Not applicable)
Number of stumps	Counts	Number of cut stumps within 5 meters of campsite and/or site trails
Number of ghost stumps	Counts	Number of cut ghost tree stumps within 5 meters of campsite and/or site trails
Number of fire sites	Counts	Number of fire sites within 5 meters of campsite
Number of trails	Counts	Number of trails leaving campsite in any direction
Number of tent rocks	Counts	Four level tent rock scale (1 = None; 2 = 1-5 rocks; 3 = 6-15 rocks; 4 = > 15 rocks)
Trash	Ocular estimation	Four level trash scale (1 = None to a handful; 2 = More than handful to a gallon; 3 = Gallon to 5 gallons; 4 = > 5 gallons)
Human waste	Counts	Three level waste scale (1 = None; 2 = 1 to 3 sites; 3 = 4 or more sites evident)
Condition class	Ocular estimation	Six level condition class scale, 0 to 5

TABLE 2.2. Summary of visitor responses to open-ended questions (n = 13).

Response Category	Proportion of Visitors Reporting (%)
<i>What did you enjoy most about your visit?</i>	
Wildlife	46.2
Scenery/beauty	30.8
Viewing glaciers	23.1
Experiencing solitude	23.1
<i>What did you enjoy least about your visit?</i>	
Bad weather	76.9
Noise from tour boats	7.7
<i>What would you ask the NPS to change about how it manages KEFJ?</i>	
Nothing	
Limit development in the area	7.7
Increase recreational access to backcountry	7.7
Allow fewer tour boats	7.7
Increase visitor service (e.g., lodging, viewpoints)	15.2
<i>What did you value most about your visit?</i>	
Being in nature	38.5
Sense of wildness/freedom	23.1
<i>What do you consider to be the most important qualities of KEFJ?</i>	
Wildlife	38.5
Solitude/serenity	30.8

TABLE 2.3. Respondent ratings of potential problems within the KEFJ coastal backcountry.

Item	N	Mean	SD
Noise from tour boats	13	2.31	0.86
Speed of tour boats	10	1.90	0.99
Presence of tour boats	13	1.85	0.99
Damage to ghost trees	7	1.57	0.79
Environmental impact to campsites	9	1.56	0.73
Presence of large kayaking groups	12	1.50	0.67
Visitors making too much noise	12	1.46	0.78
Environmental impact to beaches	9	1.44	0.73
Visitors harassing wildlife	12	1.33	0.65
Air quality	12	1.25	0.62
Number of people at beaches	11	1.18	0.41
Number of kayaking groups	13	1.15	0.38

1 = Not a problem; 2 = Small problem; 3 = Big problem

*4 = Don't Know (excluded from analysis)

TABLE 2.4. Respondent ratings of the importance of potential reasons for visiting KEFJ.

Item	N	Mean	SD
To view natural scenery	44	4.80	0.51
To view glaciers	43	4.60	0.73
To view wildlife	44	4.48	0.73
To be with my friends and/or family	45	4.27	1.10
To learn about the natural environment of this area	45	4.20	0.82
To experience peace and tranquility	44	3.82	1.04
To get exercise	45	3.42	0.99
To experience solitude	44	3.18	1.30
To learn about the cultural history of this area	45	2.78	1.06

1 = Not at all important; 2 = Slightly important; 3 = Moderately important
4 = Very important; 5 = Extremely important

TABLE 2.5. Respondents' level of agreement with statements pertaining to social and biophysical conditions in the KEFJ backcountry.

Item	N	Mean	SD
Opportunities to view wildlife are sufficient	43	4.65	0.57
The number of boats allowed to access backcountry areas should be limited	44	2.95	1.16
Managers should restrict the use of backcountry campsites (e.g., establish group size limits, limit the number of groups allowed to camp in an area each night, require backcountry permits)	39	2.79	1.24
There is too much noise from motor boats	45	2.62	1.19
There are too many tour boats	45	2.51	1.24
Trampled vegetation is a problem at backcountry campsites	34	2.15	1.08
Soil erosion is a problem at backcountry campsites	29	2.14	0.92
Soil erosion is a problem at landing beaches	40	2.05	0.96
The presence of tent rocks/rock piles left by visitors is a problem at backcountry campsites	32	2.00	0.84
Trampled vegetation is a problem at landing beaches	40	1.93	0.80
Visitors are damaging ghost trees	34	1.91	0.90
There are too many kayak groups on the coast	45	1.91	0.85
Litter is a problem at landing beaches	40	1.87	0.76
Visitors are harassing wildlife	41	1.85	0.82
There is too much noise from visitors	45	1.84	0.74
Litter is a problem at backcountry campsites	31	1.81	0.87

1 = Strongly disagree; 2 = Disagree; 3 = Neither disagree nor agree; 4 = Agree; 5 = Strongly agree; *6 = Don't know/Doesn't apply (not counted in means presented above)

TABLE 2.6. Summary of visitor norm types for three potential indicator variables.

Variable	Norm Type*											
	Variable		Norm Type*		N		A		UA		MT	
	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N
<i>Kayaks</i>												
0	3.89	38	-	0	0	1	4	1	-	0	0	4
2	3.32	38	-	0	0	1	4	1	-	0	3	4
4	1.61	38	-	0	0	1	4	1	-	0	2	4
6	-0.11	38	-	0	0	1	4	1	-	0	-0.25	4
10	-2.13	38	-	0	0	1	3	1	-	0	-0.25	4
14	-2.92	38	-	0	0	1	2	1	-	0	-1	4
18	-3.45	38	-	0	0	1	1	1	-	0	-1.75	4
>18	-3.84	38	-	0	0	1	1	1	-	0	-2	4
<i>Boats</i>												
0 boats	3.77	35	-	0	-	0	3.25	4	-1	1	0	4
8 kayaks	1.09	35	-	0	-	0	2.5	4	0	1	3.5	4
16 kayaks	-1.94	35	-	0	-	0	2.75	4	0	1	-1.25	4
24 kayaks	-3.09	34	-	0	-	0	1.75	4	-4	1	-2.25	4
2 tour	1.52	25	-	0	0	1	0.5	2	-2.69	16	0	1
4 tour	-1.36	25	-	0	0	1	1.5	2	-3.44	16	0	1
6 tour	-2.88	25	-	0	0	1	0	2	-3.94	16	-2	1
5 mixed	1.42	24	-	0	-	0	3.5	4	-2.71	14	-1.5	2
10 mixed	-1.71	24	-	0	-	0	1.75	4	-3	14	0.5	2
15 mixed	-3.46	24	-	0	-	0	1.5	4	-3.71	14	0.5	2
<i>Campsites</i>												
13m ² x12%	3	2	-	0	-	0	3.06	34	-	0	0.5	2
13m ² x55%	-1	2	-	0	-	0	3.09	34	-	0	-0.5	2
13m ² x88%	-2.5	2	-	0	-	0	3.26	34	-	0	1.5	2
36m ² x12%	-	0	-1.33	9	-	0	2.67	27	-3	1	0	1
36m ² x55%	-	0	1.78	9	-	0	3.19	27	-4	1	0	1
36m ² x88%	-	0	2.89	9	-	0	3.15	27	-4	1	1	1
100m ² x12%	-	0	-1.63	8	0	1	2.86	21	-2.8	5	-1.5	2
100m ² x55%	-	0	1.25	8	0	1	2.9	21	-2.8	5	2.5	2
100m ² x88%	-	0	2.25	8	0	1	3.14	21	-2.6	5	-0.5	2

*T = threshold norm; RN = reverse norm; N = neutral norm; A = acceptable norm; UA = unacceptable norm; MT = multiple-tolerance norm. Mean denotes mean acceptability rating for each condition on a scale

of +4 (“Very acceptable”) to -4 (“Very unacceptable”) given by respondents with a particular norm type; N is the number of respondents.

TABLE 2.7. Summary of current (2010) campsite conditions in KEFJ (n= 80).

Site Attribute	KEFJ Study Area
<i>Continuous Measures^a</i>	
Area of observable impact (m ²)	26.52 ± 3.35
Condition class	2.42 ± .11
Campfire sites (#)	.11 ± .04
Informal trails (#)	2.27 ± .15
Mineral soil exposure (%)	59.78 ± 4.14
Stumps/cut shrubs (#)	.11 ± .06
Ghost tree stumps (#)	.21 ± .1
Vegetation cover loss (%)	55.67 ± 4.39
<i>Ordinal Measures^b</i>	
Human waste	1 ± 0
Litter/trash	1 ± 1
Root exposure	1 ± 3
Tree damage	1 ± 2
Ghost tree damage	0 ± 3

^a Values are means ± SE

^b Values are medians ± range

TABLE 2.8. Frequency of impact problems at campsites in KEFJ in 2010 (n = 80). Values are the percentage of sites that exhibit the indicated impact parameter and severity.

Impact Parameter	Frequency	Percent
≥ moderate tree/shrub damage	13	16.3
≥ moderate ghost tree damage	6	7.5
≥ moderate root exposure	12	15
Presence of cut tree stumps/cut shrubs	4	5
Presence of cut ghost tree stumps	6	7.5
Multiple trailing	59	73.75
Campfire impacts present	8	10
Significant presence of camping trash	0	0
Observable human waste	0	0
Campsites larger than 50m ²	5	6.25

TABLE 2.9. Factor analysis of ten site impact indicators at KEFJ.

Site Attribute	Rotated Factor Loadings			
	Factor 1	Factor 2	Factor 3	Factor 4
Root exposure	.736			
Trails	.734			
Tree damage	.604			
Site area	.597			
Vegetation cover loss		.840		
Soil exposure		.825		
Ghost tree damage			.869	
Ghost tree stumps			.854	
Stumps				.701
Fire sites				.673
Eigenvalue	2.466	1.913	1.371	1.026
Cum. Variation Explained	22.414	39.805	52.265	61.592

TABLE 2.10. Final cluster centers from analysis of factor scores of campsite impacts at KEFJ.

Factor Name	Cluster, campsite type			
	1	2	3	4
Areal disturbance	-.192	.737	-.189	-.225
Ground-cover disturbance	.038	-.852	-.128	-.264
Ghost tree damage	.551	-.279	3.49	-.020
Behavior-related disturbance	.679	-.208	-.438	2.843
<i>N</i>	39	31	4	6

TABLE 2.11. A description and comparison of continuous-measure site attributes among four campsite types at Kenai Fjords National Park.

Site Attribute	Campsite Type				df	Mean Square	F	<i>p</i>
	Intensively Impacted	Extensively Impacted	Cultural Resource Concern	Behavior Influence				
Stumps	0.0	0.0	0.0	1.50	3	4.163	42.180	.000
Ghost stumps	0.0	0.06	3.75	0.0	3	17.589	125.860	.000
Trails	1.97	2.39	3.00	3.50	3	4.990	3.165	.029
Soil exposure	87.10	32.66	64.75	28.58	3	19269.753	29.429	.000
Veg. cover loss	79.44	25.53	61.98	61.86	3	16848.670	17.976	.000
Site area	31.07	21.23	40.87	19.15	3	938.603	1.032	.383
Fire sites	0.0	0.10	0.25	0.83	3	1.231	14.873	.000
Condition class	2.64	2.00	3.50	2.83	3	4.331	5.413	.002
<i>N</i>	39	31	4	6				

TABLE 2.12. A description and comparison of ordinal-measure site attributes among four campsite types at Kenai Fjords National Park.

Site Attribute	Campsite Type				df	Pearson Chi-Square	Sig.
	Intensively Impacted	Extensively Impacted	Cultural Resource Concern	Behavior Influence			
Trash	1	1	1	1	3	1.065	.786
Human waste ^a	1	1	1	1	3	-	-
Tree damage	1	1	1	2	3	23.893	.001
Ghost tree damage	0	0	2	0	3	37.550	.000
Root exposure	1	1	1	1.5	3	24.767	.003
<i>N</i>	39	31	4	6			

^a Human waste had variance 0, no statistics calculated

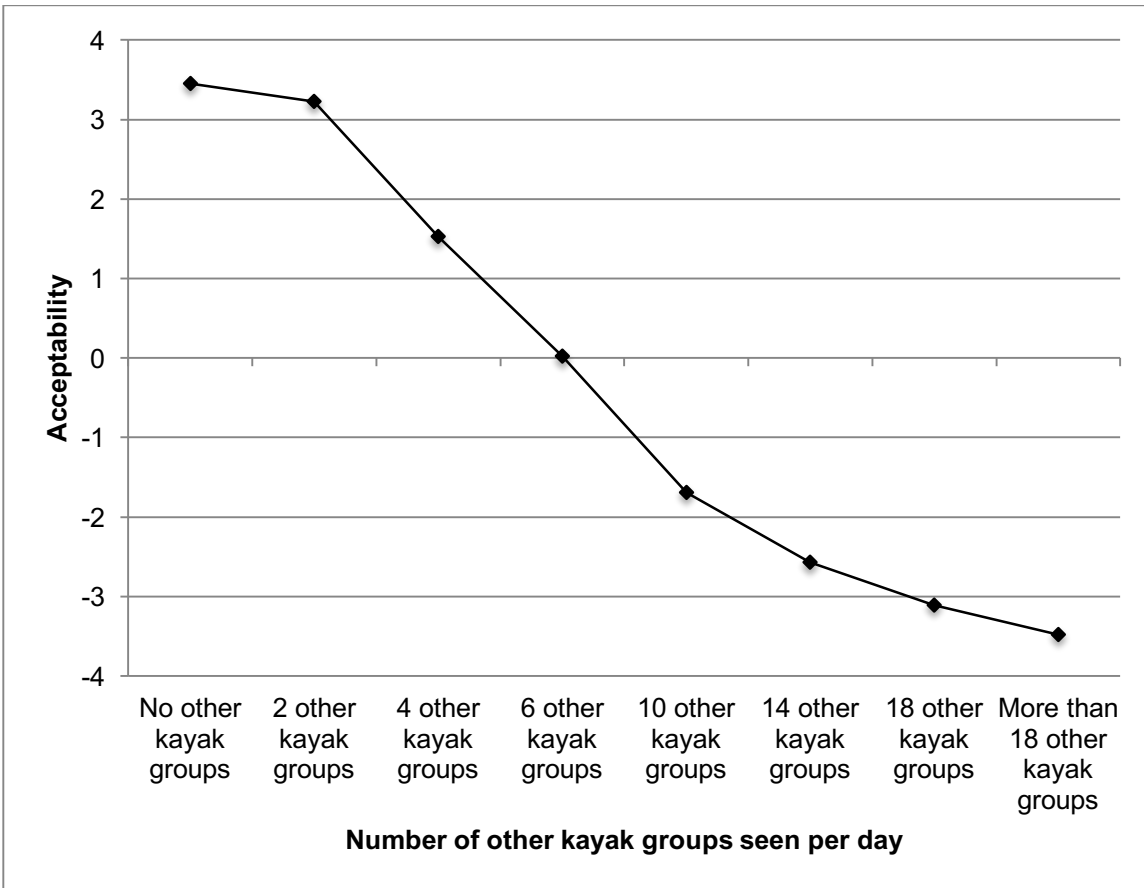


Figure 2.1. Acceptability of number of kayak groups seen per day.

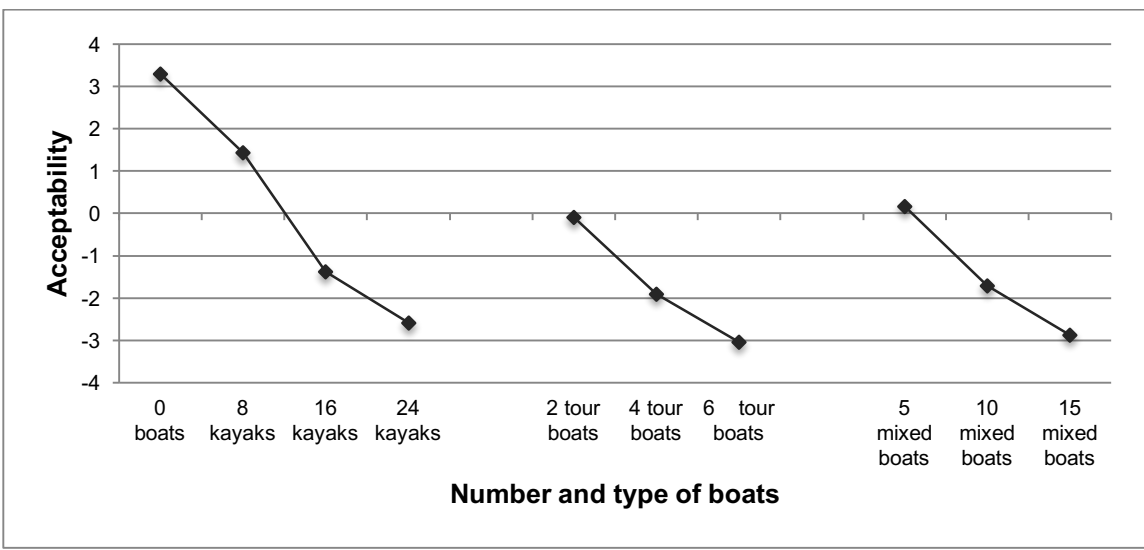


Figure 2.2. Acceptability of number and types of boats seen.

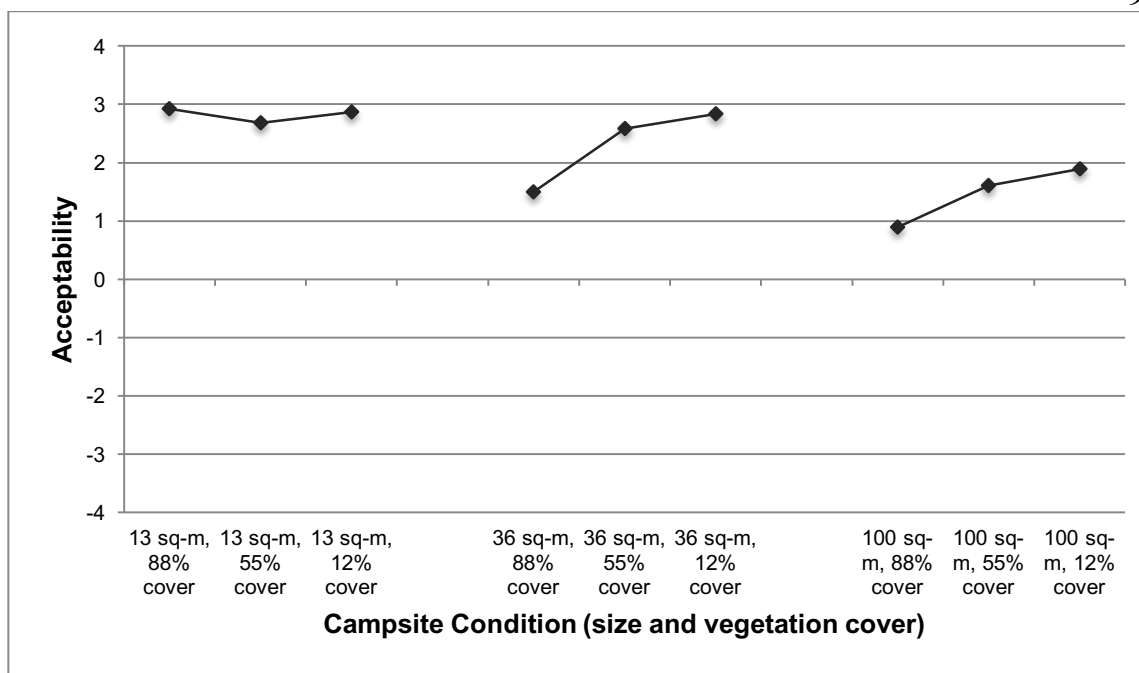


Figure 2.3. Acceptability of campsite condition.

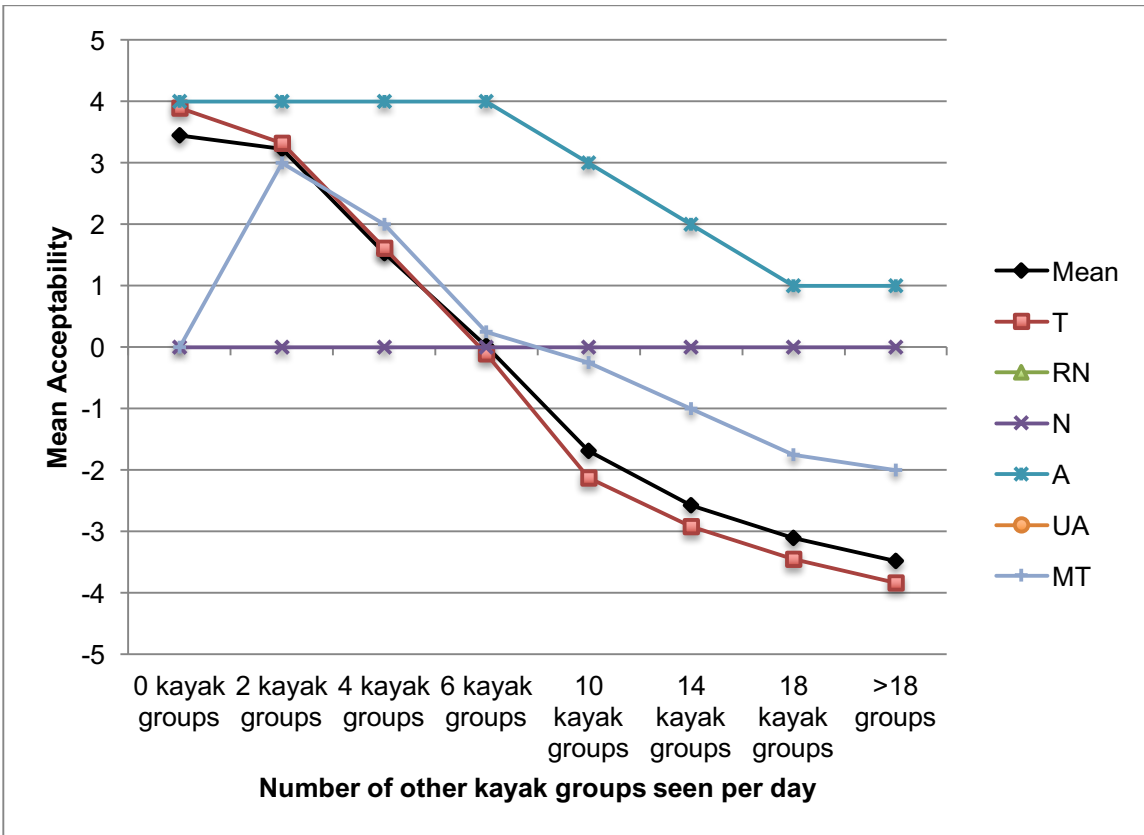


Figure 2.4. Norm types for the acceptability of the number of kayak groups seen per day (T = threshold norm; RN = reverse norm; N = neutral norm; A = acceptable norm; UA = unacceptable norm; MT = multiple-tolerance norm).

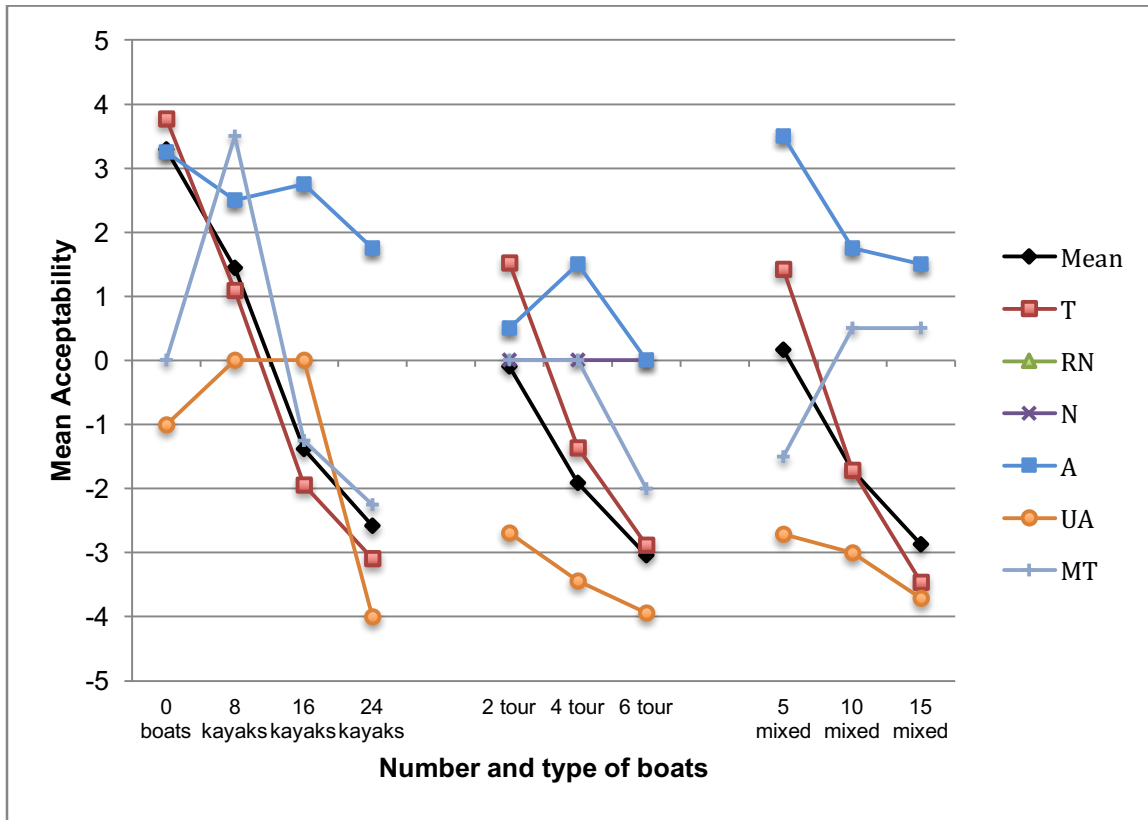


Figure 2.5. Norm types for the acceptability of the number and type of boats seen at one time (T = threshold norm; RN = reverse norm; N = neutral norm; A = acceptable norm; UA = unacceptable norm; MT = multiple-tolerance norm).

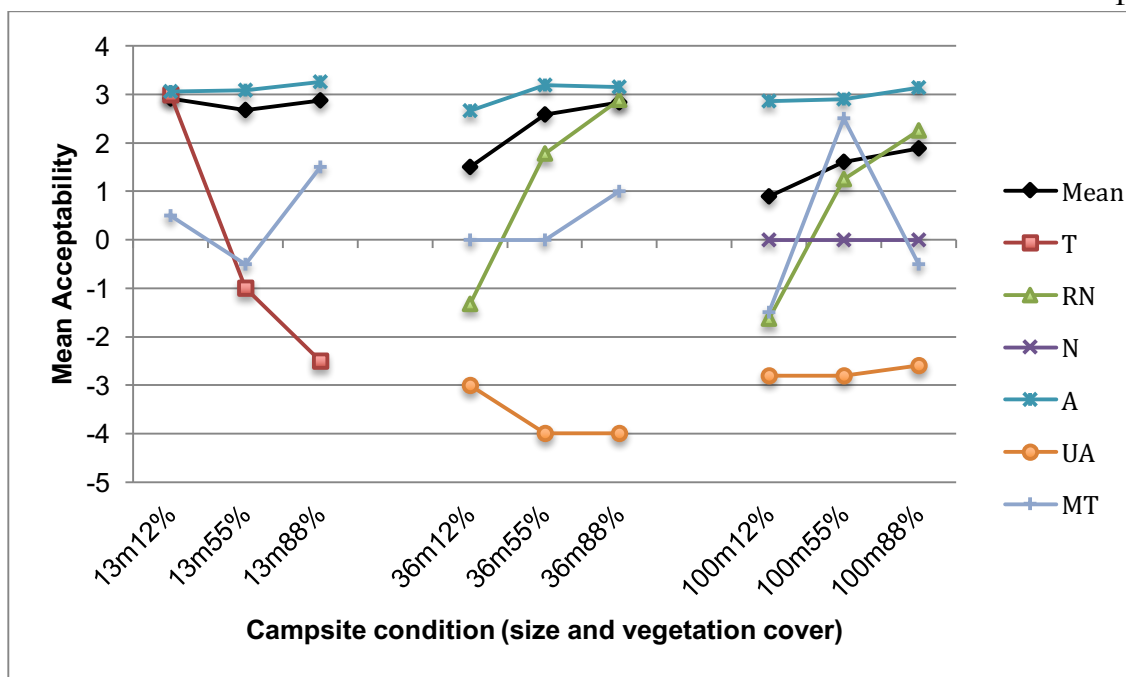


Figure 2.6. Norm types for the acceptability of backcountry campsite conditions -(T = threshold norm; RN = reverse norm; N = neutral norm; A = acceptable norm; UA = unacceptable norm; MT = multiple-tolerance norm).

