Journal of Great Lakes Research 38 (2012) 157–166

Contents lists available at ScienceDirect

Journal of Great Lakes Research

journal homepage: www.elsevier.com/locate/jglr

Resource conditions and paddler standards for primitive campsites along Lake Champlain

Kelly A. Goonan [a,*], Christopher A. Monz [b,1], Robert E. Manning [c,2], Laura E. Anderson [d,3]

[a] Rubenstein School of Environment and Natural Resources, University of Vermont, Utah State University, 5215 Old Main Hill, Logan, UT 84322, USA
[b] Department of Environment and Society and the Ecology Center, Utah State University, 5215 Old Main Hill, Logan, UT 84322, USA
[c] Rubenstein School of Environment and Natural Resources, University of Vermont, 218 Hills Building, 81 Carrigan Drive, Burlington, VT 05405, USA
[d] Rubenstein School of Environment and Natural Resources, University of Vermont, 13 Hills Building, 81 Carrigan Drive, Burlington, VT 05405, USA

ARTICLE INFO

Article history:
Received 7 October 2010
Accepted 18 April 2011
Available online 12 June 2011

Communicated by: Eric Howe

Keywords:
Recreation ecology
Campsite impact
Primitive campsites
Recreation management
Indicators and standards
Lake Champlain

ABSTRACT

Primitive campsites located on a paddlers' trail on Lake Champlain in the northeastern USA were assessed for their resource condition quality using standard campsite assessment protocols common to campsite monitoring studies. Site attributes such as vegetation cover loss, campsite size, campsite condition class and several other measures of resource conditions were assessed. Comparative analyses of resource conditions at camping areas using at-large and confinement strategies were conducted. In addition, paddler standards for two important campsite attributes, vegetation loss and campsite size, were determined via paddlers surveys incorporating the use of normative and visual research methods. Findings suggest that the overall quality of campsite conditions is relatively high from both a biophysical and visitor experience perspective. Several differences in resource conditions were observed between campsites in at-large and confinement camping areas. The current at-large camping strategy in place at some areas appears to have been successful in minimizing resource impacts. Results of this study have implications for the management of primitive campsites in general, with particular importance to similar large lake ecosystems.

Introduction

Lake Champlain, bordered by the states of New York and Vermont and the Canadian province of Quebec, is an important regional recreation resource. The lake supports a wide variety of recreational activities, including sailing, canoeing and kayaking, motorized boating, jet skiing, diving, fishing, hunting, and swimming. One of the goals specified in the Champlain Valley National Heritage Partnership (CVNHP) management plan is to promote sustainable recreational activities on Lake Champlain (Lake Champlain Basin Program, 2010). The CVNHP supports several regional programs that advance this goal, including the Lake Champlain Paddlers' Trail (LCPT), a canoe and kayak trail established in 1996 to promote low-impact recreation on Lake Champlain. The LCPT currently consists of a network of 39 sites that facilitate paddling activities (Lake Champlain Committee, 2010). Sites are located on state, town, and private lands, and include day-use areas, overnight camping with facilities, and primitive campsites. The paddlers' trail is overseen and managed by the Lake Champlain Committee (LCC), a nonprofit citizens' environmental organization involved in maintaining recreational access to Lake Champlain (Lake Champlain Committee, 2008).

The LCPT provides the opportunity for a primitive recreational experience on a lake that is shared by a number of different user groups (Capen et al., 2010). While paddling is a relatively sustainable form of recreation, canoeist and kayaker activities may impact ecological resources. This is particularly apparent at primitive campsites used by paddlers, as camping activities have the potential to affect resource conditions intensively at the on-site scale and extensively through site expansion and the formation of new sites (Cole, 2004; Leung and Marion, 1999; Twardock et al., 2010). Ecological impacts at recreation areas also have the potential to detract from the quality of the visitor experience (Lynn and Brown, 2003; Manning et al., 2004; Roggenbuck and Watson, 1993). LCPT sites serve as destinations for paddlers and thus are nodes of concentrated visitor use along the shore of Lake Champlain. Therefore, minimizing undesirable impacts and maintaining high quality conditions at campsites is important from both a managerial and visitor use perspective. Understanding the nature and trends of impact to biophysical conditions at campsites resulting from recreational use, as well as visitor judgments regarding the acceptability of site conditions, is important in establishing appropriate resource protection and visitor experience goals and determining the

* Corresponding author. Tel.: +1 435 797 1009.
E-mail addresses: kelly.goonan@aggiemail.usu.edu (K.A. Goonan), chris.monz@usu.edu (C.A. Monz), Robert.Manning@uvm.edu (R.E. Manning), Laura.E.Anderson@uvm.edu (L.E. Anderson).
[1] Tel.: +1 435 797 2773.
[2] Tel.: +1 802 656 3096.
[3] Tel.: +1 802 656 3113.