CHAPTER 3

BEYOND CONDITION CLASS: ALTERNATIVE METHODS FOR ASSESSING
RESOURCE CONDITIONS ON CAMPSITES**Abstract**

This study uses a multivariate approach to analyze data from multiple-indicator campsite condition assessments. Factor analyses of multiple impact parameter assessments were conducted on data from three U.S. national parks representing unique geographic locations and environments: Isle Royale National Park, Michigan; Zion National Park, Utah; and Kenai Fjords National Park, Alaska. Interpretable four-factor solutions were identified for each area explaining between 61% and 71% of the variation in the data. The factor solutions illustrate site-specific patterns in the data from each study area. Cluster analyses of factor scores for campsites at each study area identified four distinct campsite types at Isle Royale and Kenai Fjords National Parks, and three distinct campsite types at Zion National Park. Characteristics of campsite typologies were compared to traditional scalar condition class ratings based on visual criteria assigned to campsites in the field in order to evaluate the relative advantages and disadvantages of each approach to classifying campsites based on overall levels of impact. Unlike traditional condition class ratings, typologies identified through the factor analyses and subsequent cluster analyses highlight specific impacts of concern at the site level. This work demonstrates the effectiveness of multivariate analysis methods in analyzing multiple-indicator campsite assessment data spanning a wide range of environments and the ability of this approach to provide more meaningful information to managers that will

help guide management actions intended to limit the proliferation or intensification of resource impacts.

1. Introduction

Trends in outdoor recreation in the United States suggest that public demand for nature-based recreation opportunities and appreciation of natural areas continues to grow (Cordell, 2012). Public lands are highly important for the recreation opportunities they offer (Cordell, 2012), serving as destinations for visitors seeking to engage in nature-based recreational activities. Outdoor recreation produces numerous individual (e.g., Orsega-Smith et al., 2004; Lee, 2011; Dorsch et al., 2016) and societal (e.g., Moore et al., 1992; Budruk et al., 2009; Outdoor Industry Association, 2017; Headwaters Economics, 2017) benefits including, but not limited to, enhanced physical and mental health, community cohesion, and economic benefits. However, public lands are also often established and managed to protect natural and cultural resources in addition to recreational opportunities. In the presence of repeated recreational use, some level of change in condition is inevitable (Leung and Marion, 2000; Hammitt et al., 2015; Marion et al., 2016). These challenges extend beyond the U.S. to parks and protected areas around the world (Buckley, 2004; Pigram and Jenkins, 2006), highlighting the need to assess and monitor recreation resource conditions and evaluate the effectiveness of management actions directed toward protecting biophysical resources.

Campsites are often a focal point of studies and monitoring efforts aimed at examining the biophysical impacts of recreation. Campsites serve as destinations and nodes of visitor use: they are locations where concentrated recreation activities impact

biophysical resources, and where visitors interact with and observe those resources.

Visitors may consider certain impacts, like bare soil (e.g., Knudson and Curry, 1981; Martin et al., 1989; Shelby and Shindler, 1992; Farrell et al., 2001) fire rings (Shelby and Shindler, 1992), and large areas (Lucas, 1990), to be desirable as they are perceived as enhancing the functionality of the location as a campsite (Brown and Shomaker, 1974; Heberlein and Dunwiddie, 1979; Shelby et al., 1988). In other words, some impacts might be perceived as being amenity attributes that enhance the desirability of a campsite. While the impact of camping activities on ground cover vegetation and soils is well documented (Leung and Marion, 2000; Cole, 2004; Marion et al., 2016), camping also has the potential to impact other ecosystem components such as wildlife, water quality, and soundscapes (Hammitt et al., 2015). Visitors can also cause other impacts like damaging trees and shrubs, building campfires, and improperly disposing of trash and human waste (Leung and Marion, 2004). In addition to the resource concerns identified above, diminished resource quality can also negatively affect the visitor experience (Roggenbuck et al., 1993; Cole et al., 1997; Lynn and Brown, 2003; Manning et al., 2004). Therefore assessing and monitoring conditions at campsites is a valid objective for recreation resource managers.

Managing recreation resources requires information related to descriptive and evaluative components of capacity. The descriptive component defines the observable workings of recreation systems and involves management parameters, impact parameters, and the relationship between the two; the evaluative component integrates value judgments into determining capacity based on the acceptability of impacts (Shelby and Heberlein, 1984). Campsite studies provide valuable information related to the

descriptive component of recreation capacity, including inventorying current resource conditions, tracking trends in resource conditions over time, serving as surrogate measures of visitor use patterns, evaluating the effectiveness of management actions, and examining the spatial and temporal aspects of use and resource change. As such, campsite studies have been undertaken in numerous parks and protected areas, and have led to established monitoring efforts in many of these areas (e.g., Boyers et al., 2000; Cole et al., 2008; Twardock et al., 2010).

Methods for assessing and monitoring campsite conditions have been developed and applied over the past several decades (Frissell, 1978; Cole, 1989; Marion, 1991; Marion, 1995; Newsome et al., 2012). Contemporary assessment protocols often use a multiple-indicator approach in which several campsite condition variables are measured. However, multiple-indicator methods often also assign an overall condition class rating to each individual site in order to classify campsites based on a continuum of impact. An early approach to classifying campsites attempted to assign impact classifications based on ordinal classifications of measured variables (Merriam et al., 1973), therefore approximating a multivariate approach to classifying campsite impact stages. Later applications have largely followed the visual approach introduced by Frissell (1978) in which the evaluator assigns a condition class rating based on visually observed site conditions.

While the visual approach is an easy way to classify sites and can be applied rapidly and efficiently in the field, it has three major shortcomings. First, rating assignment can suffer from observer bias. Second, assigning a single impact rating can be difficult if co-variation of presumably related indicators does not occur. Finally, this

method provides little information regarding specific impacts of concern at individual sites. Multiple-indicator methods have been developed to address some of the shortcomings outlined above (e.g., Cole, 1989; Marion, 1991; Marion, 1995; Newsome et al., 2012). These methodologies increase the sensitivity and precision of site assessments by measuring several indicators at each site, yielding a robust dataset with information about several specific impact parameters.

Despite the development of multiple-indicator methods for assessing campsite conditions, these protocols often continue to assign an overall condition class rating to each individual campsite (e.g., Cole, 1993; Boyers et al., 2000; Monz et al., 2011; Goonan et al., 2012). Examining only the condition class ratings in a multiple-indicator dataset can obscure important information about the nature of observed campsite impacts.

Multiple-indicator campsite studies are well suited to multivariate analyses that may reveal meaningful patterns within the data (Leung and Marion, 1999; Monz and Twardock, 2010). Unlike the traditional scalar condition class rating, a holistic examination of multiple resource condition indicators can give managers a better understanding of specific impacts of concern at individual campsites and more efficiently direct management actions. Despite the apparent advantages of multivariate approaches, their application to evaluating recreation resource conditions at campsites has been very limited. Published examples of multivariate applications include examinations of campsites along the Rio Grande River in Big Bend National Park, Texas (Ditton et al., 1977); in Rushing River Provincial Park, Ontario, Canada (James et al., 1979); in the Boundary Waters Canoe Area Wilderness, Minnesota (Marion and Merriam, 1985); at Heart Lake, Lolo National Forest, Montana (Zabinski and Gannon, 1997); in the

backcountry of Great Smoky Mountains National Park, North Carolina/Tennessee (Leung and Marion, 1999); and in Prince William Sound, Alaska (Monz and Twardock, 2010).

This research builds on the work carried out by Leung and Marion (1999) and Monz and Twardock (2010) to examine the utility of conducting multivariate analyses on data from multiple-indicator campsite studies. The purpose is to examine the application of a multivariate statistical approach and determine whether interpretable structures can be found within the data. If an interpretable structure can be found, campsites can be classified based on the empirical measures collected. Data from campsite assessments conducted at Isle Royale National Park, Michigan; Zion National Park, Utah; and Kenai Fjords National Park, Alaska are used in the analysis. This study has six primary objectives: (1) to examine the application of a multivariate statistical approach to analyzing multiple-indicator campsite data; (2) determine whether interpretable structures can be found within multiple-indicator campsite data; (3) determine whether campsites can be classified based on the empirical measures collected; (4) compare results of the multivariate analysis across multiple datasets representing a range of environments; (5) compare results with traditional scalar condition class ratings if an empirically-based classification is possible; and (6) examine the advantages and disadvantages of using a multivariate approach to analyzing campsite condition data within the context of recreation resources management in parks and protected areas.

2. Methods

2.1 Study sites

Data from campsite assessments conducted at Isle Royale National Park, Michigan; Zion National Park, Utah; and Kenai Fjords National Park, Alaska are used in the analysis. These datasets were chosen because similar variables were used in each study, impact parameters were measured using standard protocols, and the study sites represented a range of environments from different geographic locations. The impact parameters and measurement scales used allow for comparison of analysis results.

Isle Royale National Park (ISRO) is located at approximately 48°6'N 88°33'W in the northwest corner of Lake Superior, 73 miles from Houghton, Michigan and 22 miles from Grand Portage, Minnesota. Established in 1940, the park protects approximately 132,000 acres, nearly 99% of which was designated as Wilderness in 1976. The park consists of one large island surrounded by over 450 smaller islands, encompassing a total area of 850 square miles. The park is open April 16 to October 31 each year, with transportation from the mainland via boat or floatplane. Hiking and paddling are popular recreational activities in the park, and several camping areas are located throughout the island. All campers are required to obtain a permit from the National Park Service (NPS), and most camp within the 36 designated backcountry campgrounds in the park. Data used in this assessment were collected at these backcountry campgrounds in 1996 as part of ISRO's campsite inventory and monitoring program by Tracy Farrell and Jeffrey Marion (see Farrell and Marion, 1998).

Zion National Park (ZION) is located at approximately 37°18'N 113°3'W in Washington, Iron, and Kane Counties in southwestern Utah. ZION protects

approximately 148,000 acres of desert, riparian, woodland, and coniferous forest habitat. The park was established in 1909, and in 2009 over 124,000 acres were designated as federal Wilderness. Hiking, bicycling, rock climbing, and canyoneering are popular activities in the park. Over 90 miles of trails and an additional 90 miles of non-designated cross-country routes access the backcountry and wilderness areas of the park. All overnight groups are required to obtain a permit from the NPS, and visitors may camp at either designated campsites or in at-large areas on the high plateaus, in the low desert shrublands, or next to a river in a narrow canyon (Zion National Park, 2016). Camping is restricted to designated campsites in higher-use backcountry areas to minimize resource damage and improve the visitor experience. The data used in this assessment were collected in the LaVerkin, West Rim, and Narrows backcountry areas in 2007 as part of the development of a campsite monitoring program for ZION by Karen Hockett and Jeffrey Marion (see Marion and Hockett, 2008).

Kenai Fjords National Park (KEFJ) is located at approximately 59°55'N 149°59'W in southern Alaska. Established in 1980, KEFJ protects nearly 670,000 acres of glaciers, alpine habitat, spruce-hemlock coniferous forest, deciduous forest, and fjord estuaries. In 1964, a powerful earthquake caused areas of the shoreline to subside several feet, causing salt water to infiltrate the water table and kill stands of trees near the coast. These standing “ghost trees” are an important testimony to the dynamic nature of the area and are considered protected cultural resources by the NPS. Although there is no designated wilderness in KEFJ, most of the park is remote backcountry and nearly 85% is considered eligible wilderness. With approximately 400 miles of coastline, the park offers excellent opportunities for sea kayaking. A system of campsites located along the

coast supports overnight visitor activities in the backcountry. All overnight backcountry visitors are encouraged to complete a voluntary backcountry registration with the NPS, but only guided groups are required to register. Data used in this analysis were collected in Resurrection Bay, Aialik Bay, and Northwestern Fjord in 2010 as part of KEFJ's campsite inventory and monitoring program (Monz et al., 2011).

2.2 Campsite Assessments

Campsite conditions were measured using standard campsite assessment protocols (Marion, 1995; Monz, 2000) with minor modifications to adapt methodologies to the environments represented (Table 3.1). Vegetation cover and soil exposure measurements followed the ocular measurement approach suggested by Marion (1995). An undisturbed area adjacent to each campsite was selected as a control for vegetation loss calculations. Control sites were similar to campsites in their substrate, slope, aspect, and ecological characteristics. Campsite size was measured using the variable radial transect method. Condition class measurements followed a standard scale (Marion, 1995) of 1 through 5, with higher condition class ratings representing higher levels of impact. In some cases, a condition class rating of 0 was assigned to an area where camping had been observed in the past but no clear ground impact was present to define as a campsite and confirm recent use. Other site attributes were assessed as suggested in Marion (1995).

2.3 Data Analysis

Vegetation cover loss was calculated using the following formula:

$$\text{Cover loss} = 1 - \frac{\% \text{ cover in campsite}}{\% \text{ cover in control plots}} \times 100$$

Campsite areas were calculated geometrically from the radial transect data using a custom computer program (Dr. J. Marion, Virginia, USA, 2008).

Data from the campsite assessments were summarized and synthetic variables were calculated using SPSS (v. 19, SPSS Inc., Chicago, IL USA). The analysis strategy closely follows Monz and Twardock (2010) and Leung and Marion (1999). Exploratory factor analysis using principal components extraction was conducted on impact variables to determine whether interpretable structures existed in the data sets. Only factors with Eigenvalues greater than 1.0 were retained. A varimax rotation was used and factor loadings less than 0.4 were suppressed for ease of interpretation. Factor scores were saved for each campsite. If an interpretable structure emerged, agglomerative (hierarchical) cluster analysis using Ward's Method (interval = squared Euclidean distance) was conducted on the factor scores to classify campsites according to impact characteristics. Dendrograms of the cluster analyses for each study area (Appendix E) were examined to determine the appropriate number of clusters, and additional cluster analyses were performed for a range of solutions. Final cluster membership of each campsite was saved for each solution. One-way analyses of variance (ANOVA) were conducted on the resulting clusters to describe their respective characteristics and examine any differences between groups. Resulting factor solutions, variable loadings, and campsite typologies for the study sites included in this study (ISRO, ZION, and KEFJ) were compared to results reported for Great Smoky Mountains National Park (GRSM) and Prince William Sound (PWS) by Leung and Marion (1999) and Monz and Twardock (2010), respectively.

3. Results

3.1 Isle Royale National Park

Full assessments were conducted at a total of 243 campsites in ISRO (Table 3.2). On average, sites exhibited an impacted area of 67.75 m², and a vegetation cover loss and soil exposure of 69% and 35.5%, respectively. Other impacts such as stumps (mean = 1.59), access trails (mean = 2.93), proportion of moderately to severely damaged trees (mean = 36.3%), and the proportion of trees with moderate to severe root exposure (mean = 26.8%) were generally present; trash (mean = 3.33%), fire sites (mean = 0.25), and human waste (mean = 0.04) were less prevalent. On average, campsites exhibited a moderate level of aggregate impact with a mean condition class rating of 3.0 on a scale of 1 to 5.

Exploratory factor analysis of the standardized variables for the ten measured resource indicators resulted in an interpretable four-factor solution that accounted for approximately 61% of the total variation (Table 3.3). Factor loadings for individual items less than 0.4 were eliminated from the results to aid interpretation. Factor 1 was interpreted as “areal disturbance” with tree damage, root exposure, and campsite area loading on this factor; Factor 2 was interpreted as “ground-cover disturbance” with soil exposure and vegetation cover loss loading on this factor; Factor 3 was interpreted as “behavior-related disturbance” with trails, fire sites, and trash loading on this factor; and Factor 4 was interpreted as “depreciative behavior-related disturbance” as stumps and human waste loaded most substantially on this factor. Examining the full dendrogram (Appendix E) suggested a solution of four clusters. Examining the mean factor scores of the final cluster centers supported this solution (Table 3.4) and resulted in four distinct

campsite groupings: 1) *Minimally impacted sites* with low mean scores on all factors; 2) *Behavior influence sites* with a high mean score on the behavior influence factor; 3) *Intensive behavior influence sites* with a very high mean score on the depreciative behavior factor; and 4) *Extensively impacted sites* with a very high mean score on the areal disturbance factor. A total of 86 sites were classified as minimally impacted, 44 were classified as behavior influence sites, 13 were classified as intensive behavior influence sites, and 100 as extensively impacted sites.

A comparison of the site attributes of the four campsite types illustrates how these types differ based on individual measures (Table 3.5). Minimally impacted sites have the smallest area; fewest stumps, trails, and fire sites; and have less trash, tree damage, and root exposure than the other campsite types. Behavior influence sites have a large amount of trash and the highest level of tree damage. Intensive behavior influence sites have the highest level of root exposure and the most stumps and human waste. Extensively impacted sites have the largest campsite area, the most soil exposure, and the most vegetation cover loss. Statistically significant differences ($p < .05$) between clusters were observed for each measured variable except the amount of trash present ($F = 2.369, p = 0.71$). Mean condition class ratings were similar across the four groups identified via the cluster analysis ($F = 2.205, p = .088$).

3.2 Zion National Park

Full assessments were conducted on a total of 38 backcountry campsites in ZION (Table 3.6). Sites exhibited an impacted area of approximately 100 m² on average, with a vegetation cover loss of 86.5% and soil exposure of 72.7%. Multiple trails (mean = 4.11)

were generally present at sites, whereas other impacts such as stumps (mean = 0.18), human waste (mean = 1.11), fire sites (mean = 0.42), tree damage (mean = 11.12%), and root exposure (mean = 3.79%) were less prevalent. On average, campsites exhibited a moderate-to-high level of aggregate impact with a mean condition class rating of 3.89 on a scale of 1 to 5.

Exploratory factor analysis of standardized variables for the nine measured resource indicators resulted in an interpretable four-factor solution that accounted for approximately 71% of the variation in the data (Table 3.7). Factor loadings for individual items less than 0.4 were eliminated from the results to aid interpretation. Factor 1 was interpreted as “areal disturbance” with site area, soil exposure, and fire sites loading on this factor; Factor 2 was interpreted as “tree damage” with root exposure and tree damage loading on this factor; Factor 3 was interpreted as “ground vegetation disturbance” with trails and vegetation cover loss loading on this factor; and Factor 4 was interpreted as “behavior-related disturbance,” with stumps and human waste loading on this final factor. Examining the full dendrogram (Appendix E) suggested a three-cluster solution. Examining the mean factor scores of the final cluster centers supported this solution (Table 3.8) and resulted in three distinct campsite groupings: 1) *Minimally impacted sites* with low mean scores on all factors; 2) *Moderately impacted sites* with a moderate mean score on all factors; and 3) *Comprehensively impacted sites* with a high mean score on the tree damage factor and positive mean scores on all other factors. A total of 20 campsites were classified as minimally impacted, 13 campsites were classified as moderately impacted, and 5 campsites were classified as comprehensively impacted.

A comparison of the site attributes of the three campsite types illustrate how these types differ based on individual measures (Table 3.9). Differences in vegetation cover loss, soil exposure, site area, and tree damage appear to be driving the classifications. Minimally impacted campsites have the smallest area and little tree damage or other evidence of depreciative behavior. Moderately impacted sites have less vegetation cover loss and soil exposure than the minimally impacted sites, yet they are about 50% larger on average. Comprehensively impacted sites exhibit high levels of soil exposure and vegetation cover loss, large site area, and very high levels of tree damage and root exposure. Statistically significant differences in soil exposure ($F = 28.885, p = .000$), vegetation cover loss ($F = 8.636, p = .001$), area of observable impact ($F = 3.411, p = .044$), tree damage ($F = 265.016, p = .000$), and root exposure ($F = 17.765, p = .000$) were observed between clusters. Mean condition class ratings were different between groups ($F = 8.647, p = .001$), however the substantive differences were fairly small with mean condition class ratings ranging from 3.38 to 4.20 for the three campsite types identified by the cluster analysis.

3.3 Kenai Fjords National Park

Full assessments were conducted on a total of 80 backcountry coastal campsites in KEFJ (Table 3.10). Overall, sites exhibited an average impacted area of 26.5 m², with vegetation loss and mineral soil exposure of approximately 56% and 60%, respectively. Trails were generally present at campsites (mean = 2.27), whereas other impacts like stumps (mean = 0.1), ghost tree stumps (mean = 0.2), trash (median = 1), human waste (median = 1), tree damage (median = 1), ghost tree damage (median = 0), root exposure

(median = 1), and campfire sites (mean = 0.1) are less prevalent. On average, campsites exhibit a low-to-moderate level of aggregate impact, with a mean condition class rating of 2.42 on a scale of 1 to 5.

Exploratory factor analysis of standardized variables for the twelve measured resource indicators resulted in an interpretable four-factor solution that accounted for approximately 61% of the variation in the data (Table 3.11). Factor loadings for individual items less than 0.4 were eliminated from the results to aid interpretation. The trash and human waste variables had variance 0 and were excluded from the analysis. Factor 1 was interpreted as “areal disturbance” with root exposure, trails, tree damage, and site area loading on this factor; Factor 2 was interpreted as “ground-cover disturbance” with vegetation cover loss and mineral soil exposure loading on this factor; Factor 3 was interpreted as “ghost tree damage” with the ghost tree damage and ghost stumps variables loading on this factor; and Factor 4 was interpreted as “behavior-related disturbance” with stumps and fire sites loading on this final factor. Examining the full dendrogram (Appendix E) suggested a four-cluster solution. This solution was supported by examining the mean factor scores of the final cluster centers (Table 3.12) for the four distinct groupings: 1) *Intensively impacted sites* with moderate mean scores on the ghost tree damage and behavior-related disturbance factors; 2) *Extensively impacted sites* with a high mean score on the areal disturbance factor and negative mean scores for all other factors; 3) *Cultural resource concern sites* with a very high mean score on the ghost tree damage factor; and 4) *Behavior influence sites* with a very high mean score on the behavior-related disturbance factor. A total of 39 campsites were classified as intensively

impacted, 31 sites were classified as extensively impacted, 4 were classified as cultural resource concern sites, and 6 were classified as behavior-related disturbance sites.

A comparison of the site attributes of the four campsite types illustrates how these types differ based on individual measures (Table 3.13, Table 3.14). Intensively impacted sites exhibit the highest levels of mineral soil exposure and vegetation cover loss, as well as a large mean campsite area. Extensively impacted sites show moderate levels of most measured impact parameters. Cultural concern sites have the most ghost tree stumps and the highest level of damage to ghost trees; behavior-influence sites have the most cut stumps, trails, and the highest level of tree damage. Statistically significant differences were observed for all measured variables (ANOVA for continuous measures, Table 3.13; Chi-square for ordinal measures, Table 3.14) except amount of trash present (Pearson Chi-square = 1.065, $p = .786$), human waste (variance 0), and campsite area ($F = 1.032$, $p = .383$). Significant differences in mean condition class ratings were observed among campsite types ($F = 5.413$, $p = .002$), however the substantive differences were not very large, with mean condition class ratings ranging from 2.00 to 3.50 on a scale of 1 to 5.

4. Discussion

4.1 Application of multivariate approach to analyzing campsite data

This study successfully analyzed multiple indicator campsite data using a multivariate statistical approach. Factor analysis revealed interpretable structures within the data, and subsequent cluster analysis successfully classified campsites based on their factor scores. The ability to reduce the data from as many as twelve variables down to

four factors could have significant implications for measuring campsite impacts in the field and increasing the efficiency of data analysis. These findings are addressed in more detail in the following sections of the discussion.

4.2 Dimensional structures and typologies of camping impacts

The findings presented in this study demonstrate the ability to observe meaningful patterns and associations of variables in campsite resource assessment data, and to develop an empirical classification of campsites based on measures of multiple impact parameters taken in the field. The dimensional structures identified in this study illustrate site-specific patterns of campsite impacts (Table 3.15). Although many of the same impact parameters were measured at each location, these variables did not always load the same way. Monz and Twardock (2010) speculate that slightly different dimensional structures may exist in data from varying environments. However, the results of this study only partially support that speculation. The campsite assessments in PWS and KEFJ represent studies in nearly identical environments conducted using nearly identical methods. While the dimensional structure of the factor solution for KEFJ clearly accounts for impacts to ghost trees, which were not assessed in PWS, the campsite area variable loaded differently in the two solutions. While there is no clear explanation for these differences, they may result from site-specific factors other than the ecosystem in which campsites are located. Differences may also be due to the exploratory nature of previous studies and the analyses presented here; repeated analysis with other datasets and confirmatory analyses may suggest a more stable factor structure. Other differences in how impact parameters associate with one another can also be observed between the

different study sites (Table 3.15). While structures vary by study site and, thus, environment type, further research will need to be done to examine the influence of environment on dimensional structures of impact parameters.

The analyses in this study were successful in developing an empirical classification of campsites based on measures of multiple impact parameters taken in the field during three separate, independent campsite assessments. The cluster analyses and resulting campsite classifications or types provide meaningful information about the nature and severity of impacts present at individual campsites (Table 3.16). Four campsite types were identified at ISRO (Table 3.5), three campsite types were identified at ZION (Table 3.9), and four campsite types were identified at KEFJ (Tables 3.13 and 3.14). Examining the characteristics of impacts based on these campsite types illustrates key differences in the kinds of impacts present. For example, all three campsite types identified in ZION exhibited moderate to high levels of vegetation cover loss and soil exposure; the Moderately-Impacted sites were very large in size; and Comprehensively-Impacted sites were characterized by impacts associated with depreciative visitor behavior (i.e., cut stumps/shrubs, tree damage). Examining only the condition class rating would not highlight these specific impact concerns, and understanding the nature and severity of impacts has a greater potential to inform subsequent management actions. These points are addressed further in the following sections of the discussion.

4.3 Condition class ratings based on visual criteria

This study demonstrates that the multivariate methods described here are superior to the traditional method of assessing overall campsite condition based on visual criteria

for several reasons. First, traditional condition class estimates based on visual criteria usually do not take into account the full range of impacts that can be present: often they focus on vegetation and soil impacts. Monz and Twardock (2010) note, “In our experience, condition class estimates are perhaps the most subjective and difficult of all impact indicators” (p. 1570). This is because the observer is often required to consider multiple impact factors simultaneously, and frequently the impacts do not co-vary in the field. Similarly, the scalar nature of the traditional condition class estimate does not necessarily account for the types of impact that may be present in different classes of sites (e.g., the difference between a CC 3 and CC 4 campsite). Table 3.17 provides a comparison of the visual condition class ratings among the campsite typologies identified in the multivariate analyses. Only the PWS analysis shows any relationship between condition class and the campsite types identified by the cluster analysis: Minimally-, Intensively-, and Comprehensively-Impacted sites have mean condition class ratings of 1.5, 3.6, and 4.1, respectively. In contrast, although significant differences in condition class rating were found for campsite types in ZION (Table 3.9), Moderately-Impacted sites had a lower mean condition class rating than Minimally- and Comprehensively-Impacted sites. In KEFJ, no clear pattern in mean condition class ratings can be observed even though they did differ significantly among campsite types (Table 3.13). Finally, ISRO mean condition class ratings did not differ significantly among the different campsite types (Table 3.5), and exhibit no clear pattern (Table 3.17).

The lack of any clear relationship of condition class ratings based on visual criteria to the campsite types identified by multivariate analysis and subsequent cluster analyses is likely due to the fact that condition class cannot highlight specific impacts of

concern at the individual site level (Tables 3.16 and 3.17). For example, Minimally-Impacted sites and Intensive Behavior-Influence sites at ISRO have similar mean condition class ratings (2.95 and 2.92, respectively), and the same range between minimum and maximum condition class ratings for sites in each category. However, Minimally-Impacted sites have the smallest area; fewest stumps, trails, and fire sites; and low levels of trash, tree damage, and root exposure, whereas Intensive Behavior-Influence sites have the most stumps and human waste and the highest level of tree damage for ISRO backcountry campsites. Examining only the condition class ratings would fail to identify any of the impacts listed. By classifying campsites based on the multiple parameters measured during the field assessment, we can have a better understanding of the nature and severity of impacts at each campsite.

4.4 Management implications

As discussed in the previous sections, using multivariate methods to identify campsite types based on the multiple impact parameters measured in the field results in a classification system that highlights specific impacts of concern at the site level in a manner that traditional condition class ratings are unable to do. By highlighting specific impacts of concern, classifying campsites in this manner provides managers with more detailed information about the nature and severity of impact and consequently can guide management actions designed to address campsite impacts. Leung and Marion (1999) note that it "...may be more effective [for managers] to formulate campsite management strategies based on campsite types than on characterizations of individual impact parameters" (p. 201). For example, three types of sites were identified at ZION:

Minimally-Impacted, Moderately-Impacted, and Comprehensively-Impacted sites.

Mean condition class ratings, although statistically significant, did not differ much among site types (4.15, 3.38, and 4.20, respectively). However, examining the characteristics of impacts based on the clusters illustrated key differences in the kinds of impacts present. While all three types exhibited moderate to high levels of vegetation cover loss and soil exposure, Moderately-Impacted sites were very large in size and Comprehensively-Impacted sites were characterized by impacts associated with depreciative visitor behavior (i.e., cut stumps/shrubs, tree damage, campfire impacts, multiple trailing, improper disposal of human waste). Thus management actions directed at reducing undesirable visitor behavior would be most appropriate for reducing impacts at Comprehensively-Impacted sites, whereas actions directed at limiting the areal extent of campsites would be more appropriate at Moderately-Impacted sites. Similarly, managers at ISRO could focus actions designed to address behavioral issues like damaging/cutting down trees of improperly disposing of human waste at the Behavior Influence sites, and managers at KEFJ can take appropriate action to minimize visitor damage to ghost trees at Cultural Resource Concern sites.

Condition class ratings based on the visual approach and scalar classification lack the detail necessary to inform management actions to address campsite impacts as they simply communicate a general level of impact from low to high, but fail to highlight specific impacts requiring management attention. Multivariate approaches have been criticized as being difficult for managers to apply and interpret, however these results demonstrate the relative intuitiveness of applying factor analysis and cluster analysis methods to data from multiple-indicator campsite monitoring studies. The advantages of

this approach over the traditional condition class rating may be worth the extra time involved in conducting the analyses. With the increasing demand for outdoor recreation opportunities and the growing visitation to our national parks (Olson, 2016), managers will benefit from methods of summarizing campsite impacts that highlight specific impacts of concern at the site level and suggest appropriate management strategies for addressing those impacts.

Finally, the ability to reduce datasets containing between nine and twelve variables to four meaningful factors demonstrates the ability to reduce large multiple impact parameter protocols to a smaller subset of measurement variables. This could enhance the efficiency of field assessment procedures, allowing managers to select three or four variables that account for the highest amount of variation in the data rather than measuring upwards of ten distinct variables. Greater efficiency of data analysis would also be achieved, either through a reduced number of variables to be analyzed or by reducing a large multivariate dataset to a more manageable number of interpretable factors.

5. Conclusions

This research examined the application of a multivariate statistical approach to analyzing multiple-indicator campsite data from three independent campsite studies representing unique environments. The analysis revealed interpretable structures within the data from all study locations, and was able to classify campsites based on the empirical measures collected in the field. This research supports the results of previous studies (Leung and Marion, 1999; Monz and Twardock, 2010), and demonstrates the

ability to identify meaningful patterns and associations of variables in campsite data from assessments conducted at sites representing a range of geographic locations, climates, and ecosystems. This approach provides more detailed information about specific impacts of concern than the traditional scalar condition class rating based on visual criteria or examining impact parameters in isolation, thus allowing managers of parks and protected areas to more effectively direct management actions to certain areas. Additional work will need to be conducted in order to determine whether a more stable factor structure exists, the extent to which campsite typologies based on natural groupings of empirical measures can be generalized, and the utility of reducing the number of variables included in field assessments of campsite impact. This method of summarizing campsite impacts may also lend itself well to integration with visitor evaluations of the acceptability of resource conditions at campsites, providing valuable information for managers.

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Table 3.1

Impact assessment parameters, assessment methods, and measurement scales.

Site	Attribute	Method	Scale
<i>Isle Royale National Park</i>	Stumps/cut shrubs	Counts	Total number of cut stumps present
	Access trails	Counts	Total number of trails present
	Trash	Ocular estimation	Percent of campsite with trash present
	Human waste	Counts	Total number of observable human waste sites
	Soil exposure	Ocular estimation	Six level cover scale: 0-5%, 6-25%, 26-50%, 51-75%, 76-95%, 96-100%
	Vegetative ground cover on site and in control areas	Ocular estimation	Six level cover scale: 0-5%, 6-25%, 26-50%, 51-75%, 76-95%, 96-100%
	Campsite area	Radial transect	Square area of campsite (m)
	Campfire sites	Counts	Total number of fire sites present
	Tree damage	Counts	Proportion of moderately or severely damaged trees on-site
	Root exposure	Counts	Proportion of trees on-site with moderate or severe root exposure
<i>Zion National Park</i>	Stumps/cut shrubs	Counts	Total number of cut stumps present
	Access trails	Counts	Total number of trails present
	Human waste	Counts	Total number of observable human waste sites
	Soil exposure	Ocular estimation	Six level cover scale: 0-5%, 6-25%, 26-50%, 51-75%, 76-95%, 96-100%
	Vegetative ground cover on site and in control areas	Ocular estimation	Six level cover scale: 0-5%, 6-25%, 26-50%, 51-75%, 76-95%, 96-100%
	Campsite area	Radial transect	Square area of campsite (m)
	Number of fire sites	Counts	Total number of fire sites present
	Tree damage	Counts	Proportion of moderately or severely damaged trees on-site
Root exposure	Counts	Proportion of trees on-site with moderate or severe root exposure	
<i>Kenai Fjords National Park</i>	Stumps/cut shrubs	Counts	Total number of cut stumps present
	Ghost stumps	Counts	Total number of cut ghost tree stumps
	Trash	Ocular estimation	Four level trash quantity scale
	Access trails	Counts	Total number of trails present
	Human waste	Ocular estimation	Three level human waste scale
	Soil exposure	Ocular estimation	Six level cover scale: 0-5%, 6-25%, 26-50%, 51-75%, 76-95%, 96-100%
	Vegetative ground cover on site and in control areas	Ocular estimation	Six level cover scale: 0-5%, 6-25%, 26-50%, 51-75%, 76-95%, 96-100%
	Campsite area	Radial transect	Square area of campsite (m)
	Campfire sites	Counts	Total number of fire sites present
	Tree damage	Ocular estimation	Three level tree damage scale
	Ghost tree damage	Ocular estimation	Three level tree damage scale
	Root exposure	Ocular estimation	Three level root exposure scale

Table 3.2

Summary of 1996 campsite conditions in Isle Royale National Park. Values are means \pm SE.

Site Attribute	ISRO Study Area ^a
Stumps/cut shrubs	1.59 \pm .12
Trails	2.93 \pm .08
Trash	3.33 \pm .46
Human waste	.04 \pm .02
Soil exposure	35.52 \pm 1.72
Vegetation cover loss	68.97 \pm 1.78
Campsite area	67.75 \pm 2.90
Campfire sites	.25 \pm .03
Tree damage	36.32 \pm 2.89
Root exposure	26.83 \pm 2.70
Condition class	3.0 \pm .03

^a*N* = 243

Table 3.3

Factor analysis of ten site impact indicators at Isle Royale National Park.

Site Attribute	Rotated Factor Loadings			
	Factor 1	Factor 2	Factor 3	Factor 4
Tree damage	.872			
Root exposure	.839			
Site area	.617			
Soil exposure		.820		
Vegetation cover loss		.796		
Trails			.742	
Fire sites			.681	
Trash			.520	
Stumps				.759
Human waste				.527
Eigenvalue	2.077	1.619	1.288	1.118
Cum. Variation Explained	20.772	36.996	49.850	61.029

Table 3.4

Final cluster centers from analysis of factor scores of campsite impacts at Isle Royale National Park.

Factor Name	Cluster, campsite type			
	1	2	3	4
Areal disturbance	-.816	-.607	-.621	1.050
Ground-cover disturbance	.114	-.516	-.460	.189
Behavior-related disturbance	-.503	1.246	-.327	-.073
Depreciative behavior-related disturbance	-.253	-.215	2.650	-.032
<i>N</i>	86	44	13	100

Table 3.5

A description and comparison of site attributes among four campsite types in Isle Royale National Park.

Site Attribute	Campsite Type				df	Mean Square	F	<i>p</i>
	Minimally Impacted	Behavior Influence	Intensive Behavior Influence	Extensively Impacted				
Stumps	0.91	1.48	5.38	1.73	3	76.609	26.886	.000
Trails	2.48	3.84	2.77	2.97	3	18.212	13.010	.000
Trash	2.45	5.84	3.92	2.94	3	121.067	2.369	.071
Human waste	0.0	0.0	0.54	0.02	3	1.159	30.129	.000
Soil exposure	36.53	25.49	27.54	40.09	3	2475.761	3.529	.016
Veg. cover loss	68.59	58.39	45.05	77.40	3	6490.712	9.266	.000
Site area	40.66	54.41	89.00	94.33	3	49149.808	33.362	.000
Fire sites	0.02	0.89	0.08	0.2	3	7.624	66.726	.000
Tree damage	1.28	8.60	0.0	82.75	3	124030.188	246	.000
Root exposure	0.0	1.40	7.69	63.59	3	76741.448	92.092	.000
Condition class	2.95	2.89	2.92	3.10	3	.610	2.205	.088
<i>N</i>	86	44	13	100				

Table 3.6

Summary of 2007 backcountry campsite conditions in Zion National Park. Values are means \pm SE.

Site Attribute	ZION Study Area ^a
Stumps/cut shrubs	.18 \pm .09
Trails	4.11 \pm .32
Human waste	1.11 \pm .23
Soil exposure	72.67 \pm 4.0
Vegetation cover loss	86.49 \pm 3.08
Campsite area	100.36 \pm 9.12
Campfire sites	.42 \pm .09
Tree damage	11.12 \pm 4.85
Root exposure	3.79 \pm 2.25
Condition class	3.89 \pm .11

^a*N* = 38

Table 3.7

Factor analysis of nine site impact indicators at Zion National Park.

Site Attribute	Rotated Factor Loadings			
	Factor 1	Factor 2	Factor 3	Factor 4
Site area	-.840			
Soil exposure	.774			
Fire sites	.577			
Root exposure		.918		
Tree damage		.855		
Trails			.881	
Vegetation cover loss			.689	
Stumps				.819
Human waste				.615
Eigenvalue	2.468	1.592	1.316	1.034
Cum. Variation Explained	27.421	45.107	59.729	71.222

Table 3.8

Final cluster centers from analysis of factor scores of campsite impacts at Zion National Park.

Factor Name	Cluster, campsite type		
	1	2	3
Areal disturbance	.572	-.965	.220
Tree damage	-.362	-.309	2.254
Ground vegetation disturbance	.341	-.584	.152
Behavior-related disturbance	-.377	.479	.260
<i>N</i>	20	13	5

Table 3.9

A description and comparison of site attributes among three campsite types in Zion National Park.

Site Attribute	Campsite Type			df	Mean Square	F	<i>p</i>
	Minimally Impacted	Moderately Impacted	Comprehensively Impacted				
Stumps	0.0	0.38	0.40	2	.717	2.441	.102
Trails	4.25	3.69	4.60	2	1.930	.477	.625
Human waste	1.00	1.15	1.40	2	.343	.165	.849
Soil exposure	86.75	46.08	85.50	2	6990.733	28.885	.000
Veg. cover loss	94.10	71.57	94.88	2	2202.128	8.636	.001
Site area	80.67	129.82	102.51	2	9528.239	3.411	.044
Fire sites	0.45	0.23	0.80	2	.603	2.097	.138
Tree damage	0.0	0.0	84.55	2	15518.741	265.016	.000
Root exposure	0.0	0.0	28.79	2	1799.258	17.765	.000
Condition class	4.15	3.38	4.20	2	2.576	8.647	.001
<i>N</i>	20	13	5				

Table 3.10

Summary of 2010 backcountry campsite conditions in Kenai Fjords National Park.

Site Attribute	KEFJ Study Area ^c
<i>Continuous measures^a</i>	
Stumps (#)	.11 ± .06
Ghost tree stumps (#)	.21 ± .1
Trails (#)	2.27 ± .15
Soil exposure (%)	59.78 ± 4.14
Vegetation cover loss (%)	55.67 ± 4.39
Campsite area (m ²)	26.52 ± 3.35
Campfire sites (#)	.11 ± .04
Condition class	2.42 ± .11
<i>Ordinal measures^b</i>	
Trash	1 ± 1
Human waste	1 ± 0
Tree damage	1 ± 2
Ghost tree damage	0 ± 3
Root exposure	1 ± 3

^a Values are means ± SE^b Values are medians ± range^c N = 80

Table 3.11

Factor analysis of ten site impact indicators at Kenai Fjords National Park.

Site Attribute	Rotated Factor Loadings			
	Factor 1	Factor 2	Factor 3	Factor 4
Root exposure	.736			
Trails	.734			
Tree damage	.604			
Site area	.597			
Vegetation cover loss		.840		
Soil exposure		.825		
Ghost tree damage			.869	
Ghost tree stumps			.854	
Stumps				.701
Fire sites				.673
Eigenvalue	2.466	1.913	1.371	1.026
Cum. Variation Explained	22.414	39.805	52.265	61.592

Table 3.12

Final cluster centers from analysis of factor scores of campsite impacts at Kenai Fjords National Park

Factor Name	Cluster, campsite type			
	1	2	3	4
Areal disturbance	-.192	.737	-.189	-.225
Ground-cover disturbance	.038	-.852	-.128	-.264
Ghost tree damage	.551	-.279	3.49	-.020
Behavior-related disturbance	.679	-.208	-.438	2.843
<i>N</i>	39	31	4	6

Table 3.13

A description and comparison of continuous-measure site attributes among four campsite types at Kenai Fjords National Park.

Site Attribute	Campsite Type				df	Mean Square	F	<i>p</i>
	Intensively Impacted	Extensively Impacted	Cultural Resource Concern	Behavior Influence				
Stumps	0.0	0.0	0.0	1.50	3	4.163	42.180	.000
Ghost stumps	0.0	0.06	3.75	0.0	3	17.589	125.860	.000
Trails	1.97	2.39	3.00	3.50	3	4.990	3.165	.029
Soil exposure	87.10	32.66	64.75	28.58	3	19269.753	29.429	.000
Veg. cover loss	79.44	25.53	61.98	61.86	3	16848.670	17.976	.000
Site area	31.07	21.23	40.87	19.15	3	938.603	1.032	.383
Fire sites	0.0	0.10	0.25	0.83	3	1.231	14.873	.000
Condition class	2.64	2.00	3.50	2.83	3	4.331	5.413	.002
<i>N</i>	39	31	4	6				

Table 3.14

A description and comparison of ordinal-measure site attributes among four campsite types at Kenai Fjords National Park.

Site Attribute	Campsite Type				df	Pearson Chi-Square	Sig.
	Intensively Impacted	Extensively Impacted	Cultural Resource Concern	Behavior Influence			
Trash	1	1	1	1	3	1.065	.786
Human waste ^a	1	1	1	1	3	-	-
Tree damage	1	1	1	2	3	23.893	.001
Ghost tree damage	0	0	2	0	3	37.550	.000
Root exposure	1	1	1	1.5	3	24.767	.003
<i>N</i>	39	31	4	6			

^a Human waste had variance 0, no statistics calculated

Table 3.15

Summary of factor solutions and variable loadings for multivariate analyses of campsite data from five study areas.

Study Site	Factor Solution	Cum. Variation Explained (%)	Variable Loadings			
			Factor 1	Factor 2	Factor 3	Factor 4
GRSM (Leung and Marion 1999)	3	58.2	<ul style="list-style-type: none"> • Campsite size • Fire sites • Social trails 	<ul style="list-style-type: none"> • Trees with exposed roots • Vegetation cover loss • Exposed soil 	<ul style="list-style-type: none"> • Tree damage • Stumps 	
PWS (Monz and Twardock 2010)	3	54.9	<ul style="list-style-type: none"> • Tree damage • Root exposure • Trails 	<ul style="list-style-type: none"> • Area of impact • Mineral soil exposure • Vegetation cover loss 	<ul style="list-style-type: none"> • Stumps • Fire sites • Trash • Human waste 	
ISRO	4	61.0	<ul style="list-style-type: none"> • Tree damage • Root exposure • Campsite area 	<ul style="list-style-type: none"> • Soil exposure • Vegetation cover loss 	<ul style="list-style-type: none"> • Trails • Fire sites • Trash 	<ul style="list-style-type: none"> • Stumps • Human waste
ZION	4	71.2	<ul style="list-style-type: none"> • Campsite area • Soil exposure • Fire sites 	<ul style="list-style-type: none"> • Tree damage • Root exposure 	<ul style="list-style-type: none"> • Trails • Vegetation cover loss 	<ul style="list-style-type: none"> • Stumps • Human waste
KEFJ	4	61.6	<ul style="list-style-type: none"> • Root exposure • Trails • Tree damage • Campsite area 	<ul style="list-style-type: none"> • Vegetation cover loss • Soil exposure 	<ul style="list-style-type: none"> • Ghost tree damage • Ghost stumps 	<ul style="list-style-type: none"> • Stumps • Fire sites

Table 3.16

Summary of campsite typologies for multivariate analyses of campsite data from five study areas.

Study Site	Cluster	Name	N	Description
GRSM (Leung and Marion 1999)	1	Moderately- Impacted	89	Low area disturbance (F 1) score; lowest scores on soil/groundcover damage (F 2) and tree-related damage (Factor 3) factors. Account for 38% of cut stumps; moderate levels of tree damage, soil exposure, vegetation cover loss, campsite area
	2	Intensively- Impacted	78	Highest scores on soil/groundcover damage factor (F 2); low scores on area disturbance (F 1) and tree-related damage (F 3) factors. Account for 44% of all trees with exposed roots and 36% of total area of vegetation cover loss
	3	Extensively- Impacted	28	Highest scores on area disturbance (F 1) and tree-related damage (F 3); intermediate scores on soil/groundcover damage factor (F 2). Contribute 30% of total area of soil exposure, 29% of total area of vegetation cover loss, and 27% of all trees with exposed roots
	4	Low-Impact	141	Excluded from factor analysis. Minimal levels of soil and vegetation disturbance as assessed by condition class rating
PWS and Twardock 2010)	1	Minimally- Impacted	62	Low mean score on all factors. Smallest areal extent of impact, lowest cover loss, lowest mineral soil exposure
	2	Intensively- Impacted	46	High mean score on areal disturbance factor (F 2). Moderate to high levels of measured impacts
	3	Comprehensi- vely-Impacted	38	High mean score on tree and vegetation damage factor (F 1); positive scores for other factors. High levels of mineral soil exposure, tree damage, root exposure, tree stumps, and trash
ISRO	1	Minimally- Impacted	86	Low mean scores on all factors. Smallest area, fewest stumps, trails, fire sites; low levels of trash, tree damage, and root exposure
	2	Behavior- Influence	44	High mean score on behavior influence factor (F 3). Large amount of trash and highest level of tree damage
	3	Intensive Behavior- Influence	13	Very high mean score on depreciative behavior factor (F 4). Most stumps and human waste, highest level of root exposure
	4	Extensively- Impacted	100	Very high mean score on areal disturbance factor (F 1). Largest campsite area, most soil exposure, and most vegetation cover loss
ZION	1	Minimally- Impacted	20	Low mean scores on all factors. Sites have smallest area and little tree damage or other evidence of depreciative behavior
	2	Moderately- Impacted	13	Moderate mean scores on all factors. Relatively low levels of vegetation cover loss and soil exposure, 50% larger on average than Minimally-Impacted sites
	3	Comprehensi- vely-Impacted	5	High mean score on tree damage factor (F 2) and positive mean scores on all other factors. High levels of soil exposure and vegetation cover loss, large site area, very high levels of tree damage and root exposure
KEFJ	1	Intensively- Impacted	39	Moderate mean scores on ghost tree (F 3) and behavior-related (F 4) factors. Exhibit highest levels of soil exposure and vegetation cover loss; large mean campsite area
	2	Extensively- Impacted	31	High mean score on areal disturbance (F 1) factor and negative mean scores on other factors. Exhibit moderate levels of most impact parameters
	3	Cultural Resource Concern	4	Very high mean score on ghost tree damage factor (F 3). Sites have most ghost tree stumps and highest level of damage to ghost trees
	4	Behavior- Influence	6	Very high mean score on behavior-related disturbance (F 4) factor. Sites have most cut stumps, trails, and highest level of tree damage

Table 3.17

Comparison of visual condition class ratings among campsite typologies.

Study Area ^a	Cluster	Name	N	Mean CC	Min CC	Max CC
ISRO	1	Minimally-Impacted	86	2.95	2	4
	2	Behavior-Influence	44	2.89	1	4
	3	Intensive Behavior-Influence	13	2.92	2	4
	4	Extensively-Impacted	100	3.10	2	4
ZION	1	Minimally-Impacted	20	4.15	4	5
	2	Moderately-Impacted	13	3.38	3	5
	3	Comprehensively-Impacted	5	4.20	3	5
KEFJ	1	Intensively-Impacted	39	2.64	1	4
	2	Extensively-Impacted	31	2.00	0	4
	3	Cultural Resource Concern	4	3.50	3	4
	4	Behavior-Influence	6	2.83	2	3
PWS (Monz and Twardock 2010)	1	Minimally-Impacted	62	1.5	-	-
	2	Intensively-Impacted	46	3.6	-	-
	3	Comprehensively-Impacted	38	4.1	-	-

^aMonz and Twardock (2010) did not report minimum and maximum condition class ratings for the three campsite types in PWS. Leung and Marion (1999) did not report condition class data for campsites in GRSM.

CHAPTER 4
EXPLORING THE BASES OF VISITOR STANDARDS IN
NATIONAL PARKS

Abstract

An on-site visitor survey instrument was developed to examine the relationship between visitor characteristics and thresholds for recreation resource conditions. The survey was administered to visitors at Kenai Fjords National Park and Denali National Park and Preserve in Alaska. Established scales were used to measure visitors' level of prior experience, level of ecological concern, knowledge of relevant natural history topics, management issues, minimum-impact practices, and level of place attachment. Trip and demographic information was also collected. Respondents were asked to view series of computer-generated photographs showing a range of impact conditions for four recreation resource indicators and evaluate the acceptability of each condition. Responses for each visitor were analyzed and coded based on the structural characteristics of the resulting norm curve. Multiple linear regression analyses were completed to model the relationship between visitor characteristics and thresholds for recreation resource conditions. Findings indicate that visitor characteristics such as those listed above may be able to account for some of the variability in impact condition thresholds. Opportunities for theoretical and methodological development and management implications are discussed.

Introduction

The use of objectives-based management frameworks is well established in outdoor recreation management (Interagency Visitor Use Management Council, 2016;

Manning, 2001; Stankey et al., 1985; Whittaker, Shelby, Manning, Cole, & Haas, 2011). The purpose of such frameworks is to achieve and maintain desired resource conditions and visitor experiences outdoor recreation settings. The successful application of these frameworks depends on the development of management objectives (i.e., desired conditions), indicators of quality for resource and social conditions, and thresholds for the condition of indicator variables.

Proper application of recreation management frameworks requires information pertaining to both the descriptive and evaluative components of capacity (Shelby & Heberlein, 1984). As defined by the Interagency Visitor Use Management Council (2016), the visitor experience includes the perceptions, feelings, and reactions a visitor has before, during, and after a visit to an area. Visitor studies incorporating normative theory and methods can provide valuable evaluative information regarding the conditions of park resources and social settings, and have been widely applied in park and recreation settings (see Manning, 2011).

Research has examined the application of norm theory and methods in the context of outdoor recreation and management (Bacon, Manning, Johnson, & Vande Kamp, 2001; Basman, Manfredo, Barro, Vaske, & Watson, 1996; Donnelly, Vaske, Whittaker, & Shelby, 2000; Kim & Shelby, 1998; Krymkowski, Manning, & Valliere, 2009; Laven, Manning, & Krymkowski, 2005; Manning, Lime, & Freimund, 1996a; Manning, Valliere, Wang, & Jacobi, 1999; Shelby, Vaske, & Donnelly, 1996; Vaske, Donnelly, Doctor, & Petruzzi, 1995; Vaske, Beaman, Barreto, & Shelby, 2010; Manning, 2011), and visitor studies incorporating normative research have been applied to a wide variety of social, resource, and management conditions in parks and recreation areas (e.g., Kim

& Shelby, 1998; Kneeshaw, Vaske, Bright, & Absher, 2004; Manning, Valliere, Minter, Wang, & Jacobi, 2000; Randall & Rollins, 2013; Vaske, Graefe, Shelby, & Heberlein, 1986).

Despite the volume of research regarding visitor evaluations for conditions in outdoor recreation settings and the use of normative methods to measure thresholds, very little research has examined the individual visitor characteristics that underlie threshold preferences. Visitors to parks and protected areas are diverse in many ways, and they possess numerous individual characteristics that may influence how they view and respond to conditions in outdoor recreation settings (Manning, 2011). Some research has begun to explore how certain visitor characteristics influence perceptions of specific biophysical resource conditions (D'Antonio, Monz, Newman, Lawson, & Taff, 2012; Floyd, Jang, & Noe, 1997; Kyle, Graefe, Manning, & Bacon, 2004; White, Virden, & van Riper, 2008;). These studies have focused on perceptions of resource conditions encountered while participating in outdoor recreation activities at specific locations. While some research has been done to examine the influence of visitor characteristics on individual evaluations of the acceptability of a range of resource conditions, it has largely relied on comparisons between groups (Anderson & Loomis, 2012; Martin, McCool, & Lucas, 1989; Monz, 2009; Moore & Polley, 2007; Needham & Rollins, 2005; Schuster, Thompson, & Hammit, 2001; Shafer & Inglis, 2000; Shelby & Shindler, 1992). Understanding the relationship between specific visitor characteristics and visitor thresholds for acceptable conditions may allow managers to use information collected from visitor surveys more effectively in park planning efforts.