0380-1330/$ – see front matter
doi:10.1016/j.jglr.2011.05.010

effectiveness of management actions in achieving those goals. This can be addressed through a program of campsite condition assessment and monitoring supported by associated indicators and standards of quality.

Campsite conditions, trends, and management

Studies of campsites in natural areas have examined the degree to which visitor use can alter site conditions (e.g. Cole, 1983a, 1983b; Frissell, 1978; Monz and Twardock, 2004), changes in site condition over time (e.g. Cole and Hall, 1992; Cole et al., 2008; Marion and Cole, 1996; Twardock et al., 2010), functional relationships such as use–impact (Cole, 1995; Cole and Monz, 2003), and spatial patterns of impact (Cole and Monz, 2004). Three main generalizations can be drawn from these studies. First, most impact occurs at low use levels and subsequent increases in use do not result in proportional increases in impact (Cole, 1995; Cole and Monz, 2004; Cole et al., 2008; Leung and Marion, 2000; Marion and Cole, 1996). This is commonly referred to as the use–impact relationship. Second, changes in the number and areal extent of impacts on established campsites tend to be more pronounced than changes in the intensity of impact over time (Cole and Hall, 1992; Cole et al., 2008). For example, long-term studies have found that the size of established campsites increased substantially while mean vegetation cover on-site remained relatively stable (Cole and Hall, 1992; Cole et al., 2008). Finally, aggregate impact associated with campsites (i.e. the total area of disturbance due to site expansion and proliferation) tends to increase over time and may be of greater concern to managers than the level of impact at individual sites (Cole, 1993; Marion and Cole, 1996; Twardock et al., 2010). Overall, these findings support the importance of campsite assessment and monitoring in informing management actions intended to maintain the quality of resource conditions.

Additional research has examined the effectiveness of confinement and at-large management strategies in minimizing camping-related impacts (Cole et al., 2008; Marion, 1995; Marion and Farrell, 2002; Reid and Marion, 2004; Spildie et al., 2000; Twardock et al., 2010). A confinement strategy attempts to limit the number and size of campsites by concentrating use on designated sites (Cole et al., 2008; Hammitt and Cole, 1998). This is generally accomplished by requiring or encouraging visitors to camp at established sites and concentrate activities in the core area of the site. In contrast, an at-large strategy maximizes freedom by allowing visitors to select campsite locations, sometimes within a large defined area. This approach may avoid lasting impacts by dispersing use to undisturbed sites (Hammitt and Cole, 1998), but visitors may also repeatedly select the same locations and create impacts. Typically visitors are able to set up camp wherever they want in accordance with area regulations (e.g. camping within a certain distance of water may not be allowed), and are encouraged to follow minimum impact practices (Cole et al., 2008). In general, studies have found confinement to be more effective at limiting the formation of new campsites and reducing the total number of existing sites (Marion, 1995; Marion and Farrell, 2002; Reid and Marion, 2004; Spildie et al., 2000), whereas many new sites are typically formed over time in areas with an at-large camping strategy (Twardock et al., 2010). While confinement is a well-accepted practice in many areas, especially when use levels are high (Leung and Marion, 2000), it is not always fully successful in preventing new sites from forming (Cole et al., 2008). These results highlight the difficulty of minimizing camping-related impacts, particularly the spread of impacts to previously undisturbed areas.

Acceptability of site conditions

Some level of impact can be expected in areas where recreational use is present (Hammitt and Cole, 1998; Leung and Marion, 2000). The difficulty in managing these impacts and maintaining high quality conditions lies in determining what level of change is acceptable in a given area. Contemporary recreation planning and management frameworks such as Visitor Experience and Resource Protection (VERP) (National Park Service, 1997) and Limits of Acceptable Change (LAC) (Stankey et al., 1985) have been developed to assist managers in addressing recreation impacts. Indicators and standards of quality are fundamental components of these frameworks. Indicators are "measureable, manageable variables that help define the quality of… outdoor recreation areas and opportunities," and standards are "the minimum acceptable condition of indicator variables" (Manning, 2007, p. 27). Standards of quality for indicator variables can be set at different levels depending on specific management objectives and input from scientific studies (Manning, 2011; Manning and Lawson, 2002). Indicators are subsequently monitored, and management action can be taken if necessary to ensure that standards of quality are maintained.