This research examines visitor characteristics that may influence visitors' thresholds for the acceptability of recreation resource conditions. A survey incorporating established scales for measuring specific personal characteristics was administered to visitors at Kenai Fjords National Park and Denali National Park and Preserve. Characteristics measured include environmental orientation, knowledge of accepted outdoor practices, level of place attachment, local ecological knowledge, and prior experience. Respondents at both locations were asked to evaluate the acceptability of a series of photographs depicting a range of conditions for selected resource indicator variables. Thresholds were calculated for each resource indicator, and the influence of visitor characteristics on these standards was examined using multiple linear regression analysis. The purpose of this research is to explore the relationship between visitor characteristics and thresholds for recreation resource impacts in order to advance our understanding of visitor thresholds and their use in informing park planning and management.

Managing outdoor recreation

The management of outdoor recreation and its potential impacts has often been conceptualized through the concept of carrying capacity, or capacity (Manning, 2011; Shelby & Heberlein, 1986; Stankey & Manning, 1986). In the context of outdoor recreation, capacity refers to the type and level of recreation use that can be accommodated while maintaining acceptable resource, experiential, and managerial conditions in a park or recreation area (Interagency Visitor Use Management Council, 2016; Manning, 2011; Whittaker et al., 2011). The principal challenge of applying capacity to parks and protected areas is determining the maximum level of change in

conditions that is acceptable for a given area. Establishing capacities involves both a descriptive component and an evaluative component (Shelby & Heberlein, 1984). The descriptive component defines the observable working of recreation systems and involves management parameters, impact parameters, and the relationship between the two, whereas the evaluative component integrates value judgments into determining capacity based on the acceptability of impacts.

Recreation capacity can most effectively be defined, planned, and managed in the context of specific management objectives of individual parks and protected areas (Manning, 2004; Whittaker et al., 2011). Several management-by-objectives capacity frameworks have been developed, including Limits of Acceptable Change (LAC) (Stankey et al., 1985), Visitor Experience and Resource Protection (VERP) (Manning, 2001; National Park Service, 1997), Tourism Optimisation Management Model (TOMM) (Jack, 2000), and the Visitor Use Management Framework (Interagency Visitor Use Management Council, 2016). These frameworks rely on the formulation of indicators and associated thresholds for resource and social/experiential conditions that reflect desired conditions supported by a system of ongoing monitoring. Desired conditions are statements of aspiration that describe resource conditions, visitor experiences and opportunities, and facilities and services that an agency strives to achieve and maintain in a particular area. Indicators are specific resource or experiential attributes that can be measured to track changes in conditions so that progress toward achieving and maintaining desired conditions can be assessed and thresholds are minimally acceptable conditions associated with each indicator (Interagency Visitor Use Management Council, 2016). Indicators are monitored over time, and management actions can be taken to

ensure that thresholds are not violated. The management-by-objectives approach to planning and management of outdoor recreation has proven effective in several diverse parks and other protected areas across the globe (e.g., Manning, 2007; Manning, Lime, & Hof, 1996b; Moore & Polley, 2007).

Management decisions related to recreation capacities are ultimately value-based judgments about the desired conditions and acceptable levels of change in parks and protected areas (Shelby & Heberlein, 1984; Shelby et al., 1996; Manning & Lawson, 2002). These decisions should be as informed as possible and consider the legal environment; current resource and social conditions; administrative feasibility; public acceptability; costs and benefits of planned management actions; supply and demand of regional opportunities; uniqueness of opportunities; risk of irreversible change; impacts on all resources; and the best available science regarding the sensitivity of resources and recreation experiences, the relationships between visitor use and impacts, and public values and preferences (Interagency Visitor Use Management Council, 2016; Whittaker et al., 2011). Research studies of park visitors, their recreation experiences, and their evaluations of resource conditions can provide managers with important data to inform capacity decisions.

Normative research methods

Developed in sociology (e.g., Jackson, 1965), the concept of norms has attracted considerable attention as a theoretical and empirical framework in outdoor recreation research and management (Heberlein, 1977; Heywood, Manning, & Vaske, 2002; Manning, 1999; Shelby & Heberlein, 1986; Shelby et al., 1996; Vaske et al., 1986; Vaske, Donnelly, & Shelby, 1993; Whittaker & Shelby, 1988). Normative methods can

be utilized to evaluate possible conditions of various experiential, resource, and managerial indicators and aid in the selection of thresholds for acceptable conditions in parks. In the context of outdoor recreation, norms are generally defined as standards that individuals and groups use for evaluating behavior and social and environmental conditions (Donnelly, Vaske, & Shelby, 1992; Shelby & Vaske, 1991; Vaske et al., 1986). In other words, norms address conditions that result from behavior and measure the degree to which selected conditions ‘ought’ to exist (Manning, 2011).

If park visitors and other stakeholders possess norms for relevant aspects of recreation experiences, these norms can be measured and used as a basis for informing the development of condition thresholds. Individual norms can be measured by asking visitors and stakeholders to evaluate the acceptability of a range of social, resource, or managerial conditions that could be found within a park or other natural area. These data are then aggregated and graphed to form a social norm curve. Normative research in outdoor recreation has been applied to several social, ecological, and managerial issues (Goonan, Monz, Manning, & Anderson, 2012; Kneeshaw et al., 2004; Shelby, Brown, & Baumgartner, 1992; Shelby, Vaske, & Harris, 1988; Zinn, Manfredo, Vaske, & Wittmann, 1998).

A hypothetical social norm curve (Figure 4.1) illustrates the methodology described above. Respondents are asked to rate the relative acceptability of a range of conditions that could be present at a park or other recreation area, and responses are aggregated and plotted on a graph. In this hypothetical case, the norm curve traces the average visitor-rated acceptability of the number of people encountered per day along a trail. The norm curve’s structural characteristics provide a great deal of information

regarding the respondents' evaluations of potential conditions of the indicator being investigated. Detailed discussions of the structural characteristics of norms can be found in Vaske et al. (1993), Shelby et al. (1996), and Manning and Krymkowski (2010). For the purposes of this research, we are most interested in the *threshold* (also known as the *minimum acceptable condition*), or the point at which the norm curve crosses the zero point on the acceptability scale; the *range of acceptable conditions*, or all points on the curve above the zero point on the acceptability scale; and the type or general shape of the resulting curve. Conceptually, norms can be categorized into one of three types: *no tolerance*, *single tolerance*, and *multiple tolerance* (Whittaker & Shelby, 1988). No tolerance norms are generally characterized by a mode of zero impact; single-tolerance norms indicate a threshold greater than zero but an unwillingness to tolerate impacts beyond a certain level; and multiple-tolerance norms may indicate a range of acceptable conditions between the minimum and maximum presented.

To measure norms, respondents are generally asked to evaluate the acceptability of a range of conditions that could be present in parks or recreation areas. The use of visual research methods in presenting possible conditions has emerged as a useful approach to measure norms (Manning & Freimund, 2004). Visual research methods have a number of advantages over narrative/numerical techniques for measuring social norms: visual methods can help standardize research on standards of quality by presenting a constant series of images to all respondents; they can be useful in studying standards of quality for indicator variables that are too technical or complex to communicate in a narrative format; and images can be manipulated to show a range of conditions, including conditions that currently exist or could potentially exist at a recreation area in the future.

Visitor characteristics

One area in which research regarding the application of norm theory and methods to parks is lacking is an examination of the respondent characteristics that underlie norms. While some research has looked at how norms vary with selected respondent characteristics (Anderson & Loomis, 2012; Budruk & Manning, 2003; Heywood, 1993; Kneeshaw et al., 2004; Marin, Newman, Manning, Vaske, & Stack, 2011; Needham, Rollins, & Vaske, 2005; Needham, Rollins, Ceurvorst, Wood, Grimm, & Dearden, 2011; Ormiston, Gilbert, & Manning, 1998; Sayan, Krymkowski, Manning, Valliere, & Rovelstad, 2013; Shelby & Shindler, 1992; Stanfield, Manning, Budruk, & Floyd, 2006; Vaske, Donnelly, & Petruzzi, 1996; Warzecha & Lime, 2001; Wellman, Roggenbuck, & Smith, 1982; Young, Williams, & Roggenbuck, 1991), most of these studies have either only considered single characteristics or simply compared norms between groups of respondents. Other studies have begun to explore how certain visitor characteristics influence perceptions of specific biophysical resource conditions, including level of environmental concern (Floyd et al., 1997), place attachment (Kyle et al., 2004; White et al., 2008), prior experience (D'Antonio et al., 2012; White et al., 2008), local ecological knowledge, and minimum-impact knowledge (D'Antonio et al., 2012). These studies have focused on perceptions of resource conditions encountered while participating in outdoor recreation activities at specific locations.

While some research has been done to examine the influence of visitor characteristics on individual evaluations of the acceptability of a range of resource conditions, most of this research has relied on comparisons between groups (Anderson & Loomis, 2012; Martin et al., 1989; Monz, 2009; Moore & Polley, 2007; Needham & Rollins, 2005; Schuster et al., 2001; Shafer & Inglis, 2000; Shelby & Shindler, 1992) as

opposed to examining relationships between these variables. While the recreation literature is rich in research related to visitor characteristics, attitudes, and norms, little if any research has explored the influence of specific visitor characteristics on acceptability thresholds. Visitors to parks and protected areas are diverse in many ways, and it is possible these differences could affect the evaluative judgments visitors make about different conditions in parks.

Methods

Study areas

Kenai Fjords National Park (KEFJ), established in 1980, is located at approximately 59°55'N 149°59'W in southern Alaska. The park protects nearly 670,000 acres of glaciers, alpine habitat, spruce-hemlock coniferous forest, deciduous forest, and fjord estuaries. Most of the park is remote backcountry, consisting of approximately 400 miles of coastline and offering excellent opportunities for sea kayaking. Exit Glacier, northwest of the town of Seward, is the only vehicle-accessible area of the park. From here visitors can access trails ranging from an accessible trail to a viewpoint of Exit Glacier to a strenuous trail overlooking the glacier and ending at the edge of the Harding Icefield.

Denali National Park and Preserve (DENA), established in 1917 and expanded in 1980, is located at approximately 63°20'N 150°30'W in interior Alaska. Together, the park and contiguous preserve encompass over 6 million acres of mountains, glaciers, alpine tundra, shrub-scrub tundra, mixed spruce-birch and spruce-tamarack woodlands, taiga, wetlands, riparian and lowland forest areas, and lakes. Several hiking trails are located near the main entrance area of the park; much of the rest of the park is managed

as trail-less backcountry. The 92-mile long Denali Park Road is the only road and the primary means of access to most of the park. Private vehicles are restricted to the first 15 miles, and visitors must ride shuttle buses or acquire a special permit to travel beyond that point. Many visitors choose to drive their personal vehicle to the Savage River Trailhead and picnic area at Mile 15 or take the free Savage River Shuttle. An easy 1.7-mile loop trail follows the river, and visitors can hike off-trail to explore the area on their own.

Data collection

Sampling at KEFJ occurred in August 2011 in the Exit Glacier area of the park. A random sample of adult visitors were asked to complete a self-administered survey as they exited the trail system. Sampling at DENA took place in July 2012, primarily in the Savage River area. A random sample of adult visitors were asked to participate in the study by completing a self-administered survey as they exited the Savage River Loop Trail or concluded their stay at the picnic area. The two parks were chosen for this study in an effort to collect data from a broad range of visitors to national parks in Alaska, as both parks are fairly accessible to visitors and offer a variety of frontcountry and backcountry recreation opportunities. Trailhead areas that serve a variety of visitor groups and abilities were chosen as the contact locations to obtain a representative sample of visitors from each park.

A survey was drafted (USU Protocol #2961) incorporating standard scales and questions to measure the following characteristics for visitors to Alaska national parks: local ecological knowledge, knowledge of management topics, knowledge of minimum impact practices (D'Antonio et al., 2012), level of ecological concern (Cordano,

Welcomer, & Scherer, 2003), and place attachment (Warzecha & Lime, 2001). The survey also included normative and visual research methods to measure respondents' thresholds for specific recreation resource conditions. Close-ended questions asked visitors about characteristics of their trip, knowledge of natural history and relevant ecological subjects, knowledge of minimum impact practices, perceptions, and demographic information. Standard scales and questions were used to measure a variety of respondent characteristics, summarized in the following section. The same survey was administered to visitors at KEFJ and DENA, with slight adjustments made to make the survey questions relevant to the individual parks (see Appendices F and G).

A final series of questions using visual research methods measured respondents' thresholds for the following resource conditions: visitor created trails, informal visitor sites, trail condition, primitive campsite condition. A series of computer-generated photographs depicting a range of conditions for each variable was prepared, and respondents were asked to evaluate the acceptability of the condition illustrated. Photographs for each condition being measured were presented in random order. Identical sets of photographs were shown to respondents at both study locations (Appendix F).

Variables

The survey instrument included questions regarding visitor characteristics that could potentially influence respondents' evaluations of the acceptability of recreation resource impacts. Prior experience was measured as a multi-dimensional construct using three indicators. Visitors were asked to report (1) the number of organized activities they participated in during their visit to the park; (2) the total number of visits they had made

to the park in which they were contacted (KEFJ or DENA); and (3) the number of other national parks in Alaska they had visited. Activity participation was calculated as a proportion of the activities respondents participated in relative to the activities offered.

To measure local ecological knowledge, visitors were asked to self-rate their knowledge of natural history (1 = no knowledge, 2 = some knowledge, 3 = proficient knowledge) and relevant management topics (1 = no knowledge, 2 = somewhat familiar, 3 = well informed) at each park (D'Antonio et al., 2012). Natural history topics examined included birds, marine wildlife, terrestrial wildlife, plants, water, glaciers, geology, ecology, and succession in KEFJ; and birds, aquatic wildlife, terrestrial wildlife, plants, water, glaciers, geology, and ecology at DENA. Management topics examined included air quality, water quality, climate change, and nonnative species in KEFJ; and air quality, soundscapes, climate change, and nonnative species in DENA. Knowledge scores were calculated as a proportion of the maximum score available using respondents' self-reports.

Significant management focus at both parks is given to educating visitors about low-impact practices and minimizing the impact of their activities. Knowledge of low-impact practices was measured using multiple choice questions formulated from the principals of Leave No Trace (Leave No Trace Center for Outdoor Ethics, 2012) and messages communicated by the National Park Service. Minimum-impact knowledge scores were calculated as a proportion of correct responses (D'Antonio et al., 2012).

Ecological concern was measured using the abbreviated New Environmental Paradigm (NEP) scale (Cordano et al., 2003). The scale consists of eight questions that measure respondents' ecological orientation on a spectrum of "domination," in which

humans have priority over the environment, to “balance,” where humans seek to balance human needs and environmental values. Respondents rated their level of agreement with each statement on a Likert-type scale (1 = Strongly Disagree, 5 = Strongly Agree). Variables relating to “domination” were reverse coded, and a total environmental concern score was calculated using the mean, with higher scores indicating greater environmental concern.

Place attachment was measured using a standard series of questions to measure place identity, place dependence, and overall place attachment (Warzecha & Lime, 2001). Respondents rated their level of agreement with each statement on a Likert-type scale (1 = Strongly Disagree, 5 = Strongly Agree). An overall place attachment score was calculated from the mean from all variables, with higher scores indicating greater levels of place attachment.

Respondents were shown four series of photographs depicting a range of impact conditions for visitor-created trails, informal visitor sites, trail condition, and conditions at primitive campsite. Photos were created to show a range of impacts that could be observed in national parks in Alaska. Study photos for visitor-created trails depicted 0, 2, 6, 10, and 12 trail segments; photos for informal visitor sites depicted an area with 10%, 25%, 50%, 75%, and 90% vegetation loss; trail photos showed increasing levels of impact from a fairly narrow trail with no soil erosion (level 1) to a significantly widened trail with severe soil erosion (level 5); and campsite photos depicted small (13m²), medium (36m²), and large (100m²) campsites with 12%, 55%, and 88% vegetation cover. Within each series, photos were presented to respondents in a random order. Respondents

were asked to rate the acceptability of each condition presented on a scale of +4 (“Very acceptable”) to -4 (“Very unacceptable”).

Data analysis

Data from the visitor surveys were summarized and synthetic variables were calculated using SPSS (v. 24, SPSS Inc., Chicago, IL USA). Total scores were calculated for previous visits (total number), visits to other Alaska national parks (number of other parks visited), participation in activities offered at the park (percent), natural history knowledge (percent), knowledge of management topics (percent), ecological concern (mean), and place attachment (mean) were calculated as described above.

Respondents’ ratings of the acceptability of the impact parameters outlined above were individually plotted and visually inspected to identify their structure. Six structures were recognized, and norm type was recorded for each respondent and each variable. Respondent thresholds for resource condition variables were calculated for appropriate norm types.

Multiple linear regression was used to test for relationships between the independent variables related to prior experience, knowledge, ecological concern and place attachment, and the dependent condition threshold variables. This analysis method was selected since it allows for a relationship to be modeled between multiple continuous or nominal independent variables (i.e., visitor characteristics) and a single dependent variable (i.e., indicator condition threshold). It is also fairly robust against deviations from normality. Statistical assumptions were tested following the methods outlined by Laerd Statistics (2015) to ensure the data were suitable for multiple regression analysis. Analyses were conducted for the following variables that had a sufficient number of

respondents in the sample identifying thresholds: visitor-created trails, informal visitor sites, and trail condition.

Results

Visitor demographics

A total of 290 usable surveys were collected (225 in KEFJ and 65 in DENA) with an overall response rate of 61.3%. The average age of respondents was 48 years of age; females comprised 54.2% of the study participants. Overall respondents were highly educated, with 31.2% holding a Bachelors degree and 42.8% holding a graduate degree. Respondents were majority white (94%), with 2.2% of respondents identifying as Hispanic or Latino. Most respondents were domestic visitors, with 86.7% residing in the United States. Additional tables are included in Appendix G.

Visitor experience and knowledge

Overall, respondents had been to their primary park an average of 2.24 times, with the majority visiting for the first time (Table 4.1). Approximately half of respondents had visited at least one other national park in Alaska: 37.6% of respondents contacted in KEFJ had visited DENA, and 20% of respondents contacted in DENA had visited KEFJ. Overall participation in organized activities was low, with 74% of respondents indicating they had not participated in any organized activity. The most popular activities for respondents at DENA were bus tours (40%) and the sled dog demonstration (29%). The ranger-led hike to Exit Glacier was the most popular activity for respondents at KEFJ (10%).

Visitors were asked to self-rate their knowledge of natural history topics and relevant management issues (Table 4.2). For natural history, respondents were most knowledgeable about glaciers and terrestrial wildlife, and least knowledgeable about aquatic wildlife (DENA) and succession (KEFJ). Among the management issues, visitors were most informed about climate change; had some knowledge regarding air quality, water quality (KEFJ), and soundscapes (DENA); and were least informed about nonnative species. While slightly over 20% of respondents reported themselves as having proficient knowledge related to climate change, 12% or less of respondents reported having proficient knowledge in any other natural history or management topics. Overall, respondents achieved a mean score of 0.594 (*min* = 0.33; *max* = 1.00) for natural history knowledge and 0.542 (*min* = 0.33; *max* = 1.00) for knowledge of management topics. The items measuring natural history knowledge showed acceptable reliability ($\alpha = 0.87$ for KEFJ scale items; 0.77 for DENA scale items), as did those measuring knowledge of management topics ($\alpha = 0.86$ for KEFJ scale items; 0.80 for DENA scale items).

According to survey responses, visitors appear reasonably knowledgeable of minimum impact practices communicated in the parks (Appendix G). Approximately 17% of respondents answered all minimum impact questions correctly, and 34.8% only answered one question incorrectly. The question most often answered incorrectly related to where visitors should rest along a trail to reduce their impact to other visitors and recreation resources. Almost all (>95%) respondents answered questions related to viewing wildlife, picking wildflowers, and disposing of food waste correctly; nearly 20% of respondents answered the question regarding proper bear safety while hiking

incorrectly; and most (>60%) answered questions regarding hiking on durable surfaces and trip preparation correctly.

Environmental orientation

Overall, respondents appear to have a moderate level of environmental concern ($mean = 3.896$; $min = 1.38$, $max = 5.00$) as measured by the eight-item abbreviated NEP scale (Table 4.3). Visitors agreed most strongly with the statement, “The balance of nature is very delicate and easily upset,” and disagreed most strongly with the statements, “Plants and animals exist primarily to be used by humans,” and “Humans were meant to rule over the rest of nature.”

Level of place attachment

Respondents appear to have a moderate level of place attachment ($mean = 3.41$; $min = 1.73$, $max = 5.00$), with a slightly higher level of place identity ($mean = 3.57$; $min = 2.00$, $max = 5.00$) than place dependence ($mean = 3.20$; $min = 1.40$, $max = 5.00$) (Table 4.3). Visitors agreed most strongly with the statements, “This place means a lot to me,” and “I would prefer to spend more time here if I could;” and disagreed most strongly with the statement, “The time I spent here could just have easily been spent somewhere else.”

Visitor evaluations of resource conditions

With the exception of small primitive campsites (Table 4.4), the aggregated norm curves for the visitor-created trails, informal visitor sites, trail condition, and medium and large campsite indicators follow the typical norm curve structure and indicate clear condition thresholds (Fig. 4.1). According to the aggregated norm curves, the thresholds for recreation resource conditions are 3.6 visitor-created trails segments (Fig. 4.2), 30.6%

vegetation cover loss at informal visitor sites (Fig. 4.3), trail condition corresponding to impact level 1.98 (Fig. 4.4), and 16% vegetation cover on medium campsites and 68.3% cover on large campsites (Fig. 4.5). Average acceptability ratings for small primitive campsites were all positive.

Visitor norm types for resource conditions

Six distinct norm types were recognized based on structural characteristics: (i) threshold norms (T), which follow the typical norm curve pattern and indicate a clear threshold of tolerance for conditions; (ii) reverse norms (RN), in which lower impact conditions are rated as less favorable than higher impact conditions; (iii) neutral norms (N), in which all conditions were rated 0 on the acceptability scale; (iv) acceptable norms (A), in which all conditions received a positive rating or the curve made a positive *U* shape without crossing into the unacceptable range; (v) unacceptable norms (UA), in which all conditions received a negative rating or the curve made a negative *U* shape without crossing into the acceptable range; and (vi) multiple-tolerance norms (MT) where the curve crossed the x-axis two or more times or multiple conditions were rated 0 on the acceptability scale.

The visitor-created trail indicator had the largest number of T-type norms, with 78.8% of respondents indicating a T-type norm (Table 4.5). T-type norms were also the most common for the informal visitor site and trail impact indicators, with 44.6% and 54.2% of respondents indicating a T-type norm for those indicators, respectively. A-type norms were most common for all campsite condition indicators, and the percentage of respondents indicating a T-type norm for primitive campsite conditions fell to between 3.56% and 4.98% (Table 4.5). N-type norms were most reported for campsite indicators;

UA-type norms were most reported for large campsites, medium campsites, and informal visitor sites; and MT-type norms were most reported for informal visitor sites (Table 4.5). Thresholds for resource conditions were calculated using the aggregated, T-type, and RN-type norm curves (Table 4.6). Substantial differences were observed for all variables. A visual inspection of the different norm types for visitor-created trails (Fig. 4.6), informal visitor sites (Fig. 4.7), trail condition (Fig. 4.8), and campsite conditions (Fig. 4.9) highlights the differences between them, including the range of acceptability for each condition assessed, the shapes of the curves, and thresholds.

Multiple regression analyses

A multiple regression was conducted to predict indicator thresholds for visitor-created trails, informal visitor sites, and trail condition from the following independent variables: number of previous visits, rate of participation in organized activities, number of other Alaska national parks visited, knowledge of natural history topics, knowledge of management issues; minimum-impact knowledge, level of ecological concern, level of place attachment, gender, age, country of origin, and education level. Analyses were only conducted for the three indicators listed as they had sufficient responses indicating T-type norms from which a threshold could be calculated (see Table 4.6).

In the analysis for visitor-created trail thresholds, there was linearity as assessed by partial regression plots and a plot of studentized residuals against the predicted values. A Durbin-Watson statistic of 1.803 indicated independence of residuals. Homoscedasticity was assessed by visual inspection of a plot of studentized residuals against unstandardized predicted values. Scores for place dependence, place identity, and place attachment were highly correlated, so only the total place attachment score was

used in the regression. Tolerance values greater than 0.1 indicated no multicollinearity. Four outliers with studentized residuals greater than ± 3 standard deviations or leverage values greater than 0.5 were removed from the analysis. There were no values for Cook's distance above 1. The assumption of normality was met, as assessed by Q-Q Plot. The multiple regression model statistically significantly predicted visitor-created trail threshold, $F(16, 196) = 1.815, p = .031$. R^2 for the overall model was 12.9% with an adjusted R^2 of 5.8%. Ecological concern was the only variable that added statistically significantly to the prediction, $p < .05$ (Table 4.7).

The analysis for informal visitor site thresholds returned a Durbin-Watson statistic of 1.802. Thirteen outliers with studentized residuals greater than ± 3 standard deviations or leverage values greater than 0.5 were removed from the analysis. All other necessary assumptions were met. The multiple regression model did not statistically significantly predict the informal visitor site threshold, $F(15, 100) = .980, p = .482$. R^2 for the overall model was 12.8% with an adjusted R^2 of 0. None of the variables added statistically significantly to the prediction, $p < .05$ (Table 4.8).

The trail condition threshold analysis returned a Durbin-Watson statistic of 1.961, and three outliers were removed. All necessary assumptions were met. The multiple regression model did not statistically significantly predict trail condition threshold, $F(15, 129) = 1.189, p = .289$. R^2 for the overall model was 12.1% with an adjusted R^2 of .019. Rate of participation in organized activities was the only variable that added statistically significantly to the prediction, $p < .05$ (Table 4.9). Regression coefficients and standard errors can be found in.

Discussion

Visitor characteristics

Visitors in this study tended to be fairly inexperienced with their primary destination parks, KEFJ and DENA. While the mean number of previous visits was 2.24, the median response was 1, with over 66% of respondents visiting the park for the first time. Previous studies (D'Antonio et al., 2012; White et al., 2008) included respondents with a broader range of experience with the primary park they were visiting. D'Antonio and colleagues (2012) found a mean of 37.7 visits to Rocky Mountain National Park, with a median of 3 and over half of respondents having visited the park three or more times. While specific values of respondents' reported number of years visiting the Molalla River Recreation Corridor and Table Rock Wilderness are not provided, White and colleagues (2008) did find prior experience to be an important independent variable in their research examining perceptions of recreation resource impacts. The results of this study may be due to the high investments in cost and travel time for most visitors to reach KEFJ and DENA. Alaska residents made up 14.1% of the respondents in this study, as indicated by the ZIP codes provided in survey responses. Respondents also had not generally visited any other national parks in Alaska, and nearly 75% of visitors did not participate in any organized activities offered at the park (including Junior Ranger activities, Ranger-led programs, or special tours). This may contribute to the natural history and management knowledge scores averaging below "Some knowledge" for all variables. However, visitors' self-reported knowledge of relevant natural history and management topics is comparable to results of research conducted in Rocky Mountain National Park (D'Antonio et al., 2012).

Visitors to DENA and KEFJ were fairly knowledgeable of minimum-impact practices recommended by the NPS: nearly 50% of respondents answered all minimum-impact questions correctly or only made one error. Minimum-impact messages are communicated widely in both parks using a variety of methods and media to reach visitors. While this research did not ask visitors to reflect on how they knew the information, future research could examine the effectiveness of various sources (e.g., park newspaper, park website, personal delivery by ranger, visitor center exhibits, wayside exhibits and trailhead signs, etc.) for delivering minimum-impact information to visitors.

Overall, respondents appeared to exhibit moderate levels of ecological concern and place attachment. Previous research has posited that high levels of environmental concern (Floyd et al., 1997) and strong place attachment (Kyle et al., 2004; White et al., 2008) might cause recreationists and park visitors to be less tolerant or accepting of impacts to recreation resources. This will be addressed further in the context of this research in the discussion of relationships between visitor characteristics and evaluations of resource conditions.

Visitor norms

Respondents were asked to evaluate the acceptability of a range of impact conditions for four recreation resource indicators. Previous research has characterized norms based on structural characteristics, and generally categorizes them as either single-tolerance, no-tolerance, or multiple-tolerance norms (Kim & Shelby, 1998; Martinson & Shelby, 1992; Whittaker & Shelby, 1988; Williams, Roggenbuck, & Bange, 1991). However, this study identified six different norm types based on their structure.

Threshold (T) norms, like single-tolerance norms, identify a clear threshold or minimum

acceptable condition for the target indicator variable. *Reverse (RN) norms*, like single-tolerance norms, also identify a clear threshold; however the shape of a RN-type norm is the inverse of a T-type norm, with higher levels of impact rated as being more acceptable. *Unacceptable (UA) norms* might be most similar to no-tolerance norms however, unlike no-tolerance norms, where there is generally one low-impact condition considered to be acceptable, with UA-type norms no condition received an acceptable rating. The inverse condition is the *acceptable (A) norm* type, in which all conditions received positive ratings. While it is possible a different norm structure with a clear threshold might emerge by asking respondents to consider a greater number of impact conditions for the target variable, the A-norm type is different from single-, no-, and multiple-tolerance norms as the curve never crosses the x -axis. As with previous studies, this research identified *multiple-tolerance (MT) norms*, in which the curve intersected the x -axis two or more times. In this study, MT-type norms were generally characterized by a zig-zag, U-shaped, or upside-down U-shaped curve. Finally, several respondents rated all impact conditions as neutral, or neither acceptable nor unacceptable. These flat *neutral (N) norms* were most common with respondent ratings of the primitive campsite condition in this study (Table 4.5). It is possible that for some impacts that are less clearly the result of recreation use, visitors may be less willing to evaluate a condition as acceptable or unacceptable. In the case of the primitive campsites, conditions in coastal and tundra ecosystems that are subject to storms, shifting rivers, glacial influences, and other physical forces of nature tend to exhibit a “patchy” pattern of vegetation and exposed soil or rock. In the case of this study, it is possible respondents were unsure whether they were evaluating a natural patchy landscape or an area that had been

impacted by recreation use. Future studies should weigh the issue of whether to explicitly tell respondents that they are evaluating campsites and not just “conditions that could be found at a park or protected area.”

The different norm types also pose some interesting questions for researchers and managers attempting to use study data and visitor norms to inform recreation planning and capacity decisions. This is addressed below in the discussion of implications for research and management.

Relationships between characteristics and thresholds

Previous work has compared mean acceptability ratings for conditions (Anderson & Loomis, 2012; Martin et al., 1989; Needham & Rollins, 2005; Shelby & Shindler, 1992) and attitudes (Monz, 2009) between different user/interest groups. Some studies have used factor analysis of “acceptability items” (Floyd et al., 1997) or developed scales (D’Antonio et al., 2012; Kyle et al., 2004; White et al., 2008) related to use impacts of recreation resources. Floyd and colleagues (1997) used ANOVA to examine differences in the acceptability of impact items, measured by a 5-factor scale, between park visitors based on their NEP score. The more recent examples have used structural equation modeling (SEM) to examine relationships between selected visitor characteristics and “use impact” (Kyle et al., 2004), “environmental impacts” (White et al., 2008), “noticing impacts,” and “being affected by impacts” (D’Antonio et al., 2012). These studies are important for advancing our understanding of differences in the way users evaluate the acceptability of impacts; impact constructs that can be useful in conceptualizing the ways users perceive impacts, building research designs and statistical models; and the

relationship between visitor characteristics and perceptions of recreation resource impacts. However, no research has explicitly examined the relationship between visitor characteristics and their thresholds for resource condition impacts. In other words, the relationship between visitor characteristics and the limit of acceptable change in conditions as indicated by normative data has not been addressed.

Multiple regression analysis was used to examine the relationships between respondent characteristics and their thresholds for resource conditions. Although a reasonable sample size was achieved ($n = 290$), not all respondents indicated a threshold for each of the indicator variables included in the study. As such, analyses could only be completed for three indicators in which a sufficient number of respondents reported a threshold.

Results of the analyses produced one statistically significant model that accounted for 5.8% of the variability in respondent thresholds for visitor-created trails. Ecological concern was the only statistically significant variable in this model. The analyses for informal visitor site and trail condition thresholds did not yield significant models, however the trail condition model did produce a very small R^2 of .019 (1.9% variability explained). Rate of participation in organized activities at the national park being visited was significant in the trail condition threshold model. In a small way, these results support previous findings by Floyd and colleagues (1997) regarding level of environmental concern and impact acceptability, and those of White and colleagues (2008) regarding the influence of experience at a place and the acceptability of impacts.

Contrary to other studies, place attachment (Kyle et al., 2004) and knowledge (D'Antonio et al., 2012) did not emerge as significant variables in this research. This may

be a result of the large proportion of respondents who were first-time visitors to the respective parks at which they were contacted in this study. Further investigations into the relationships between visitor characteristics and condition thresholds may lead to a more reliable model being developed in the future. This is discussed in more detail below.

Implications for research and management

While this study did not reveal strong relationships between visitor characteristics and condition thresholds, it did take the first step in exploring that interesting and important question. Visitors to national parks are diverse, and the experiences, assumptions, expectations, and knowledge they carry with them likely influence their evaluations of recreation resource conditions and resulting standards. Future research should be explicit in measuring respondents' acceptability evaluations of resource impacts and should strive to obtain sample sizes that are large enough to allow for appropriate statistical analyses of the relationships between measured visitor characteristics and reported condition standards.

Multiple regression analysis requires a continuous dependent variable. Thus in this study, it could only be applied to examining the numerical threshold identified by respondents with T-type norm curves. This study identified a new typology of norm curves based on an examination of structural characteristics. Alternative analysis methods like discriminant analysis might be useful in examining visitor characteristics as they relate to norm types. This would be worth investigating as many respondents indicated different types of norms for different indicators. Discriminant analysis is appealing because it can be used to determine how one or more independent variables can be used

to discriminate between different categories or classify a case to a nominal (polychotomous) variable. A study of this nature would require a large enough sample size to produce sufficient numbers of each norm type in order for discriminant analysis to be conducted.

In addition to the need for further investigation into the relationships between visitor characteristics and norm types, results from other studies should be examined to see whether the six structural norm types observed here can be identified in other study areas and with other target indicators. The six-norm typology provides more information about the specific characteristics of visitor norms for recreation resource conditions. As illustrated by Table 4.5 and Figures 4.5-4.8, examining aggregate (mean) acceptability ratings may obscure patterns in the data that could be meaningful to informing park management. For example, in the case of visitor-created trails, the threshold identified by examining the aggregate ratings was 3.6 trail segments. However, we can also see that over 78% of respondents indicated a T-type norm for this indicator. The threshold identified by examining only the T-type norms is substantially lower than that identified by the aggregate at 2.97 trail segments (Table 4.6). This tells managers, then, that the majority of their visitors do have thresholds for visitor-created trails, and that any more than 3 trail segments in an area would be considered unacceptable. In a similar manner, we see that primitive campsites had the fewest T-type norms and the greatest number of N-type and A-type norms (Table 4.5). This could indicate that visitors are not as concerned with the amount of ground cover vegetation present at primitive campsites: they are either neutral or find all conditions to be acceptable. Information like this can be very useful to managers collecting normative data related to park conditions as part of a

planning process and help them make more informed decisions regarding capacities and thresholds for resource conditions.

Future research should consider the profiles of visitors at parks where data collection will occur. The findings of this study were likely influenced by the low levels of prior experience, low-to-moderate levels of knowledge regarding natural history and management topics, and fairly “neutral” levels of place attachment that characterize the sample of visitors in this study. Parks and recreation areas that attract a more balanced mix of new visitors and frequent users would be optimal places to pursue studies of visitor characteristics and condition thresholds as a “broader” sample could be measured.

Conclusions

An understanding of visitors to national parks and their evaluations of park conditions is imperative to informed park and recreation management. This study used established scales to measure characteristics of visitors to two national parks in Alaska and asked participants to evaluate the acceptability of several recreation resource conditions that could be observed in parks in the region. Six types of norms were identified based on the structural characteristics of respondents’ norm curves for condition acceptability ratings. This typology of norms can provide managers with important insights into visitor evaluations of the acceptability of resource conditions that might otherwise be obscured by examining only aggregate (mean) results. A multiple regression model examining the relationship between visitor characteristics and condition thresholds explained 5.8% of the variability in visitor-created trail thresholds. Ecological concern and respondents’ rate of participation in organized park activities emerged as

significant variables in regression models for visitor-created trails and trail condition thresholds.

This study provides support for the use of normative methods to assess park visitors' tolerance of recreation resource conditions. The expanded norm typology can provide important insight into visitors' evaluations of the acceptability of impacts that will provide managers with valuable information to enhance park planning and decision-making. Future research should look beyond comparing norms between groups of visitors to examine the relationships between visitor characteristics, the structural characteristics of visitor norms, and thresholds for acceptable conditions in national parks.

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Table 4.1. Summary of respondents' prior experience with Alaska national parks.

Prior Experience	Frequency (%)	Mean	SE
<i>Total number of visits to primary park</i>		2.24	0.228
1st visit	66.2		
2nd visit	20.9		
3-10 visits	9.3		
>10 visits	4.1		
<i>Total number of other Alaska national parks visited</i>		0.64	0.045
0 other parks	50.7		
1 other park	37.9		
2 other parks	8.6		
3-5 other parks	2.8		
>5 other parks	0		
<i>Rate of participation in organized activities at primary park</i>		0.061	0.007
0% of activities offered	74.1		
13% of activities offered	4.5		
20% of activities offered	10.3		
25% of activities offered	6.2		
38% of activities offered	3.1		
40% of activities offered	1.7		

$n = 290$

Table 4.2. Summary of self-rated knowledge of local ecological topics and management issues.

	Frequencies (%)			Mean	SE
	No Knowledge	Some Knowledge	Proficient Knowledge/Well Informed		
<i>Knowledge of natural history</i>				0.594	0.007
Birds	35.4	61.1	3.5	1.68	0.032
Terrestrial wildlife	21.8	66.1	12.1	1.90	0.034
Plants	33.1	62.4	4.5	1.71	0.032
Water	23.7	68.3	8.0	1.84	0.032
Glaciers	13.4	75.5	11.0	1.98	0.029
Geology	30.3	64.1	5.5	1.75	0.032
Ecology	24.0	68.4	7.6	1.84	0.032
Marine wildlife (KEFJ)	28.1	63.4	8.5	1.80	0.038
Aquatic wildlife (DENA)	45.3	54.7	0	1.55	0.063
Succession (KEFJ)	45.0	48.2	6.8	1.62	0.041
<i>Knowledge of management issues</i>				0.542	0.010
Air quality	50.3	43.1	6.6	1.56	0.036
Climate change	24.8	54.5	20.7	1.96	0.040
Nonnative species	63.4	32.4	4.2	1.41	0.034
Water quality (KEFJ)	49.8	40.9	9.3	1.60	0.044
Soundscapes (DENA)	46.2	47.7	6.2	1.60	0.075

$n = 290$ (KEFJ $n = 225$; DENA $n = 65$). Scale from 1 (*no knowledge*) to 3 (*proficient knowledge/well informed*)

Table 4.3. Summary of visitor responses to environmental and place attachment items.

Statement	Frequency (%)					Mean	SE
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree		
<i>Environmental Orientation</i>							
The balance of nature is very delicate and easily upset	1.0	1.7	8.3	41.7	47.2	4.32	0.046
When humans interfere with nature it often produces disastrous consequences	0.7	6.6	16.7	37.6	38.3	4.06	0.055
Humans have the right to modify the natural environment to suit their needs ¹	31.4	32.1	21.3	12.2	3.1	3.76	0.066
Humans are severely abusing the environment	4.2	15.4	23.2	29.8	27.4	3.61	0.069
Humans were meant to rule over the rest of nature ¹	50.2	22.3	16.4	8.7	2.4	4.09	0.065
The so-called ecological crisis facing humankind has been greatly exaggerated ¹	37.3	28.2	19.5	10.5	4.5	3.83	0.069
Plants and animals exist primarily to be used by humans ¹	41.4	32.3	16.8	8.8	0.7	4.05	0.059
If things continue on their present course, we will soon experience a major ecological catastrophe	5.6	15.7	27.5	30.7	20.6	3.45	0.068
<i>Environmental Orientation Score</i>						3.896	0.041
<i>Place Dependence</i>							
This place makes me feel like no other place can	0.7	19.2	40.2	28.3	11.5	3.31	0.055
The time I spent here could just have easily been spent somewhere else ¹	22.6	42.9	25.4	7.7	1.4	3.78	0.055
No other place can compare to this area	5.6	24.0	33.1	25.1	12.2	3.14	0.064
I get more satisfaction out of visiting this place than from any other	3.5	30.4	47.6	14.3	4.2	2.85	0.051
I can't imagine a better place for what I like to do	2.8	28.2	46.7	16.4	5.9	2.94	0.053
<i>Place Dependence Score</i>						3.201	0.041
<i>Place Identity</i>							
This place means a lot to me	0.0	0.7	16.0	49.0	34.4	4.17	0.042
I would prefer to spend more time here if I could	0.0	2.4	14.3	48.3	35.0	4.16	0.045
I am very attached to this place	1.7	19.2	46.2	22.7	10.1	3.20	0.055
I feel like this place is a part of me	4.5	22.3	50.2	16.4	6.6	2.98	0.054
I identify strongly with this place	2.1	14.0	45.5	29.7	8.7	3.29	0.053
This place is very special to me	1.0	7.3	36.7	40.2	14.7	3.60	0.051
<i>Place Identity Score</i>						3.574	0.0394
<i>Place Attachment Score</i>						3.409	0.0375

n = 290 (KEFJ *n* = 225; DENA *n* = 65). Scale from 1 (*strongly disagree*) to 5 (*strongly agree*)

¹Variable was reverse-coded for the calculation of mean and overall scores for each dimension

Table 4.4. Summary of visitor evaluations of potential recreation resource conditions.

Variable	Mean Acceptability	N	SE
<i>Visitor-created trails</i>			
0 segments	3.27	288	0.081
2 segments	1.06	288	0.140
6 segments	-1.54	287	0.138
10 segments	-1.99	288	0.134
12 segments	-2.43	288	0.134
<i>Informal visitor sites</i>			
10% vegetation cover loss	1.61	289	0.122
25% vegetation cover loss	0.58	288	0.136
50% vegetation cover loss	-2.01	288	0.132
75% vegetation cover loss	-2.46	288	0.135
90% vegetation cover loss	-1.15	289	0.134
<i>Trail condition</i>			
Level 1	2.09	288	0.112
Level 2	-0.05	287	0.131
Level 3	-3.13	288	0.105
Level 4	-1.12	288	0.131
Level 5	-2.65	288	0.110
<i>Primitive campsite condition</i>			
13m ² , 88% vegetation cover	1.50	282	0.119
13m ² , 55% vegetation cover	0.88	282	0.119
13m ² , 12% vegetation cover	0.77	282	0.120
36m ² , 88% vegetation cover	1.13	281	0.114
36m ² , 55% vegetation cover	0.58	281	0.126
36m ² , 12% vegetation cover	-0.06	281	0.139
100m ² , 88% vegetation cover	0.52	281	0.119
100m ² , 55% vegetation cover	-0.35	281	0.130
100m ² , 12% vegetation cover	-0.68	281	0.137

Table 4.5. Summary of visitor norm types for four potential resource condition indicators (T = threshold norm; RN = reverse norm; N = neutral norm; A = acceptable norm; UA = unacceptable norm; MT = multiple-tolerance norm).

Variable	Norm Type																	
	T			RN			N			A			UA			MT		
	Mean	N	SE	Mean	N	SE	Mean	N	SE	Mean	N	SE	Mean	N	SE	Mean	N	SE
<i>Visitor-created trails</i>																		
0 segments	3.51	227	0.054	-3.00	1	0.00	0	1	0.000	3.41	34	0.141	-3.00	4	0.408	2.14	21	0.545
2 segments	0.74	227	0.159	3.00	1	0.00	0	1	0.000	3.21	34	0.118	-2.75	4	0.629	1.71	21	0.379
6 segments	-2.30	227	0.115	4.00	1	0.00	0	1	0.000	2.73	33	0.159	-3.00	4	0.000	-0.14	21	0.326
10 segments	-2.79	227	0.093	4.00	1	0.00	0	1	0.000	2.59	34	0.153	-3.25	4	0.479	-0.90	21	0.425
12 segments	-3.33	227	0.065	4.00	1	0.00	0	1	0.000	2.62	34	0.140	-3.00	4	0.408	-1.24	21	0.525
<i>Informal visitor sites</i>																		
10% cover loss	2.36	129	0.103	-1.67	3	0.667	0	2	0.000	3.00	25	0.141	-2.14	44	0.168	2.14	86	0.161
25% cover loss	0.57	129	0.165	-2.00	3	0.577	0	2	0.000	3.08	24	0.146	-2.66	44	0.162	1.65	86	0.197
50% cover loss	-2.67	129	0.132	-1.00	3	1.155	0	2	0.000	2.63	24	0.224	-3.43	44	0.123	-1.67	86	0.237
75% cover loss	-3.52	128	0.078	0.67	3	1.856	0	2	0.000	2.72	25	0.187	-3.77	44	0.072	-1.88	86	0.235
90% cover loss	-2.43	129	0.091	1.67	3	0.667	0	2	0.000	2.80	25	0.163	-3.32	44	0.096	0.59	86	0.174
<i>Trail condition</i>																		
Level 1	2.62	156	0.101	-	0	-	0.00	1	-	3.10	20	0.204	-1.74	31	0.167	2.33	80	0.191
Level 2	-0.38	156	0.158	-	0	-	0.00	1	-	2.95	20	0.198	-2.48	31	0.185	0.82	79	0.223
Level 3	-3.82	156	0.037	-	0	-	0.00	1	-	2.15	20	0.284	-3.55	31	0.153	-2.99	80	0.171
Level 4	-2.35	156	0.100	-	0	-	0.00	1	-	2.75	20	0.239	-2.74	31	0.173	0.93	80	0.169
Level 5	-3.42	156	0.060	-	0	-	0.00	1	-	2.55	20	0.211	-3.48	31	0.130	-2.18	80	0.179

Table 4.5. (continued).

Variable	Norm Type																	
	T			RN			N			A			UA			MT		
	Mean	N	SE	Mean	N	SE	Mean	N	SE	Mean	N	SE	Mean	N	SE	Mean	N	SE
<i>Primitive campsite condition</i>																		
13m ² , 88% veg.	-0.77	13	0.257	1.44	41	0.178	0	10	0.000	2.76	146	0.081	-1.92	39	0.178	1.36	33	0.285
13m ² , 55% veg.	1.46	13	0.332	-0.46	41	0.252	0	10	0.000	2.32	146	0.085	-2.15	39	0.186	-0.15	33	0.138
13m ² , 12% veg.	1.31	13	0.175	-1.05	41	0.212	0	10	0.000	2.29	146	0.080	-2.33	39	0.157	-0.03	33	0.119
36m ² , 88% veg.	-1.10	10	0.936	1.59	86	0.113	0	12	0.000	2.50	105	0.091	-1.84	45	0.149	0.52	23	0.258
36m ² , 55% veg.	0.00	10	0.856	0.16	86	0.208	0	12	0.000	2.32	105	0.101	-2.20	45	0.158	0.13	23	0.145
36m ² , 12% veg.	1.20	10	0.593	-1.71	86	0.130	0	12	0.000	2.38	105	0.097	-2.58	45	0.151	-0.70	23	0.270
100m ² , 88% veg.	-1.14	14	0.329	1.31	83	0.107	0	10	0.000	2.52	66	0.124	-2.03	72	0.114	0.92	36	0.216
100m ² , 55% veg.	-0.50	14	0.562	-0.64	83	0.197	0	10	0.000	2.27	66	0.149	-2.42	72	0.131	-0.42	36	0.216
100m ² , 12% veg.	1.43	14	0.343	-1.90	83	0.129	0	10	0.000	2.36	66	0.120	-2.89	72	0.121	-0.03	36	0.180

Table 4.6. Summary of thresholds for resource indicators based on aggregated response, threshold (T), and reverse (RN) norm curves.

Variable	Threshold					
	Aggregated Responses		T Norms		RN Norms	
	Mean	N	Mean	N	Mean	N
Number of visitor-created trail segments	3.6	288	2.97	227	1.0	1
Percent veg. cover loss on informal visitor sites	30.6	289	29.4	129	65.0	3
Level of trail impact	1.98	288	1.87	156	NA	0
Percent veg. cover on small primitive campsites	NA	282	76.6	13	63.0	41
Percent veg. cover on medium primitive campsites	16	281	55.0	10	51.3	86
Percent veg. cover on large primitive campsites	68.3	281	43.9	14	65.8	83

Table 4.7. Summary for multiple regression analysis for visitor-created trail indicator threshold ($n = 213$).

Variable	B	SE_B	β	p -value
Intercept	10.759	2.051		.000
Number of previous visits	-0.025	0.045	-0.042	.569
Rate of participation in organized activities	-0.619	1.538	-0.029	.688
Number of other Alaska national parks visited	-0.160	0.225	-0.051	.477
Knowledge of natural history topics	-2.264	1.752	-0.110	.198
Knowledge of management issues	1.779	1.232	0.123	.150
Knowledge of minimum impact practices	-1.740	1.031	-0.118	.093
Ecological concern	-0.895	0.284	-0.235	.002*
Place attachment	-0.392	0.277	-0.102	.158
Gender (female)	0.247	0.354	0.049	.485
Age	-0.007	0.012	-0.040	.573
US residency	-0.517	0.527	-0.071	.328
High school graduate or GED education level	0.785	0.921	0.060	.395
Vocational or trade certificate	0.527	1.486	0.025	.723
Some college	1.226	0.628	0.149	.052
Associates or two-year degree	1.020	0.839	0.086	.226
Graduate degree	-0.044	0.406	-0.009	.914

B = unstandardized regression coefficient; SE_B = Standard error of the coefficient; β = standardized coefficient; * $p < .05$

Table 4.8. Summary for multiple regression analysis for informal visitor site indicator threshold ($n = 116$).

Variable	B	SE_B	β	p -value
Intercept	27.192	13.602		.048
Number of previous visits	-1.078	0.586	-0.200	.069
Rate of participation in organized activities	-5.452	9.860	-0.054	.582
Number of other Alaska national parks visited	1.535	1.785	0.093	.392
Knowledge of natural history topics	-4.682	10.908	-0.051	.669
Knowledge of management issues	6.056	7.962	0.093	.449
Knowledge of minimum impact practices	2.615	7.154	0.036	.715
Ecological concern	0.906	1.804	0.053	.617
Place attachment	2.615	1.754	-0.023	.822
Gender (female)	-1.962	2.351	-0.084	.406
Age	-0.074	0.083	-0.092	.375
US residency	5.011	3.990	0.127	.212
High school graduate or GED education level	-2.552	5.842	-0.045	.663
Some college	7.585	4.032	0.206	.063
Associates or two-year degree	-3.670	4.768	-0.080	.443
Graduate degree	-2.425	2.694	-0.104	.370

B = unstandardized regression coefficient; SE_B = Standard error of the coefficient; β = standardized coefficient; * $p < .05$

Table 4.9. Summary for multiple regression analysis for trail condition indicator threshold ($n = 145$).

Variable	B	SE_B	β	p -value
Intercept	2.398	0.441		.000
Number of previous visits	0.011	0.011	0.094	.296
Rate of participation in organized activities	0.689	0.313	0.191	.029*
Number of other Alaska national parks visited	0.043	0.055	0.069	.433
Knowledge of natural history topics	-0.594	0.394	-0.154	.134
Knowledge of management issues	0.148	0.265	0.058	.576
Knowledge of minimum impact practices	-0.155	0.207	-0.065	.455
Ecological concern	-0.080	0.067	-0.109	.235
Place attachment	0.052	0.060	0.077	.390
Gender (female)	-0.108	0.080	-0.121	.178
Age	-0.003	0.003	-0.087	.352
US residency	0.035	0.114	0.027	.758
High school graduate or GED education level	-0.270	0.196	-0.121	.170
Some college	0.120	0.133	0.085	.370
Associates or two-year degree	0.090	0.176	0.046	.613
Graduate degree	0.045	0.088	0.050	.613

B = unstandardized regression coefficient; SE_B = Standard error of the coefficient; β = standardized coefficient; * $p < .05$

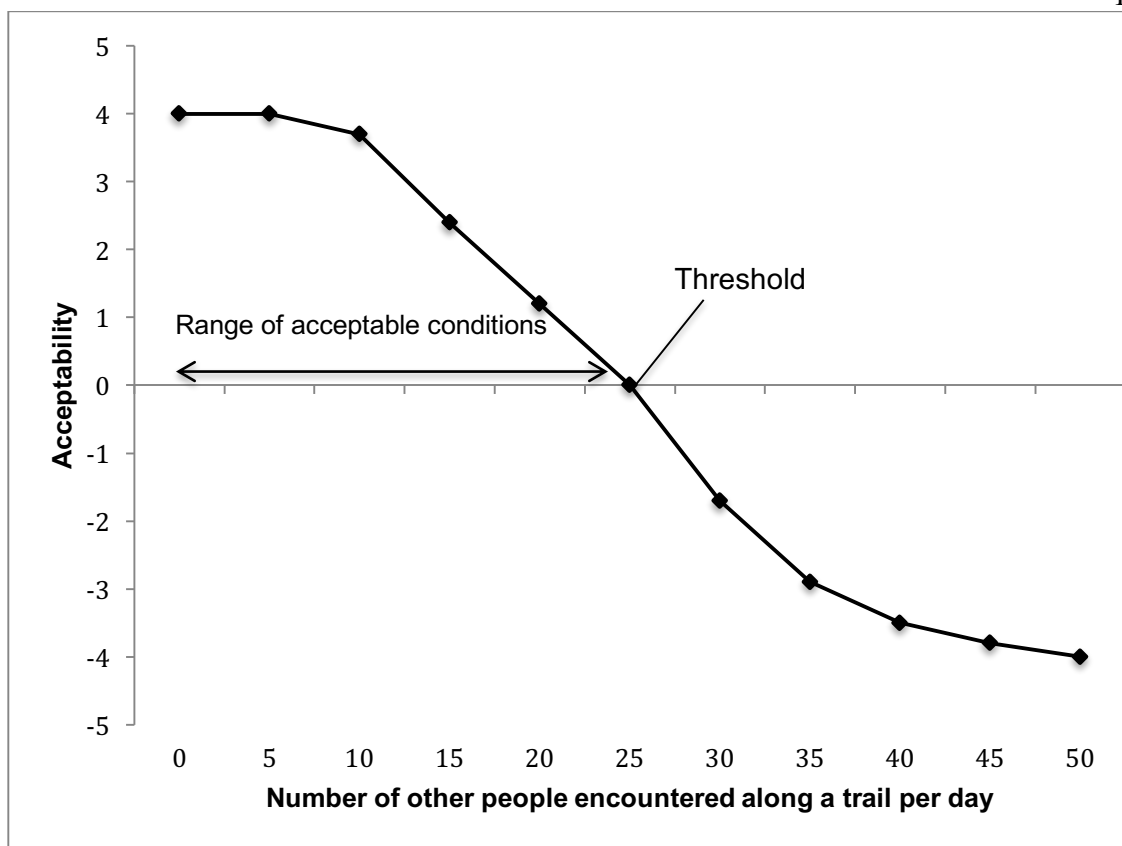


Figure 4.1. Hypothetical social norm curve for hiking trail encounters per day. Adapted from *Parks and Carrying Capacity*, by Robert E. Manning. Copyright © 2007 by the author (Fig. 5.1, p. 43). Reproduced by permission of Island Press, Washington D.C.