One approach to measuring visitor standards for recreation conditions, including social and biophysical conditions, is the use of normative theory and associated visual research methods (Manning and Freimund, 2004; Vaske and Whittaker, 2004). Respondents are presented with a series of computer-generated photographs depicting a range of impact levels for a particular indicator variable, such as campsite conditions, and asked to evaluate the acceptability of each condition shown. Acceptability ratings for each photograph are aggregated and plotted on a graph to form a social norm curve. Social norm curves have several structural characteristics that can be useful in formulating indicators and standards of quality. The point at which the curve crosses "neutral" on the evaluation scale, or where aggregate evaluations fall into the "unacceptable" range of the scale, identifies the minimum acceptable condition of the indicator variable. The distance between the extremes of the curve is known as norm intensity or norm salience and represents the importance of that particular indicator to respondents. The amount of variance around each point on the curve, or crystallization, indicates the level of consensus or agreement among respondents. Crystallization can be measured using Van der Eijk's measure of agreement (A) (Krymkowski et al., 2009). Van der Eijk's A is measured on a scale of -1 to $+1$, with -1 indicating complete polarization in responses, 0 indicating a uniform distribution of responses across the scale, and $+1$ indicating complete agreement.

The use of normative theory and visual research methods is a widely accepted and common method of measuring visitor standards in the context of outdoor recreation (Manning, 2011). These methods have been used to measure visitor evaluations for a wide variety of indicator variables for recreation conditions, including social conditions (e.g., crowding, behaviors of other visitors), resource conditions, and type and intensity of management (Manning, 2011; Vaske and Whittaker, 2004). The use of visual methods can be especially useful in measuring standards for indicator variables that may be too technical or complex to communicate in a narrative format (Manning and Freimund, 2004), such as ecological impacts to recreation resources like campsites.

Primitive camping along the Lake Champlain Paddlers' Trail

The existing campsite literature is dominated by studies conducted in areas where sites are accessed primarily by over-land travel, such as hiking or stock travel (e.g., Boyers et al., 2000; Cole, 1993; Cole et al., 2008; Gettinger et al., 1998; Leung and Marion, 1999), with campsite assessment studies of near-shore environments accessible only by boat being fairly rare. Early studies of campsite conditions in the Boundary Waters Canoe Area, Minnesota (Marion and Merriam, 1985; Marion and Sober, 1987; Merriam and Peterson, 1983; Merriam and Smith, 1974) and studies of a long-term monitoring effort of campsites in Prince William Sound, Alaska (Monz, 1998; Monz and Twardock, 2004; Twardock et al., 2010) represent most of this

research. Near-shore campsites that are not readily accessible by land present several unique challenges to monitoring and management. For instance, the lack of trails leading to campsites, the formation of campsites near suitable landing areas, and the dispersed nature of camping areas makes identification and management of sites difficult. Campsites in these environments may require different management strategies than hike-in backcountry sites. In the case of LCPT sites, the complex system of land ownership and management makes a holistic approach to campsite management particularly difficult. Although the LCC oversees the entire LCPT, it does not own or directly manage any of the land on which campsites are located. Rather, sites are located on state, town, city, or private land and managed by numerous public and private entities (Lake Champlain Committee, 2008). At the time of this study, the LCPT included 18 primitive camping areas. The majority of the sites are state-owned, with seven sites managed by New York State and seven managed by the State of Vermont. The remaining sites are located on private (n = 3) or town (n = 1) land. Four different entities are responsible for the direct management of the sites located on state land (Table 1).

Campsite assessment and monitoring is an important component in the overall management of outdoor recreation resource conditions, and effective monitoring programs are necessary in the application of long-term planning frameworks (National Park Service, 1997; Stankey et al., 1985). Such monitoring efforts can both highlight the need for management actions and help assess their effectiveness. Monitoring programs have been applied effectively in numerous outdoor recreation settings (e.g. Cole, 1983b; Fodor, 1990; Leung and Marion, 1999; Twardock et al., 2010). However, there is currently no formal monitoring program in place for primitive campsites along the LCPT, and no previous comprehensive assessments of sites have been conducted.