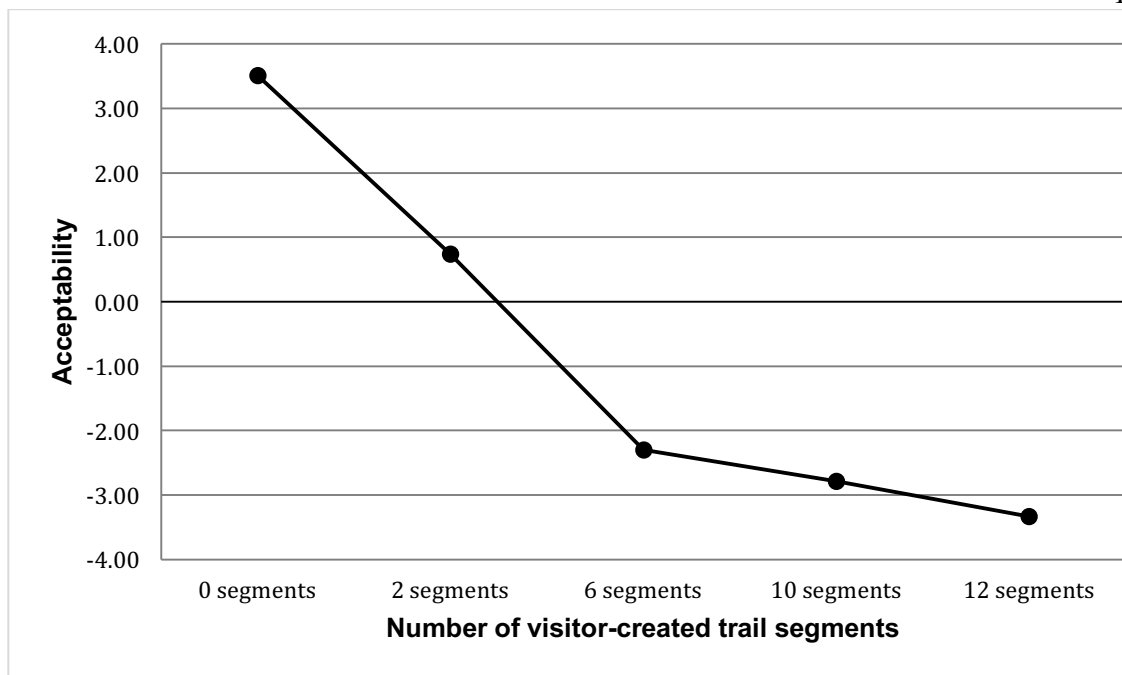


Figure 4.2. Norm curve for visitor-created trails.

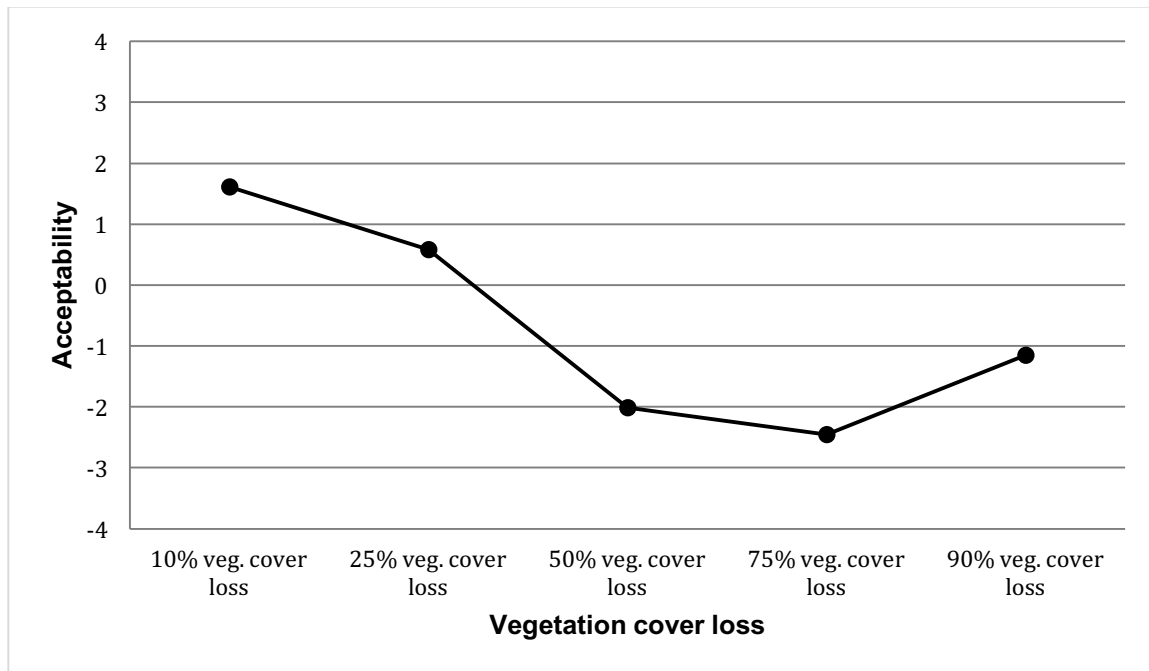


Figure 4.3. Norm curve for informal visitor site conditions.

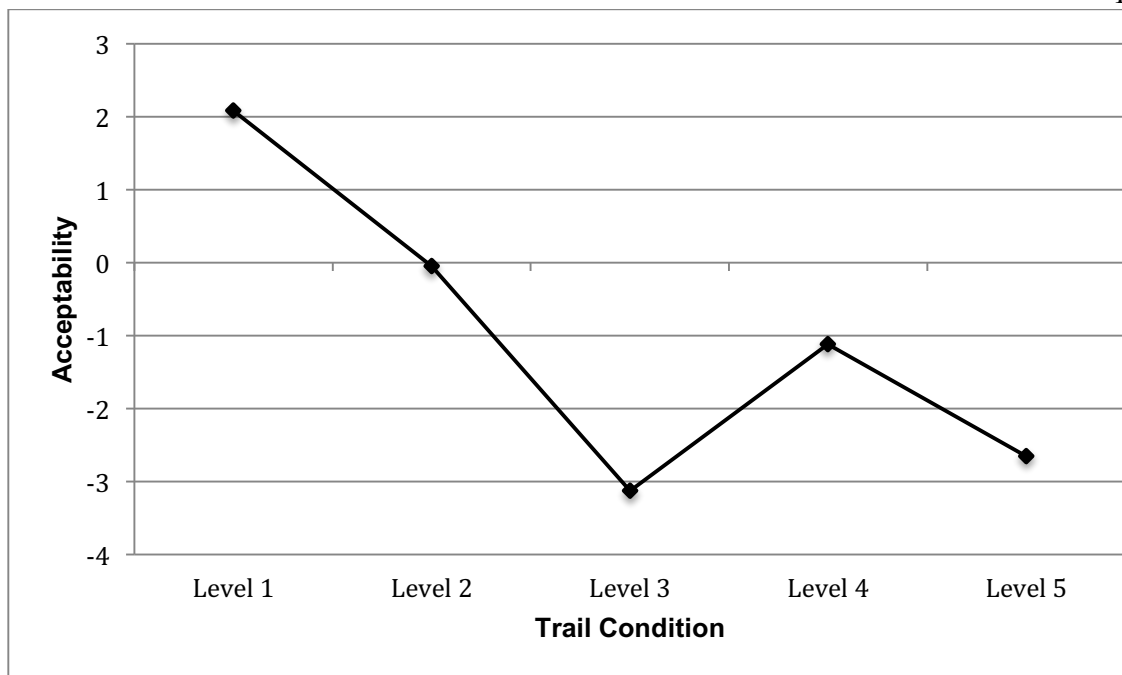


Figure 4.4. Norm curve for trail condition.

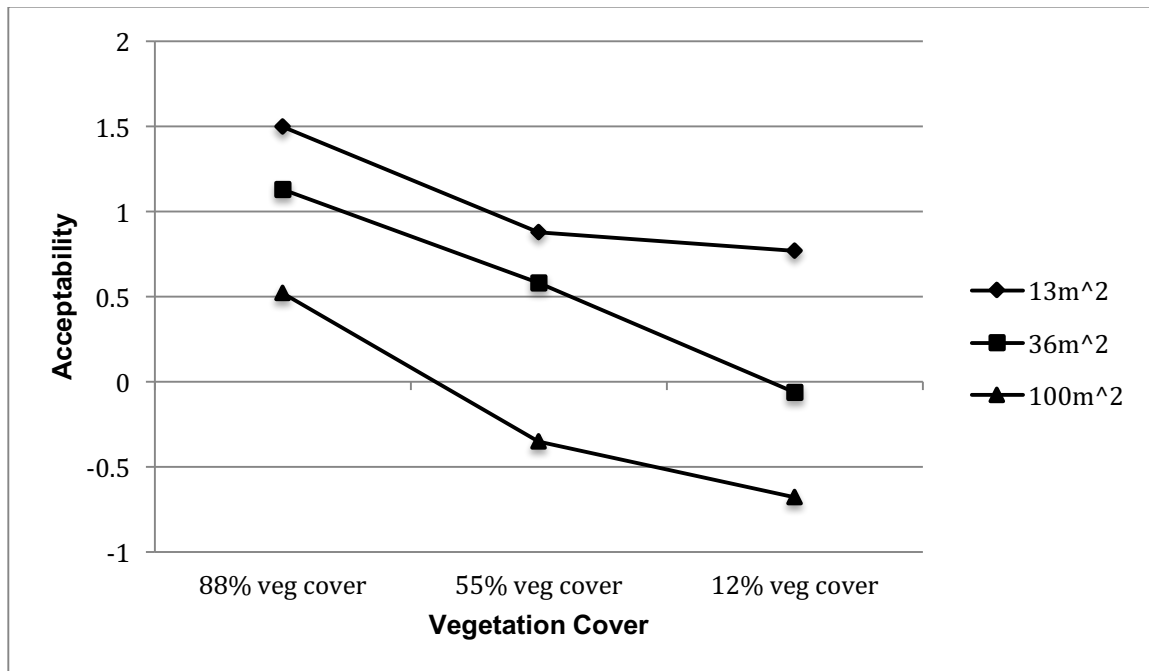


Figure 4.5. Norm curves for primitive campsite conditions.

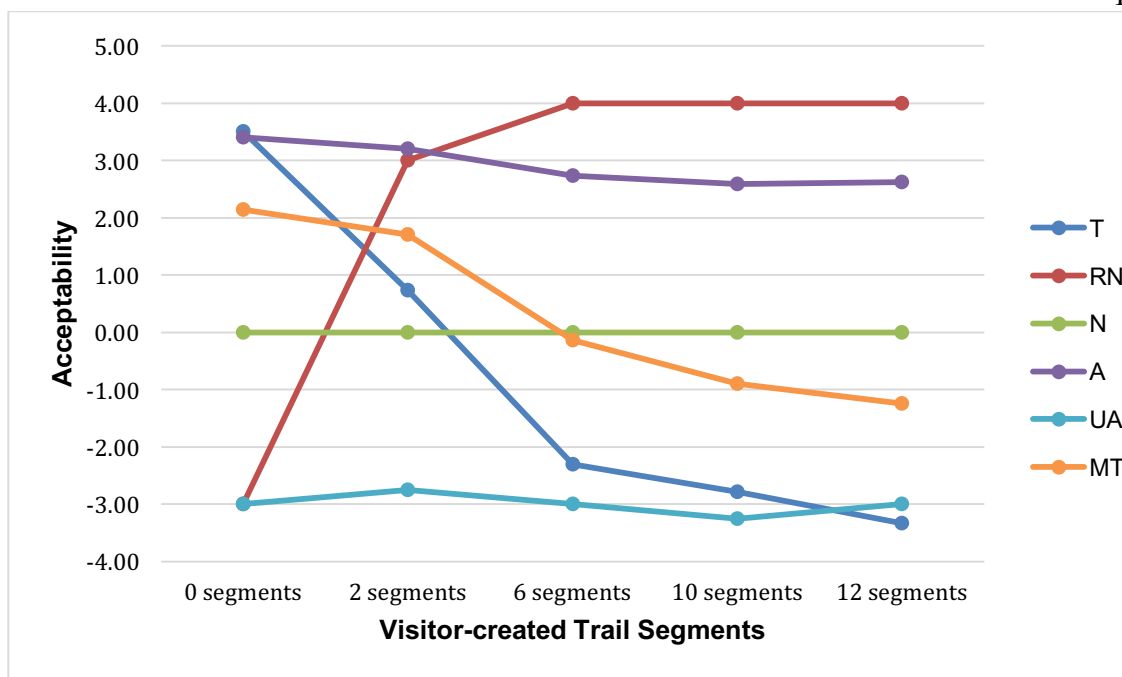


Figure 4.6. Norm types for the acceptability of visitor-created trail impacts (T = threshold norm; RN = reverse norm; N = neutral norm; A = acceptable norm; UA = unacceptable norm; MT = multiple-tolerance norm).

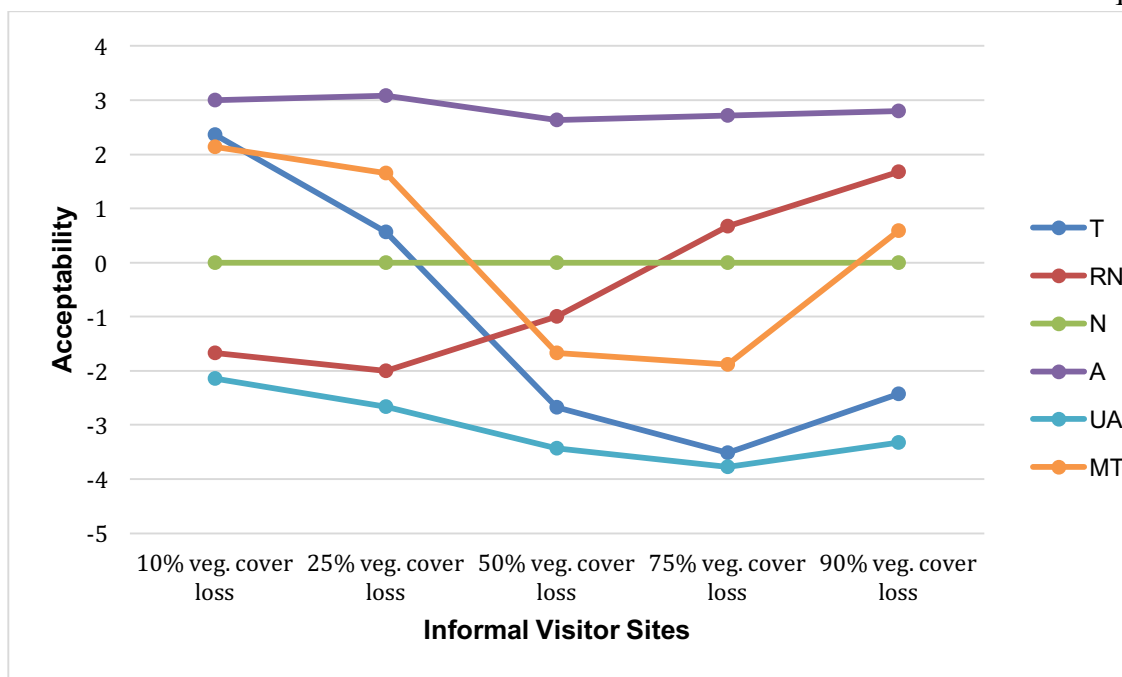


Figure 4.7. Norm curve types for the acceptability of vegetation cover loss at informal visitor sites (T = threshold norm; RN = reverse norm; N = neutral norm; A = acceptable norm; UA = unacceptable norm; MT = multiple-tolerance norm).

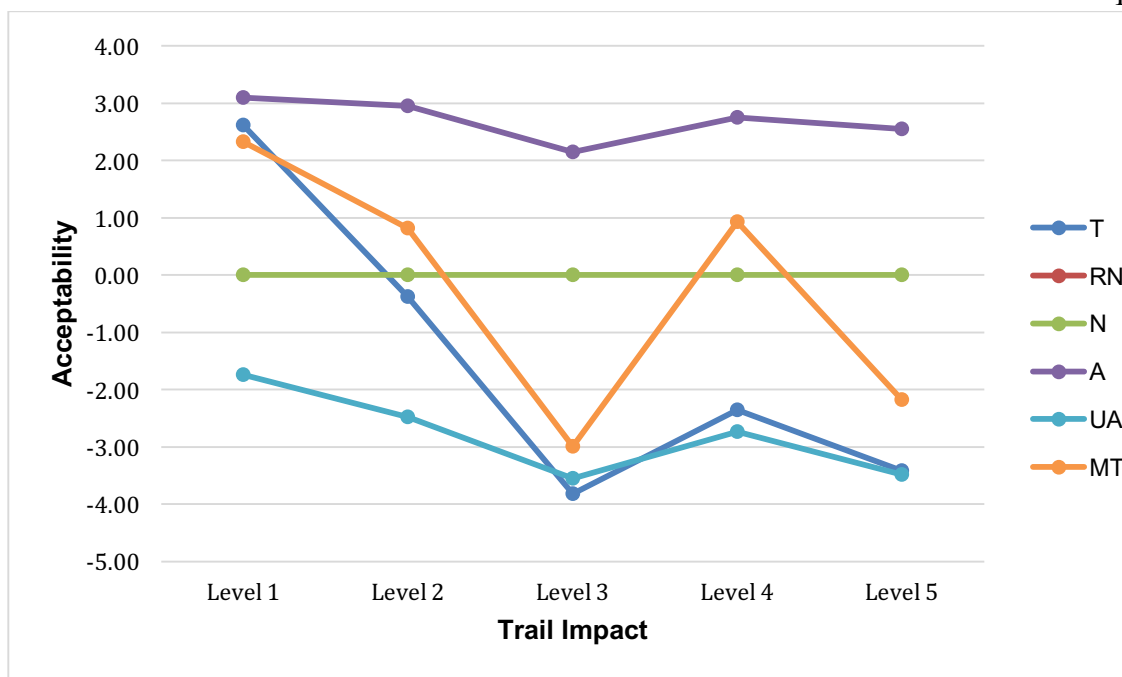


Figure 4.8. Norm curve types for the acceptability of trail impact (T = threshold norm; RN = reverse norm; N = neutral norm; A = acceptable norm; UA = unacceptable norm; MT = multiple-tolerance norm).

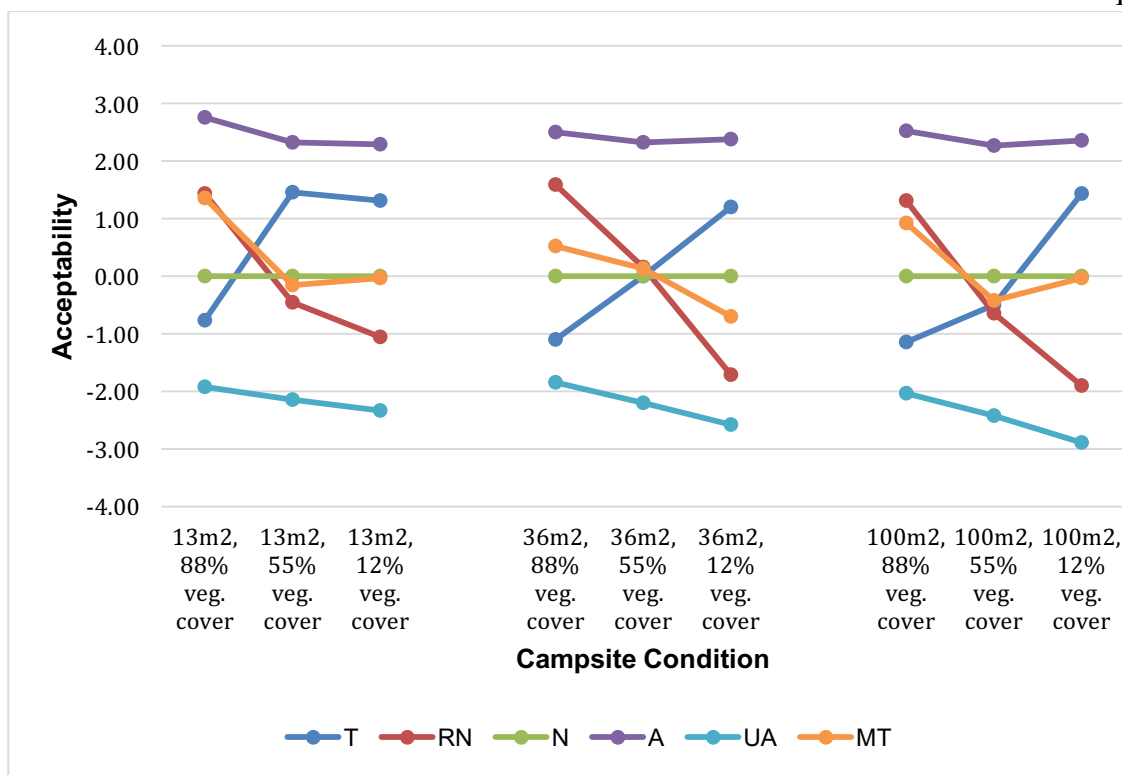


Figure 4.9. Norm types for the acceptability of primitive campsite conditions (T = threshold norm; RN = reverse norm; N = neutral norm; A = acceptable norm; UA = unacceptable norm; MT = multiple-tolerance norm).

CHAPTER 5

CONCLUSIONS

The main objective of this dissertation is to increase the utility of data collected in the field to managers through enhanced understanding. This objective unifies the studies contained in this dissertation and is informed by the following principles:

Principle 1: Outdoor recreation should be considered within a three-component framework – social/experiential, resource/biophysical, and managerial.

Principle 2: Outdoor recreation management should be guided by management objectives and associated indicators and thresholds.

Principle 3: Outdoor recreation management is a form of adaptive management.

Principle 4: Outdoor recreation management decisions are based on science as well as judgment.

The study in Chapter 2 combined social science techniques to measure visitor evaluations of the acceptability of selected experiential and resource conditions with measures of campsite impacts in Kenai Fjords National Park, AK. Structural characteristics of visitor norms were examined identifying six structural types, and acceptability thresholds for indicators were calculated. Backcountry campsites were assessed using established protocols, and Factor analysis and cluster analysis was used to classify campsites into four groups based on measured impacts. The analysis of varying norm structures highlight the potential problems with considering only average or aggregate results of social science and resource assessments. The classification of campsites based on measured values of multiple indicators demonstrates the advantages of this approach over traditional scalar methods as it highlights specific impacts of

concern and may suggest appropriate management action. The results have implications for the application of normative methods in recreation social science, as well as the analysis of resource monitoring data. The integration of these approaches can also produce more useful results that can inform management decisions.

This study illustrates how adhering to the four principles guiding this dissertation can lead to better management outcomes for visitors and the land. The examination of social science data and resource monitoring data and their use for management decisions is directly related to Principle 1. Specific indicators are built into the campsite monitoring protocol; social science results suggested indicators for the visitor experience; and the phase 2 survey successfully identified thresholds for indicator variables, this supporting Principle 2. This study identified six norm types, deviating from the three previously reported in the literature. In addition, a novel analysis of campsite data yielded a classification system based on measured variables rather than an overall rating assigned by an observer in the field. These two methods have implications for the analysis and interpretation of social science study and resource assessment results, and should be taken into account in future studies. This is an example of adaptive management in outdoor recreation, supporting Principle 3, as well as the use of empirically-based information in management decisions, supporting Principle 4.

Chapter 3 examined the application of a multivariate statistical approach to analyzing multiple-indicator campsite data from three independent campsite studies representing unique environments. The analysis revealed interpretable structures within the data from all study locations, and was able to classify campsites based on the empirical measures collected in the field. This research demonstrates the ability to

identify meaningful patterns and associations of variables in campsite data from assessments conducted at sites representing a range of geographic locations, climates, and ecosystems. This approach provides more detailed information about specific impacts of concern than the traditional scalar condition class rating based on visual criteria or examining impact parameters in isolation, thus allowing managers of parks and protected areas to more effectively direct management actions to certain areas.

The study presented in Chapter 3 supports the four principles of outdoor recreation management that inform this dissertation's objective. Campsite assessments are important for all three components stated in Principle 1: they are important to the visitor experience, directly measure biophysical effects associated with recreational use, and are important resources deserving of management attention. Campsite assessments also incorporate specific indicators related to management objectives concerning the condition of recreation resources, thus supporting Principle 2. Assessment and monitoring are essential steps in the adaptive management process. Advances in data analysis methods that provide more detailed information to managers than previous approaches support the production of "best available information" required for adaptive management as stated in Principle 3. Finally, Principle 4 states that science and judgment are required for recreation management decisions. The research presented in Chapter 3 resulted in empirical classifications of campsites based on field measurements of multiple impact parameters. The subsequent campsite typologies provide more detailed information about the nature and severity of specific impacts of concern than traditional analysis methods, and can serve to inform the type of management action required to

address specific impacts. Better information, supported by scientific research, will ultimately enable recreation managers to make better decisions.

Chapter 4 examined the relationship between a variety of visitor characteristics and visitor thresholds for recreation resource conditions. Normative methods were used to measure visitor norms and calculate condition thresholds where appropriate. Six types of norms were identified based on the structural characteristics of respondents' norm curves for condition acceptability ratings. This typology of norms can provide managers with important insights into visitor evaluations of the acceptability of resource conditions that might otherwise be obscured by examining only aggregate (mean) results. A multiple regression model examining the relationship between visitor characteristics and condition thresholds explained 5.8% of the variability in visitor-created trail thresholds. Ecological concern and respondents' rate of participation in organized park activities emerged as significant variables in regression models for visitor-created trails and trail condition thresholds. This study provides support for the use of normative methods to assess park visitors' tolerance of recreation resource conditions. The expanded norm typology can provide important insight into visitors' evaluations of the acceptability of impacts that will provide managers with valuable information to enhance park planning and decision-making.

This final study also supports the four principles informing the objective of this dissertation. With regards to Principle 1, the study primarily focused on the social/experiential component. However, it does incorporate the biophysical component by measuring norms for recreation resource conditions. The study also incorporates the managerial component of outdoor recreation by relating the findings to park management

applications. Chapter 4 strongly supports Principle 2 as it attempts to further our understanding of thresholds that are interpolated from visitor norm curves. This directly relates to Principles 3 and 4 by adding to the body of knowledge about norms and providing managers with an enhanced understanding of the relationship between visitor characteristics and thresholds.

While the studies presented here enhance our understanding of several key issues related to managing outdoor recreation, there are opportunities to build on the knowledge gained. Additional work will need to be conducted in order to determine whether a more stable factor structure for campsite indicator variables exists, the extent to which campsite typologies based on natural groupings of empirical measures can be generalized, and the utility of reducing the number of variables included in field assessments of campsite impact. Finally, future research should look beyond comparing norms between groups of visitors to examine the relationships between visitor characteristics, the structural characteristics of visitor norms, and thresholds for acceptable conditions in national parks. By using the four principles discussed above, advances in knowledge of recreation ecology and recreation social science, among other areas, can be integrated into an adaptive management approach to outdoor recreation planning and management and help managers reach more informed decisions.

APPENDICES

APPENDIX A

KENAI FJORDS INDICATOR SURVEY

OMB CONTROL #: 1024-0224 (NPS 10-029)

EXPIRATION DATE: JUNE 30, 2011

KENAI FJORDS VISITOR SURVEY

NATIONAL PARK SERVICE



Location Survey Administered: _____

Commercial or Private Group: _____

Tour Company: _____

Date: _____

Time: _____

Attendant: _____

Weather: _____ Warm
_____ Cool
_____ Sunny
_____ Partly sunny
_____ Cloudy
_____ Foggy
_____ Rain

Dear Kenai Fjords National Park Visitor:

The National Park Service is conducting this survey to learn more about our visitors so that we can improve our service to you. You are one of a select number of people randomly chosen for this survey, so your opinions are important to us. The survey takes about 10 minutes to complete, and all of the information collected will be anonymous. Please read each question carefully.

1. How many people, including you, are in your personal group today? Your “personal group” is anyone you are visiting the park with, such as spouse, family, or friends. It doesn’t include the larger group you may be traveling with, such as a tour group or school groups.

Number of people: _____

2. On this visit, what kind of personal group (not guided tour/school group) were you with? Please circle only one.

- a. Alone c. Family
b. Friends d. Family and friends
e. Other (Please describe: _____)

3. On this visit, were you and your personal group with any of the following types of groups? (Circle all that apply.)

- a. Guided tour group
b. School/educational group
c. Commercial tour
d. Other organized group (Please describe _____)

4. Have you visited the Park Information Center (in downtown Seward) during your visit?

- a. Yes b. No

5. How did you access the coast? (Circle all that apply.)

- a. Sea kayak
b. Chartered water taxi
c. Commercial outfitter service
d. Sea plane
e. Private watercraft
f. Other (Please specify: _____)

6. How would you describe your trip to the coast?

1. Day trip (did not spend the night in the backcountry) → Question 9
2. Multi-day trip (spent 1 or more nights in the backcountry)

7. What was the length of your trip in days?

Length of trip: _____ days

8. Did you spend the night at any of the following areas? (Circle all that apply.)

1. Aialik Public Use Cabin
2. Holgate Cabin
3. North Arm Cabin
4. Kenai Fjords Glacier Lodge
5. Backcountry campsite (Please specify area(s): _____
_____)

9. Have you visited Kenai Fjords National Park before? (Circle one number.)

- a. Yes
- b. No → Question 10

If YES, approximately how many times have you visited Kenai Fjords National Park before this trip?

Number of previous visits: _____

10. Below is a list of possible reasons for visiting Kenai Fjords National Park. For each item, please indicate how important the reason for visiting is to you. (Circle one number for each item.)

	Not Important	Somewhat Important	Moderately Important	Very Important	Extremely Important
a. To learn about the cultural history of this area	1	2	3	4	5
b. To see and learn about the natural environment of this area	1	2	3	4	5
c. To participate in a recreational activity (e.g., kayaking, hiking)	1	2	3	4	5
d. To be with family and/or friends	1	2	3	4	5
e. To get some exercise	1	2	3	4	5
f. To experience solitude	1	2	3	4	5
g. Other (please specify: _____ _____)	1	2	3	4	5

11. Which of the following activities did/will you participate in during your trip? (Circle all that apply.)
- a. Viewing wildlife
 - b. Photography
 - c. Bird watching
 - d. Saltwater fishing
 - e. Freshwater fishing
 - f. Sea kayaking
 - g. Hiking
 - h. Other (Please specify: _____)

These questions ask about things that made your visit more or less enjoyable.

- 12a. What did you enjoy most about your visit?

- b. What did you enjoy least about your visit?

13. If you could ask the National Park Service to change some things about the way it manages Kenai Fjords, what would you ask it to do?

14. If you have visited these areas of Kenai Fjords before, please note any things that have changed for the better or for the worse since your last visit.

OR

- a. This is my first visit to these areas.

15. Do you think visitors are having any negative effects on the natural and/or cultural resources of this area or the quality of the visitor experience?

- a. Yes
- b. No

If YES, please explain: _____

16. What do you value most about your visit to Kenai Fjords National Park?

17. What do you consider to be the most important qualities of Kenai Fjords National Park?

18. How much of a problem do you think the following issues are at Kenai Fjords National Park? (Circle one number for each item.)

	Not a Problem	Small Problem	Big Problem	Don't Know
a. The number of people at beaches	1	2	3	4
b. The number of kayaking groups	1	2	3	4
c. The presence of large kayaking groups	1	2	3	4
d. Environmental impact to beaches from visitor use	1	2	3	4
e. Environmental impact to campsites from visitor use	1	2	3	4
f. Damage to ghost trees caused by visitors	1	2	3	4
g. Presence of tour boats	1	2	3	4
h. Speed of tour boats	1	2	3	4
i. Noise from tour boats	1	2	3	4
j. Air quality	1	2	3	4
k. Visitors making too much noise	1	2	3	4
l. Visitors harassing wildlife	1	2	3	4

19. Do you live in the United States?

- a. Yes (If so, what is your zip code? _____)
 b. No (If not, what country do you live in? _____)

20. In what year were you born?

Year born: _____

21. What is your gender? (Circle one number.)

- a. Male
 b. Female

22. What is the highest level of formal education you have completed? (Circle one number.)
- Less than high school
 - High school graduate/GED
 - Vocational/trade school certificate
 - Some college
 - Two-year college degree
 - Four-year college degree
 - Graduate degree
23. Are you Hispanic or Latino?
- Yes, Hispanic or Latino
 - No, not Hispanic or Latino
24. What is your race? (Please circle one or more.)
- American Indian or Alaska Native
 - Asian
 - Black or African American
 - Native Hawaiian or other Pacific Islander
 - White
25. Does anyone in your group have a physical condition that made it difficult to access or participate in park activities?
- Yes
 - No

If YES, because of the physical condition, what specific problems did the person have?
Please circle all that apply.)

- Hearing (difficulty hearing ranger programs, guides, audiovisual exhibits or programs, or information desk staff, even with a hearing aid)
 - Visual (difficulty in seeing exhibits, directional signs, visual aids that are part of a program, even with prescribed glasses or due to blindness)
 - Mobility (difficulty in accessing facilities, services, or programs, even with walking aid and/or wheelchair)
 - Other (Please explain) _____
26. Is there anything else you would like to tell us about your visit to Kenai Fjords National Park?

Thank you for your help with this survey! Please return this completed questionnaire to the surveyor.

PRIVACY ACT and PAPERWORK REDUCTION ACT statement:
16 U.S.C. 1a-7 authorizes collection of this information. This information will be used by park managers to better serve the public. Response to this request is voluntary and anonymous. No action may be taken against you for refusing to supply the information requested. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. BURDEN ESTIMATE STATEMENT: Public reporting burden for this form is estimated to average 10 minutes per response. Direct comments regarding the burden estimate or any other aspect of this form to Laura Phillips, Ecologist, Kenai Fjords National Park, (907) 422-0540, Laura_Phillips@nps.gov.

APPENDIX B

KENAI FJORDS THRESHOLDS SURVEY

OMB CONTROL #: 1024-0224 (NPS 10-029)

EXPIRATION DATE: JUNE 30, 2011

KENAI FJORDS VISITOR SURVEY

NATIONAL PARK SERVICE



Location Survey Administered: _____

Commercial or Private Group: _____

Tour Company: _____

Date: _____

Time: _____

Attendant: _____

- Weather: _____ Warm
_____ Cool
_____ Sunny
_____ Partly sunny
_____ Cloudy
_____ Foggy
_____ Rain

Dear Kenai Fjords National Park Visitor:

The National Park Service is conducting this survey to learn more about our visitors so that we can improve our service to you. You are one of a select number of people randomly chosen for this survey, so your opinions are important to us. The survey takes about 10 minutes to complete, and all of the information collected will be anonymous. Please read each question carefully.

1. How many people, including you, are in your personal group today? Your “personal group” is anyone you are visiting the park with, such as spouse, family, or friends. It doesn’t include the larger group you may be traveling with, such as a tour group or school groups.

Number of people: _____

2. On this visit, what kind of personal group (not guided tour/school group) were you with? Please circle only one.
- a. Alone
 - b. Friends
 - c. Family
 - d. Family and friends
 - e. Other (Please describe: _____)

3. On this visit, were you and your personal group with any of the following types of groups? (Circle all that apply.)
- a. Guided tour group
 - b. School/educational group
 - c. Commercial tour
 - d. Other organized group (Please describe _____)

4. Have you visited the Park Information Center (in downtown Seward) during your visit?
- a. Yes
 - b. No

5. How did you access the coast? (Circle all that apply.)
- a. Sea kayak
 - b. Chartered water taxi
 - c. Commercial outfitter service
 - d. Sea plane
 - e. Private watercraft
 - f. Other (Please specify: _____)

6. How would you describe your trip to the coast?
- a. Day trip (did not spend the night in the backcountry) → Question 9
 - b. Multi-day trip (spent 1 or more nights in the backcountry)

7. What was the length of your trip in days?

Length of trip: _____ days

8. Did you spend the night at any of the following areas? (Circle all that apply.)

a. Aialik Public Use Cabin

b. Holgate Cabin

c. North Arm Cabin

d. Kenai Fjords Glacier Lodge

e. Backcountry campsite (Please specify area(s): _____)

_____)

9. Have you visited Kenai Fjords National Park before? (Circle one number.)

c. Yes

d. No → Question 10

If YES, approximately how many times have you visited Kenai Fjords National Park before this trip?

Number of previous visits: _____

10. Below is a list of possible reasons for visiting Kenai Fjords National Park. For each item, please indicate how important the reason for visiting is to you. (Circle one number for each item.)

	Not Important	Somewhat Important	Moderately Important	Very Important	Extremely Important
a. To learn about the cultural history of this area	1	2	3	4	5
b. To see and learn about the natural environment of this area	1	2	3	4	5
c. To participate in a recreational activity (e.g., kayaking, hiking)	1	2	3	4	5
d. To be with family and/or friends	1	2	3	4	5
e. To get some exercise	1	2	3	4	5
f. To experience solitude	1	2	3	4	5
g. Other (please specify: _____ _____)	1	2	3	4	5

11. Which of the following activities did/will you participate in during your trip? (Circle all that apply.)

- i. Viewing wildlife
- j. Photography
- k. Bird watching
- l. Saltwater fishing
- m. Freshwater fishing
- n. Sea kayaking
- o. Hiking
- p. Other (Please specify: _____)

These questions ask about things that made your visit more or less enjoyable.

- 12a. What did you enjoy most about your visit?

b. What did you enjoy least about your visit?

13. If you could ask the National Park Service to change some things about the way it manages Kenai Fjords, what would you ask it to do?

14. If you have visited these areas of Kenai Fjords before, please note any things that have changed for the better or for the worse since your last visit.

OR

b. This is my first visit to these areas.

15. Do you think visitors are having any negative effects on the natural and/or cultural resources of this area or the quality of the visitor experience?

- c. Yes
- d. No

If YES, please explain: _____

16. What do you value most about your visit to Kenai Fjords National Park?

17. What do you consider to be the most important qualities of Kenai Fjords National Park?

18. How much of a problem do you think the following issues are at Kenai Fjords National Park? (Circle one number for each item.)

	Not a Problem	Small Problem	Big Problem	Don't Know
a. The number of people at beaches	1	2	3	4
b. The number of kayaking groups	1	2	3	4
c. The presence of large kayaking groups	1	2	3	4
d. Environmental impact to beaches from visitor use	1	2	3	4
e. Environmental impact to campsites from visitor use	1	2	3	4
f. Damage to ghost trees caused by visitors	1	2	3	4
g. Presence of tour boats	1	2	3	4
h. Speed of tour boats	1	2	3	4
i. Noise from tour boats	1	2	3	4
j. Air quality	1	2	3	4
k. Visitors making too much noise	1	2	3	4
l. Visitors harassing wildlife	1	2	3	4

19. Do you live in the United States?

- c. Yes (If so, what is your zip code? _____)
 d. No (If not, what country do you live in? _____)

20. In what year were you born?

Year born: _____

21. What is your gender? (Circle one number.)

- c. Male
 d. Female

22. What is the highest level of formal education you have completed? (Circle one number.)

- h. Less than high school
 i. High school graduate/GED
 j. Vocational/trade school certificate
 k. Some college
 l. Two-year college degree
 m. Four-year college degree
 n. Graduate degree

23. Are you Hispanic or Latino?
- c. Yes, Hispanic or Latino
 - d. No, not Hispanic or Latino
24. What is your race? (Please circle one or more.)
- f. American Indian or Alaska Native
 - g. Asian
 - h. Black or African American
 - i. Native Hawaiian or other Pacific Islander
 - j. White
25. Does anyone in your group have a physical condition that made it difficult to access or participate in park activities?
- c. Yes
 - d. No

If YES, because of the physical condition, what specific problems did the person have?
Please circle all that apply.)

- a. Hearing (difficulty hearing ranger programs, guides, audiovisual exhibits or programs, or information desk staff, even with a hearing aid)
 - b. Visual (difficulty in seeing exhibits, directional signs, visual aids that are part of a program, even with prescribed glasses or due to blindness)
 - c. Mobility (difficulty in accessing facilities, services, or programs, even with walking aid and/or wheelchair)
 - d. Other (Please explain) _____
26. Is there anything else you would like to tell us about your visit to Kenai Fjords National Park?

Thank you for your help with this survey! Please return this completed questionnaire to the surveyor.

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APPENDIX C

KENAI FJORDS SURVEY STUDY PHOTOGRAPHS

Study photographs showing different types and numbers of boats



No boats



8 kayaks



16 kayaks



24 kayaks



2 tour boats



4 tour boats



6 tour boats



5 mixed boats



10 mixed boats



15 mixed boats

Study photographs showing varying levels of impact on backcountry campsites



13m², 88% vegetation cover



13m², 55% vegetation cover



13m², 12% vegetation cover



36m², 88% vegetation cover



36m², 55% vegetation cover



36m², 12% vegetation cover



100m², 88% vegetation cover



100m², 55% vegetation cover



100m², 12% vegetation cover

APPENDIX D

KENAI FJORDS MULTIVARIATE CAMPSITE ANALYSIS

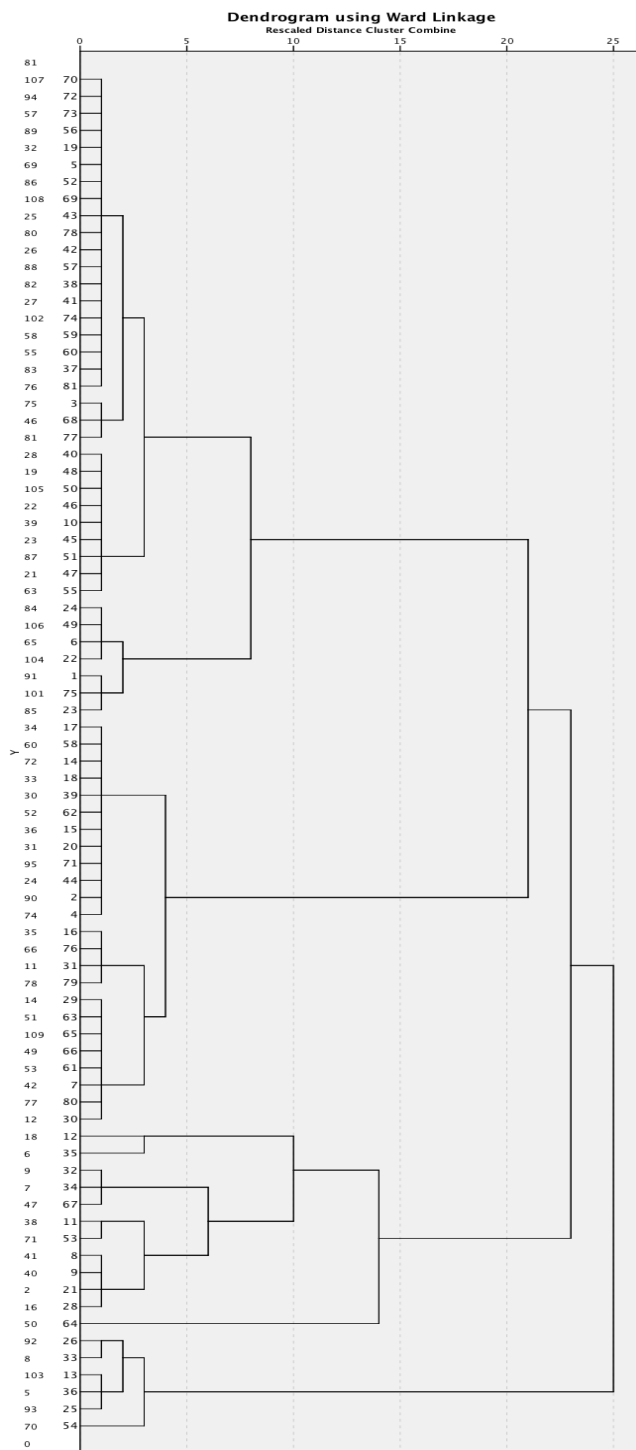


Figure D.1. Dendrogram for KEFJ campsite classification using Ward's Linkage

APPENDIX E

ADDITIONAL FIGURES FOR CHAPTER 3

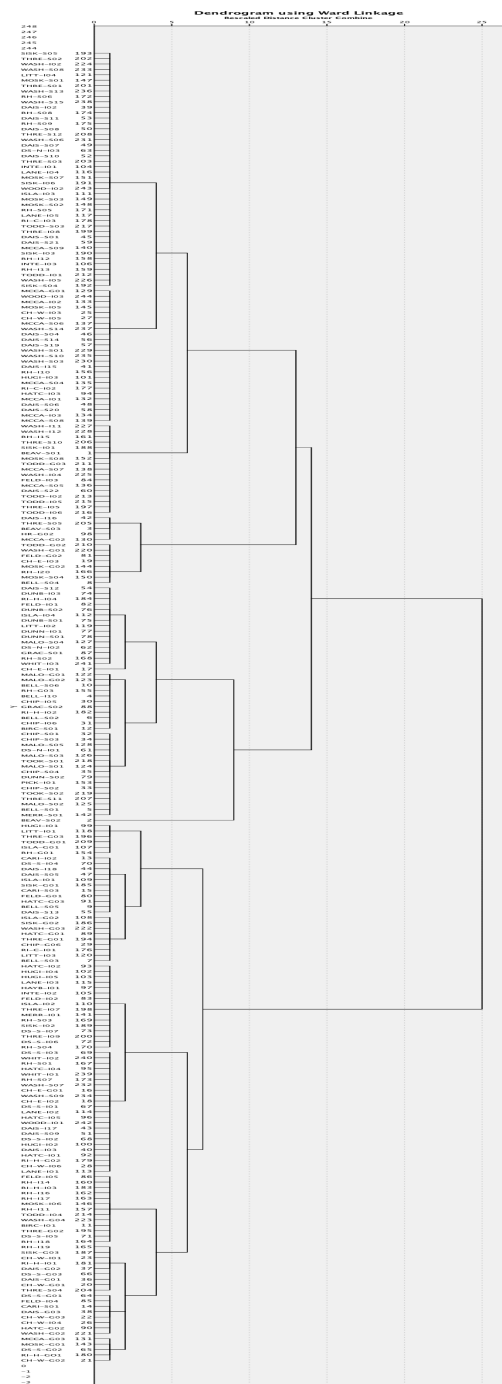


Figure E.1. Dendrogram for ISRO campsite classification using Ward's Linkage

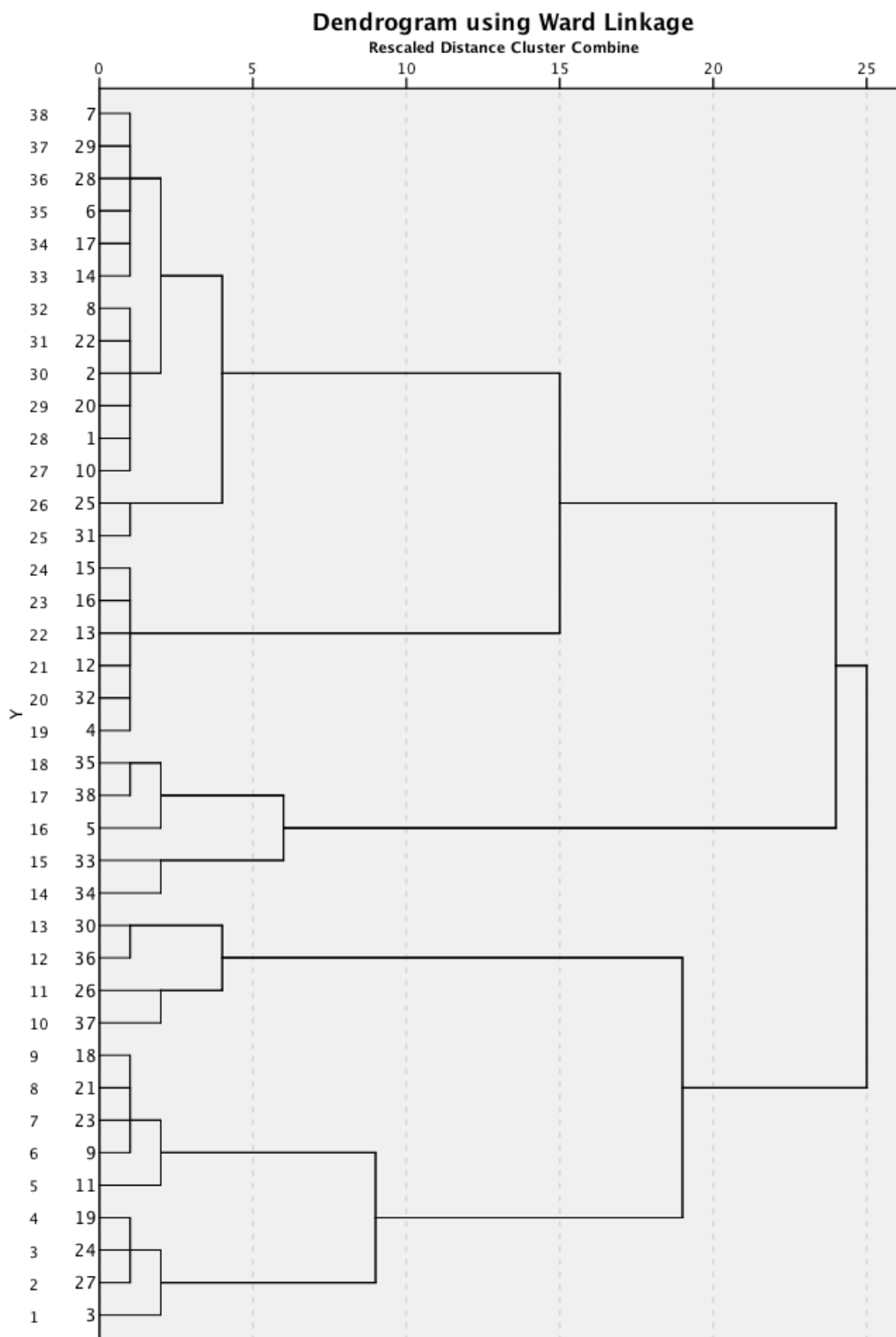


Figure E.2. Dendrogram for ZION campsite classification using Ward's Linkage

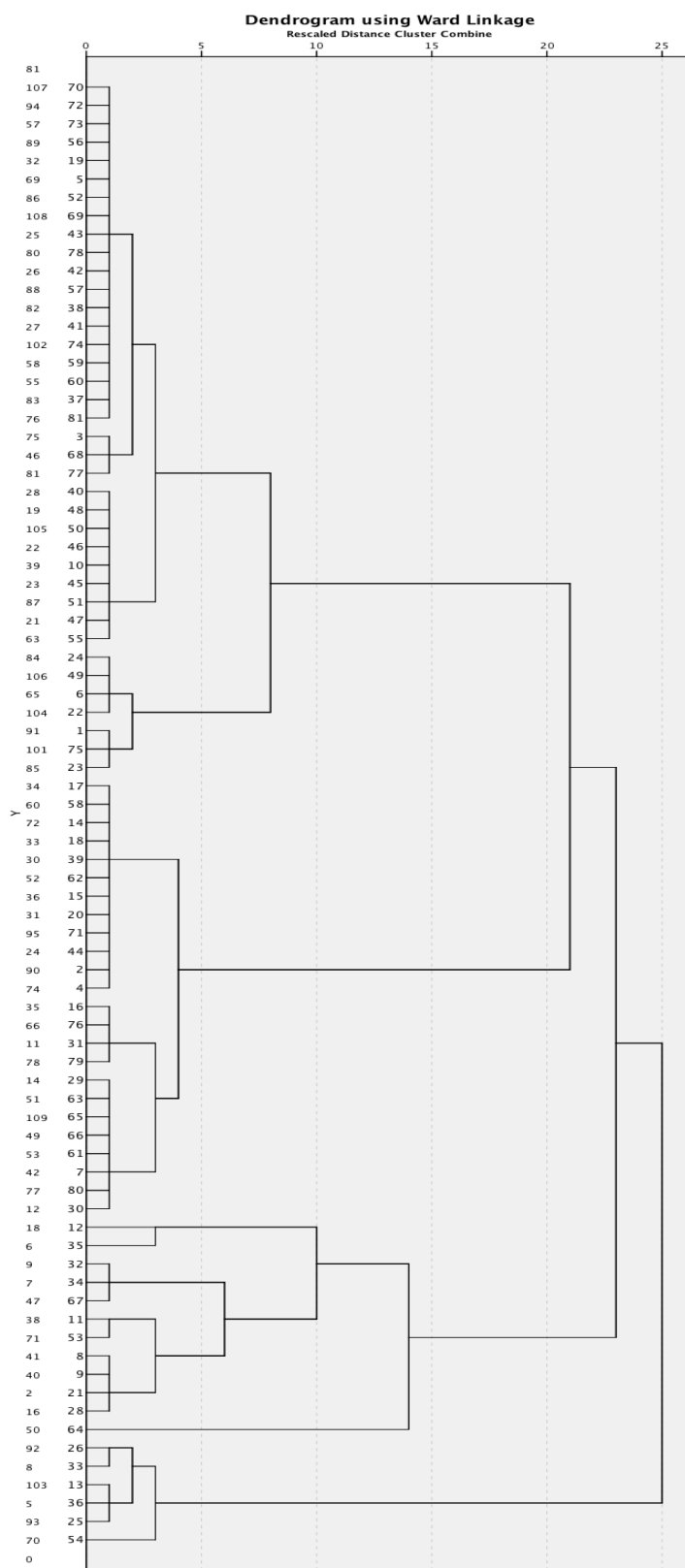


Figure E.3. Dendrogram for KEFJ campsite classification using Ward's Linkage

APPENDIX F

STUDY PHOTOS FOR ALASKA NATIONAL PARKS VISITOR SURVEY

Study Photos for Question 20: Social Trails

Photo 1



Photo 2

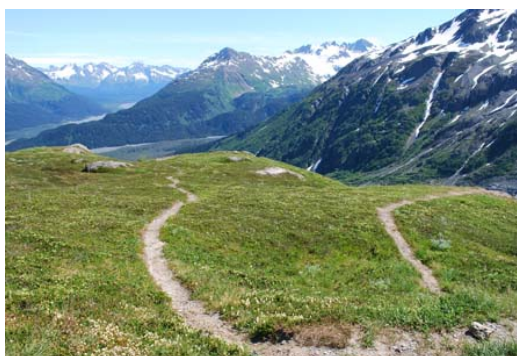


Photo 3



Photo 4

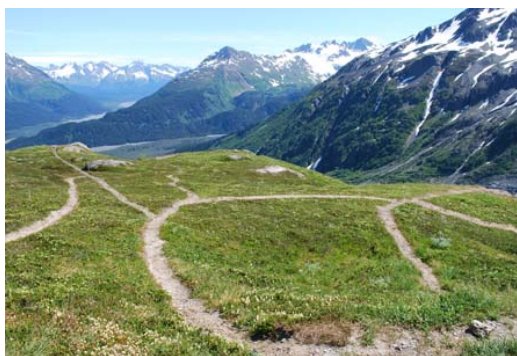


Photo 5



Study Photos for Question 21: Informal Visitor Sites

Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Study Photos for Question 22: Trail Condition

Photo 1

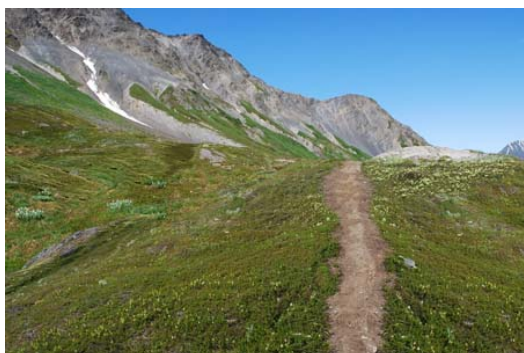


Photo 2

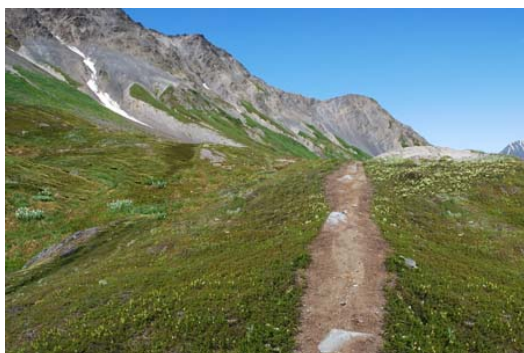


Photo 3



Photo 4



Photo 5



Study Photos for Question 23: CampsitesPhoto 1: 13m², 88% vegetation coverPhoto 2: 13m², 55% vegetation coverPhoto 3: 13m², 12% vegetation coverPhoto 4: 36m², 88% vegetation coverPhoto 5: 36m², 55% vegetation coverPhoto 6: 36m², 12% vegetation coverPhoto 7: 100m², 88% vegetation coverPhoto 8: 100m², 55% vegetation coverPhoto 9: 100m², 12% vegetation cover

APPENDIX G

ADDITIONAL TABLES FOR CHAPTER 4

Table G.1. Visitor demographics

Demographic Variables	KEFJ (n = 225)	DENA (n = 65)	Total Sample (n = 290)
Age	46.9	52.6	48.2
Male	47.3	40.3	45.8
U.S. resident	87.0	85.5	86.7
Race			
American Indian or Alaska Native	1.9		1.5
Asian	3.8	1.8	3.4
Black	0.5	3.5	1.1
White	93.8	94.7	94.0
Hispanic or Latino	1.9	3.3	2.2
Education			
Less than high school	0.9	1.6	1.1
High school graduate/GED	4.5	3.2	4.2
Vocational/trade school certificate	3.6	0	2.8
Some college	12.6	4.8	10.9
Two-year degree	7.6	4.8	7.0
Four-year degree	28.7	40.3	31.2
Graduate degree	42.2	45.2	42.8

Values are means for age, percents for other variables

Table G.2. Summary of prior experience for visitors to KEFJ and DENA

Prior Experience	KEFJ (n = 225)		DENA (n = 65)		Total Sample (n = 290)	
	Mean	SE	Mean	SE	Mean	SE
Total number of visits to primary park	2.37	0.279	1.80	0.321	2.24	0.228
Total number of other Alaska national parks visited	0.67	0.049	0.54	0.108	0.64	0.045
Rate of participation in organized activities at primary park	0.036	0.006	0.148	0.017	0.061	0.007

“Primary park” is the park at which respondents were contacted to participate in the study.

Table G.3. Summary of minimum impact knowledge

	KEFJ (n = 225)	DENA (n = 65)	Total Sample (n = 290)
<i>Minimum impact questions¹</i>			
Hiking preparation	54.1	84.4	60.8
Hiking best practice	70.9	34.4	62.7
Food waste disposal	94.6	100.0	95.8
Wildflowers	97.3	96.9	97.2
Bear safety	80.1	89.1	82.1
Wildlife viewing	98.2	100.0	98.6
Resting	44.1	54.8	46.5
<i>Knowledge of minimum impact practices, total score²</i>			
All correct (1.00)	16.4	18.5	16.9
One incorrect (0.86)	34.2	36.9	34.8
Two incorrect (0.71)	26.7	27.7	26.9
Three incorrect (0.57)	13.8	13.8	13.8
Four incorrect (0.43)	7.1	1.5	5.9
Five incorrect (0.29)	0.4	0.0	0.3
Six incorrect (0.14)	0.4	0.0	0.3
None correct (0.00)	0.9	1.5	1.0
<i>Mean</i>	<i>0.759</i>	<i>0.784</i>	<i>0.765</i>
<i>SE</i>	<i>0.012</i>	<i>0.022</i>	<i>0.011</i>

¹Values are percent responding correctly

²Values are percent achieving the noted overall score

APPENDIX H

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April 3, 2017

Kelly Goonan
Utah State University
Department of Environment and Society
Logan UT 84322

Reference # 17-027

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Thank you for your request to reproduce from:

- *Parks and Carrying Capacity*, by Robert E. Manning, figure 5.1 (page 43)

in your forthcoming dissertation titled "Integrating Social and Ecological Methods to Assess and Inform Park Monitoring and Management".

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- ORPT 4740 Organization and Administration for ORPT
- ORPT 4745 Organization and Administration for ORPT Lab
- ORPT 4860 Skills Practicum
- ORPT 4900 ORPT Senior Seminar

Utah State University, Logan, UT
Instructor

- | | |
|---|-----------|
| • ENV 4600 Natural Resources Interpretation | Fall 2013 |
| • ENV 3300 Recreation Resources Management (Broadcast IVC course) | Fall 2013 |
| • ENV 2340 Natural Resources and Society | Fall 2012 |

Teaching Assistant

- ENVS 3600 Living with Wildlife Spring 2014
- ENVS 4600/6600 Natural Resources Interpretation 2009 – 2011

University of Vermont, Burlington, VT*Teaching Assistant*

- NR 240 Park and Wilderness Management 2007 – 2008

RESEARCH EXPERIENCE**Southern Utah University, Cedar City, UT**

Dark Sky Quality Monitoring, Grand Staircase-Escalante National Monument March 2017 - Present

- Monitoring the conditions of natural darkness and dark skies and the impact of light pollution in Grand Staircase-Escalante National Monument, UT.

Recreation Impact Inventory, Monitoring, and Assessment on the Arizona Strip. Co-PI August 2015 – Present

- Collaborating with Dr. Briget Eastep to develop a protocol for monitoring recreation impacts on the Arizona Strip District, Bureau of Land Management. Supervising student interns conducting field work.

Satisfaction of Visitors to Southern Utah National Parks, collaborator 2015 – 2016

- Collaborated with Dr. Emmett Steed and Dr. Michael Kroff of the Management, Marketing, & Hospitality Department to conduct a survey of visitors to Southern Utah National Parks to explore the relationship between the successful Mighty 5 advertising campaign, increased park visitation, and the visitor experience.

Coalition of American Canyoneers, PI Dec. 2014 – 2015

- Collaborated with Coalition of American Canyoneers to develop and administer US canyoneering survey.

Dixie National Forest, Co-PI Nov. 2014 – Present

- Collaborating with U.S. Forest Service, Dixie National Forest to design a study to develop monitoring protocol and user survey for canyoneering activity on the Pine Valley Ranger District.

Red Cliffs Desert Reserve, collaborator Oct. 2014 – Present

- Collaborated with Dr. Briget Eastep on a project assessing recreation impacts in Red Cliffs Desert Reserve, St. George, UT.

Utah State University, Logan, UT*Acadia National Park, Research Assistant*

2013 – 2014

- Conducted assessments of resource conditions on two mountain summits using GPS and GIS analysis
- Trained field staff in resource assessment methods
- Administered visitor survey to assess hiking behavior and perceptions of summit conditions
- Administered GPS units to visitors to record hiking routes and behavior
- Analyzed visitor GPS tracking data and resource condition data for Cadillac Mountain

Denali National Park and Preserve, Co-PI

2012 – 2014

- Designed and administered survey assessing visitor evaluations of resource conditions

Glacier Bay National Park and Preserve, Research Assistant

2012 – 2013

- Assisted in design and field testing of monitoring protocol for backcountry coastal campsites
- Created data dictionary for collecting campsite monitoring data in the field via GPS
- Analyzed current and historic monitoring data for interobserver accuracy and condition trends

Kenai Fjords National Park, Co-PI

2011 – 2014

- Designed and administered survey assessing visitor evaluations of resource conditions

Kenai Fjords National Park, Research Assistant

2009 – 2013

- Designed and administered visitor use survey to identify indicators and standards of quality
- Examined coastal campsite resource conditions using GPS and GIS analysis

University of Vermont, Burlington, VT*Lake Champlain, Research Assistant*

2009

- Examined shoreline campsite resource conditions using GPS and GIS analysis

Northern Forest Mountain Summits, Research Assistant

2008 – 2009

- Designed and administered visitor use surveys to identify indicators and standards of quality
- Conducted assessments of resource conditions on three mountain summits using GPS and GIS analysis

RESEARCH GRANTS

2015. Recreation Impact Inventory, Monitoring and Assessment, Arizona Strip District, Arizona. \$18,000. With Dr. Briget Eastep, Co-PI. Funding from the Bureau of Land Management.

2012. Determination of Standards of Resource and Visitor Experience Conditions to Protect Sensitive Coastal Resources in Kenai Fjords National Park. \$7,427. With Dr. Christopher Monz, principal investigator. Funding from the Ocean Alaska Science and Learning Center, Pacific Ocean Parks Strategy Technical Assistance Program.

PUBLICATIONS

Peer Reviewed Journal Articles

- Kidd, A.M., Monz, C., D'Antonio, A., Manning, R.E., Reigner, N., Goonan, K.A., Jacobi, C. 2015. The effect of minimum impact education on visitor spatial behavior in parks and protected areas: An experimental investigation using GPS-based tracking. *Journal of Environmental Management*. 162: 53–62.
- Goonan, K.A., Monz, C.A., Manning, R.E., Anderson, L. 2012. An analysis of current resource conditions and visitor standards of primitive campsites along Lake Champlain. *Journal of Great Lakes Research*. 38(1): 157–166.
- Anderson, L., Manning, R.E., Monz, C.A., Goonan, K.A., Valliere, W. 2012. Indicators and standards of quality for paddling on Lake Champlain. *Journal of Great Lakes Research*. 38(1): 150–156.
- Van Riper, C. J., Manning, R. E., Monz, C.A., Goonan, K. A. 2011. Tradeoffs among resource, social, and managerial conditions on mountain summits of the Northern Forest. *Leisure Sciences*. 33(3): 228–249.
- Manning, R., Valliere, W., Anderson, L., Stanfield-McCown, R., Pettengill, P., Reigner, N., Lawson, S., Newman, P., Budruk, M., Laven, D., Hallo, J., Park, L., Bacon, J., Abbe, D., van Riper, C., Goonan, K. 2011. Defining, measuring, monitoring, and managing the sustainability of parks for outdoor recreation. *Journal of Park and Recreation Administration*. 29(3): 24–37.
- Monz, C. A., Marion, J. L., Goonan, K. A., Manning, R.E., Wimpey, J., Carr, C. 2010. Assessment and monitoring of recreation impacts and resource conditions on mountain summits: Examples from the Northern Forest, USA. *Mountain Research and Development*, 30(4) 332–343.

Refereed Articles and Book Chapters

- Goonan, K., Manning, R., van Riper, C., Monz, C. 2010. Managing recreation on mountain summits in the Northern Forest. In: Watts, C.E., and Fisher, C.L. (eds.). Proceedings of the 2009 Northeastern Recreation Research Symposium. Gen. Tech. Rep. NRS-P-66. Newton Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. p. 1–8.

- Goonan, K., Manning, R., Valliere, W. 2009. Research to guide trail management at Acadia National Park. In: Manning, R.E. (ed.), *Parks and People*. University Press of New England. p.69–78.
- Goonan, K., Manning, R., Valliere, W. 2009. Research to guide trail management at Acadia National Park. In: Klenosky, D.B., and Fisher, C.L. (eds.). Proceedings of the 2008 Northeastern Recreation Research Symposium. Gen. Tech. Rep. NRS-P-42. Newton Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. p. 266–274.
- Goonan, K.A., van Riper, C.J., Manning, R., Monz, C. 2007. Using science to manage Northern Forest tourism and recreation. *Adirondack Journal of Environmental Studies*, 14(2): 6.
- Goonan, K. 2007. [Review of the book *Translation Translation*]. *Cadernos de Tradução*, 19: 258–261.

Reports

- 2015. Canyoneering in the United States: 2015 Final Project Report. Coalition of American Canyoneers. Available at <http://www.americancanyoneers.org/canyoneering-research-report/>
- Goonan, K., C. Monz, B. Bruno, and T. Lewis. 2015. Recreation impact monitoring analysis and protocol development: Glacier Bay National Park. Natural Resource Report NPS/GLBA/NRR-2015/957. National Park Service, Fort Collins, CO.
- Goonan, K., Monz, C., Phillips, L. 2013. Visitor Experience and Social Science Indicators of NPS-Alaska Coastal Resources, Kenai Fjords National Park. Project Completion Report. 44pp.
- Goonan, K., Monz, C., Bruno, B. 2013. Campsite Monitoring Analysis and Protocol Development, Glacier Bay National Park. Project Completion Report. 61pp.
- Monz, C., Klasner, F., Goonan, K. 2011. Coastal Campsite Monitoring Protocol, Kenai Fjords National Park. Project Final Report. 72pp.
- Locke, D., Goonan, K., Romolini, M. 2009. A Report on Methods for Prioritizing Areas to Increase Urban Tree Canopy in New York City. 18pp.

JOURNAL ARTICLE REVIEWS

2011-2012. Landscape and Urban Planning (one article)

SCHOLARLY PRESENTATIONS

- “Beyond Condition Class: Alternative Methods for Assessing Resource Conditions on Campsites.” Northeastern Recreation Research Symposium. April 6-8, 2014. Cooperstown, NY.

- “An Integrated Approach to Coastal Backcountry Management and Monitoring at Kenai Fjords National Park, AK.” Protected Areas in a Changing World, the 2013 George Wright Society Conference on Parks, Protected Areas, and Cultural Sites. March 11-15, 2013. Denver, CO.
- “Campsite Monitoring in Kenai Fjords National Park: Protocol Development, Resource Conditions, and Current Trends.” Science in Southwest Alaska: Crossing Boundaries in a Changing Environment, the 2011 Southwest Alaska Park Science Symposium. November 2-4, 2011. Anchorage, AK.
- “Identifying Indicators of Quality for the Backcountry Visitor Experience at Kenai Fjords National Park, Alaska, USA.” Science in Southwest Alaska: Crossing Boundaries in a Changing Environment, the 2011 Southwest Alaska Park Science Symposium. November 2-4, 2011. Anchorage, AK.
- “Identifying Indicators of Quality for the Backcountry Visitor Experience at Kenai Fjords National Park, Alaska.” Rethinking Protected Areas in a Changing World, the 2011 George Wright Society Conference on Parks, Protected Areas and Cultural Sites. March 14-18, 2011. New Orleans, LA.
- “Campsite Impacts Along the Lake Champlain Paddlers’ Trail, Lake Champlain, USA.” Northeastern Recreation Research Symposium. April 11-13, 2010. Bolton Landing, NY.
- “Managing Recreation on Mountain Summits in the Northern Forest.” Northeastern Alpine Stewardship Gathering. May 29-30, 2009. Lake Placid, NY.
- “Managing Recreation on Mountain Summits in the Northern Forest.” Northeastern Recreation Research Symposium. March 29-31, 2009. Bolton Landing, NY.
- “Recreation-Related Ecological Conditions of Mountain Summits in the Northern Forest: A framework for management.” Rethinking Protected Areas in a Changing World, the 2009 George Wright Society Conference on Parks, Protected Areas and Cultural Sites. March 2-6, 2009. Portland, OR.
- “Research to Guide Trail Management at Acadia National Park.” 14th International Symposium on Society and Resource Management. June 10-14, 2008. Burlington, VT.
- “Research to Guide Trail Management at Acadia National Park.” Northeastern Recreational Research Symposium, March 30 – April 1, 2008. Bolton Landing, NY.

INVITED PRESENTATIONS

- “National Park Visitor Experience Study 2015: Preliminary Findings.” With Emmett Steed and Michael Kroff. Southern Utah Planning Authorities Committee (SUPAC) meeting in St. George, UT. 12 Jan. 2016.
- “People and Places: Research to Inform Outdoor Recreation Planning and Management.” Invited to be the speaker for the second annual **Alumni Colloquium** for the Environmental Studies Department at St. Lawrence University, Canton, NY. April 2-3, 2015.
- “You study what? Adventures of an Outdoor Researcher.” **SUU Outdoor Education Series**. April 16, 2015.

SELECTED UNIVERSITY SERVICE AND INVOLVEMENT

SUU Semester in the Parks <i>Instructing Faculty Member</i>	January 2016 – Present
SUU Convocations Committee <i>Member</i>	January 2016 – Present
Honors Faculty Council and Executive Council <i>Member</i>	August 2015 – Present
Festival of Excellence Steering Committee <i>Member</i>	August 2015 – Present
SUU Allies Steering Committee <i>Member</i>	August 2014 – Present
Outdoor Engagement Center Advisory Committee <i>Member</i>	Fall 2014 – Present

COMMUNITY SERVICE AND INVOLVEMENT

Wesley Bell Ringers , Shepherd of the Hills United Methodist Church, St. George, UT <i>Member</i>	December 2015 – Present
Nordic United , Logan, UT <i>Volunteer</i>	2011 – 2013
College of Natural Resources Graduate Student Council , Utah State University <i>Off-Campus Recreational Activities Chairperson</i>	2009 – 2013
Westminster Bell Choir , First Presbyterian Church, Logan, UT <i>Member</i>	2009 – 2014
English Language Center of Cache Valley , Logan, UT <i>Volunteer Tutor</i>	2009 – 2010
Diversity Task Force , Rubenstein School of Environment and Natural Resources <i>Member</i>	2008 – 2009
Bells of Ascension , Ascension Lutheran Church, South Burlington, VT <i>Member</i>	2008 – 2009
Faculty Search Committee , Environmental Studies Department, St. Lawrence University <i>Student Representative</i>	2006 – 2007
Spanish Writing Center , St. Lawrence University <i>Writing Tutor</i>	2006 – 2007
Center for International and Intercultural Studies , St. Lawrence University <i>Student Ambassador, Adirondack Semester and Costa Rica programs</i>	2006 – 2007
Academic Achievement Office , St. Lawrence University <i>Peer Tutor</i>	2006 – 2007
Women's Resource Center , St. Lawrence University <i>Member/Resident</i>	2005 – 2007
Department of Education , St. Lawrence University <i>Reading and Math Tutor, Second Grade</i>	2005

RECOGNITION

- *Nominee*, “Professor of the Year” Thunderbird Award, 2015
- *Recipient*, Graduate Student Enhancement Award, 2014
- *Recipient*, College of Natural Resources Graduate Student Travel Award, 2011
- *Recipient*, Graduate Student Senate Travel Award, 2011
- *Recipient*, S.J. & Jessie E. Quinney Graduate Fellowship, 2009 – 2013
- *Recipient*, Graduate Student Award for Outstanding Research and Scholarship, Rubenstein School of Environment and Natural Resources, 2009
- *Recipient*, Graduate Student Travel Mini-Grant, 2009
- *Recipient*, Independent Student Research Grant, St. Lawrence University, 2006
- *Recipient*, William O’Brien First Year Research Prize, St. Lawrence University, 2004
- *Recipient*, University Scholarship, St. Lawrence University, 2003 – 2007

CERTIFICATIONS

Wilderness First Responder, Wilderness Medicine Training Institute. Exp. June 2019

ADDITIONAL FIELD EXPERIENCE

- *Trek Guide*, Sabattis Scout Reservation, Long Lake, NY, 2008
- *Waterfront Director*, Sabattis Scout Reservation, Long Lake, NY, 2007
- *Trek Guide*, Sabattis Scout Reservation, Long Lake, NY, 2006
- *Freshman Orientation Trip Guide*, St. Lawrence University, 2006 – 2007
- *Study abroad*, Universidad de Costa Rica, San Jose, Costa Rica, Spr. 2006
- *Participant*, Outdoor Program Guide Training, St. Lawrence University, 2004/05 academic year
- *Assistant Waterfront Director*, Sabattis Scout Reservation, Long Lake, NY, 2004 – 2005
- *Participant*, Adirondack Semester, St. Lawrence University, Fa. 2004
- *Lifeguard and Waterfront Counselor*, Sabattis Scout Reservation, Long Lake, NY, 2001 – 2003

TEACHING PHILOSOPHY

TEACHING MISSION: I will provide students with learning experiences and opportunities of the highest quality that utilize classroom approaches and field exercises while accommodating diverse student needs and learning styles.

The roots of my career in natural resources can be found in a summer job I held for nearly ten years. I was a counselor at a resident summer camp located in the heart of the Adirondack Mountains of New York State. My enthusiasm for the practice of outdoor recreation developed greatly during this time, and continued to grow as I began my undergraduate studies. During the course of my studies I was introduced to the academic field of Recreation Management and the various challenges associated with the preservation and management of wildlands. I committed myself to work to address these challenges and maintain our wildlands and the experiences and opportunities they provide. This commitment is a central theme to the approach I bring to my classes. Although I am at the beginning of my career, I am fortunate to have gained valuable experience that provides a perspective on how to approach my subject matter. Several principals guide my pedagogy:

Develop an atmosphere of shared responsibility

I consider my role to be “mentor” rather than “teacher.” As such, I strive to create a collaborative learning environment in which I facilitate an intellectual conversation among class participants. I empower students to voice their thoughts and be more intentional in their approach to learning. Classes are structured to encourage active participation and learning, and avoid passive approaches.

Balance content and process

Information and factual knowledge form a key component of any academic course. However I place significant emphasis on the process by which knowledge is gained and decisions are made. Courses are designed to develop students’ critical thinking skills. In addition, certain essential practical skills – field skills, statistics, instrumentation, etc. – are incorporated and emphasized where appropriate. Critical thinking, analysis, and field skills are essential in any contemporary environmental and natural resource field. My goal is to better prepare students to address the complex issues and decisions they will face in their professional careers.

Create experiences to inform the academic process

Courses that have provided a balance between academic and experiential components made the greatest impact on my personal intellectual development. As such, I will strive to incorporate opportunities for experiential learning that complement and enhance the academic component in all of my classes. Allowing students to develop connections with the natural world, reflect on those connections, and analyze subject matter will allow students to develop a personal environmental ethic.

Utilize multiple teaching styles

Incorporating multiple and diverse teaching styles in every class is a central component of my teaching approach. I place particular emphasis on methods that actively engage students, such as small group discussions, workshops, and student-centered discussion leadership. I employ Socratic elements and thought exercises to provoke students to examine issues critically and consider diverse perspectives. My assessment approaches are also diverse, relying on participation, examination, student self evaluation and student peer evaluation. I also provide

formative evaluation to students throughout the course. I integrate appropriate technology into the classroom yet maintain the course in a manner that does not unduly rely on technology.

Create opportunities for individual research

I believe elements of individual, self-centered research are fundamental to all classes. This allows students to develop essential writing, analysis and presentation skills, as well as an opportunity to delve deeper into a topic of their interest.

Support intellectual and personal development

My ultimate goal in teaching is to empower students' intellectual and personal development. All classes will incorporate activities and assignments that enhance critical thinking and analysis skills. I will also strive to assist students in developing skills in written and oral communication, as well as practical applied field skills where appropriate. Furthermore, I hope to facilitate students' personal development by promoting curiosity, inquiry, and the development of a personal environmental ethic.

An international student in my Fundamentals of Recreation Resources Management class, taught Fall 2013, left the following piece of feedback on his final quiz: "Dear Kelly, I just want to say thank you for teaching me well, [sic] as a marketing major student, at the beginning of this semester, I do [sic] not have much confidence on [sic] doing well on [sic] this class, however your way of teaching make [sic] me feel much better, [sic] you gave me a good taste of recreational management which I believe I will never forget, so thank you, and I will try my best to learn as much as I can." Statements like these, or the emails I receive from students – sometimes months after they have taken the course – with a link to a news story or blog post that reminded them about something we discussed in class, fuel my passion for teaching and commitment to excellence in the classroom. I hope that my efforts will spark an interest and inspire students to pursue successful careers caring for our environment and natural resources and maintaining the associated opportunities we value so deeply.

TEACHING INTERESTS

- Introductory courses in Outdoor Recreation and Environmental Studies
- Leadership in Outdoor Recreation
- Natural Resources and Society
- Recreation Resources Management
- Behavioral Aspects of Recreation
- Ecological Aspects of Recreation
- Interpretation of Cultural and Natural Resources
- Park and Wilderness Management
- Research Methods

PROGRAM OF RESEARCH

RESEARCH GOALS AND PHILOSOPHY

My overall research goal is to integrate recreation social science and recreation ecology to understand how people participating in outdoor recreation and tourism activities interact with and affect recreation resources in parks and protected areas. I seek to generate new knowledge for land managers, the outdoor recreation and tourism industries, and the general public that will allow for the continued use and enjoyment of parks and protected areas while protecting recreation resources. I will achieve this goal by advancing theory, practice, education, and communication in this field.

Specifically, my research interests are in understanding how visitors perceive and interact with recreation resources, the consequences of visitation on protected ecosystems, and managing those consequences. I am especially interested in making research findings relevant to managers and suitable for on-the-ground application. I am also committed to improving visitor education and interpretation to help visitors to natural areas minimize their effects on recreation resources and develop a personal environmental ethic. My education, experience, and unique combination of training in both recreation social science and recreation ecology have given me a unique perspective to approach both applied and theoretical research questions.

RESEARCH INTERESTS

1. *Resource Consequences of Outdoor Recreation and Tourism*
 - a. Experimental applications of simulated recreation disturbance
 - b. Modeling the susceptibility of recreation and tourism settings to recreation disturbance
2. *Assessment Analysis of Protected Area Resources*
 - a. Survey assessments of recreation resource conditions
 - b. Examinations of related biophysical, use, and managerial factors
 - c. Spatial analysis applications and related methodological development
 - d. Improving and optimizing field assessment protocols and technology
3. *Understanding and Managing Sustainable Visitation in Parks and Protected Areas*
 - a. Biophysical and social indicators and standards in recreation and tourism settings
 - b. Application of contemporary recreation management knowledge to agency programs such as NPS Inventory and Monitoring Program
 - c. Development of decision frameworks for visitor capacity and related issues
4. *Understanding Visitor Perceptions, Norms, and Ethics*
 - a. Examinations of visitor perceptions of social, resource, and managerial conditions
 - b. Utilizing and refining normative approaches to assist in developing management standards
 - c. Exploring visitor characteristics and how they relate to evaluations of recreation resource conditions

5. *Outcome Assessment of Outdoor Education, Minimum Impact Education, and Interpretation*
 - a. Program evaluation, skill attainment, and satisfaction
 - b. Effectiveness of education and interpretation in promoting responsible behavior
 - c. Efficacy of minimum impact education and interpretation as a tool for resource management
 - d. Development, improvement, and evaluation of interpretive strategies