As discussed above, confinement and at-large strategies intended to minimize the extent and intensity of campsite impacts have been implemented and evaluated in numerous areas, sometimes with mixed results (Cole et al., 2008; Leung and Marion, 2000; Twardock et al., 2010). While most of these studies have been conducted in areas where travel to campsites is predominantly over-land (Cole et al., 2008; Marion, 1995; Marion and Farrell, 2002; Reid and Marion, 2004; Spildie et al., 2000), some studies have examined the effectiveness of camping management strategies in areas where travel is predominantly or exclusively water-based (Monz and Twardock, 2004; Twardock et al., 2010). While various factors including private property boundaries and physical or topographical features such as cliffs and steep banks may direct camping activities to certain areas on the shore of Lake Champlain, the distinction between confinement and at-large camping applies to primitive camping areas that are part of the LCPT. Current management of LCPT primitive camping areas is a mixture of confinement and at-large strategies, depending on the land ownership and management policy of specific locations. Some LCPT camping areas require visitors to camp only at designated, maintained sites. In other locations, campers may choose from a number of dispersed campsites or set up camp in previously undisturbed areas.

This study builds upon previous research in several ways. First, this study developed protocols that can be used in a monitoring program for primitive LCPT sites, and takes the first step in implementing a monitoring and assessment program by providing baseline data on the condition of these sites by documenting the current extent, location, and characteristics of impacts. Second, the effectiveness of an at-large camping management strategy at some LCPT primitive camping areas is examined from a resource and experiential perspective. Finally, this study integrates results from field assessments and a normative paddler survey to provide insights into the condition of primitive LCPT sites from both a biophysical and visitor experience perspective. Specifically, paddler standards were formulated for two important campsite parameters, campsite size and vegetation cover loss, and sites where these standards were violated were identified. While a line of research has examined visitor perceptions of resource impacts (e.g. Monz, 2009; White et al., 2008), few studies have integrated field-based ecological assessments with visitor determinations of the acceptability of resource conditions of campsites (Manning et al., 2004; Newman et al., 2005). Other indicators and standards of quality were also developed for paddling on Lake Champlain and are discussed in a companion paper for this study (Anderson et al., 2012).

Table 1
Summary of LCPT primitive camping area ownership and management.

Camping area	Ownership	Management entity
East Creek	Private	Not specified
Five Mile Point	Private	Not specified
Barn Rock Cove	State — New York	Department of Environmental Conservation
Barn Rock North	State — New York	Department of Environmental Conservation
Palisades	State — New York	Department of Environmental Conservation
Snake Den Harbor	State — New York	Department of Environmental Conservation
Whallons Bay	Town	Town of Essex, NY
Kingsland Bay	State — Vermont	Department of Forests, Parks, and Recreation
Schuyler Island	State — New York	Department of Environmental Conservation
Valcour Island	State — New York	Department of Environmental Conservation
Point Au Roche	State — New York	Office of Parks, Recreation, and Historic Preservation
Highgate Cliffs	State — Vermont	Department of Forests, Parks, and Recreation
Burton Island	State — Vermont	Department of Forests, Parks, and Recreation
Knight Island	State — Vermont	Department of Forests, Parks, and Recreation
Woods Island	State — Vermont	Department of Forests, Parks, and Recreation
Niquette Bay	State — Vermont	Department of Forests, Parks, and Recreation
Hazelette Beach	Private	Not specified
Law Island	State — Vermont	Town of Colchester, VT

Methods

Study area

Lake Champlain is located at approximately 44°32′N and 73°20′W, and is bordered by the states of New York and Vermont and the Canadian province of Quebec (Fig. 1). It covers approximately 1000 km^2 and has nearly 965 km of shoreline. The LCPT, a canoe and kayak trail spanning the length of Lake Champlain, currently consists of a network of 39 sites located on state, town, and private lands. Sites include day-use areas, overnight camping with facilities, and primitive campsites. Campsite assessments for this study focused on the 18 primitive camping areas included in the 2008 edition of the LCPT guidebook (Lake Champlain Committee, 2008). These sites are designated for low-impact camping activities and do not have amenities such as running water. Primitive camping areas are located along the entire length of the LCPT in New York and Vermont (Fig. 1) and fall under a variety of ownership and management jurisdictions (Table 1). We focused on these primitive areas given their potential sensitivity to impact and importance in maintaining primitive conditions from a visitor experience perspective.

Campsite assessment

Current campsite conditions were measured using standard campsite assessment protocols (Marion, 1995; Monz, 2000) with

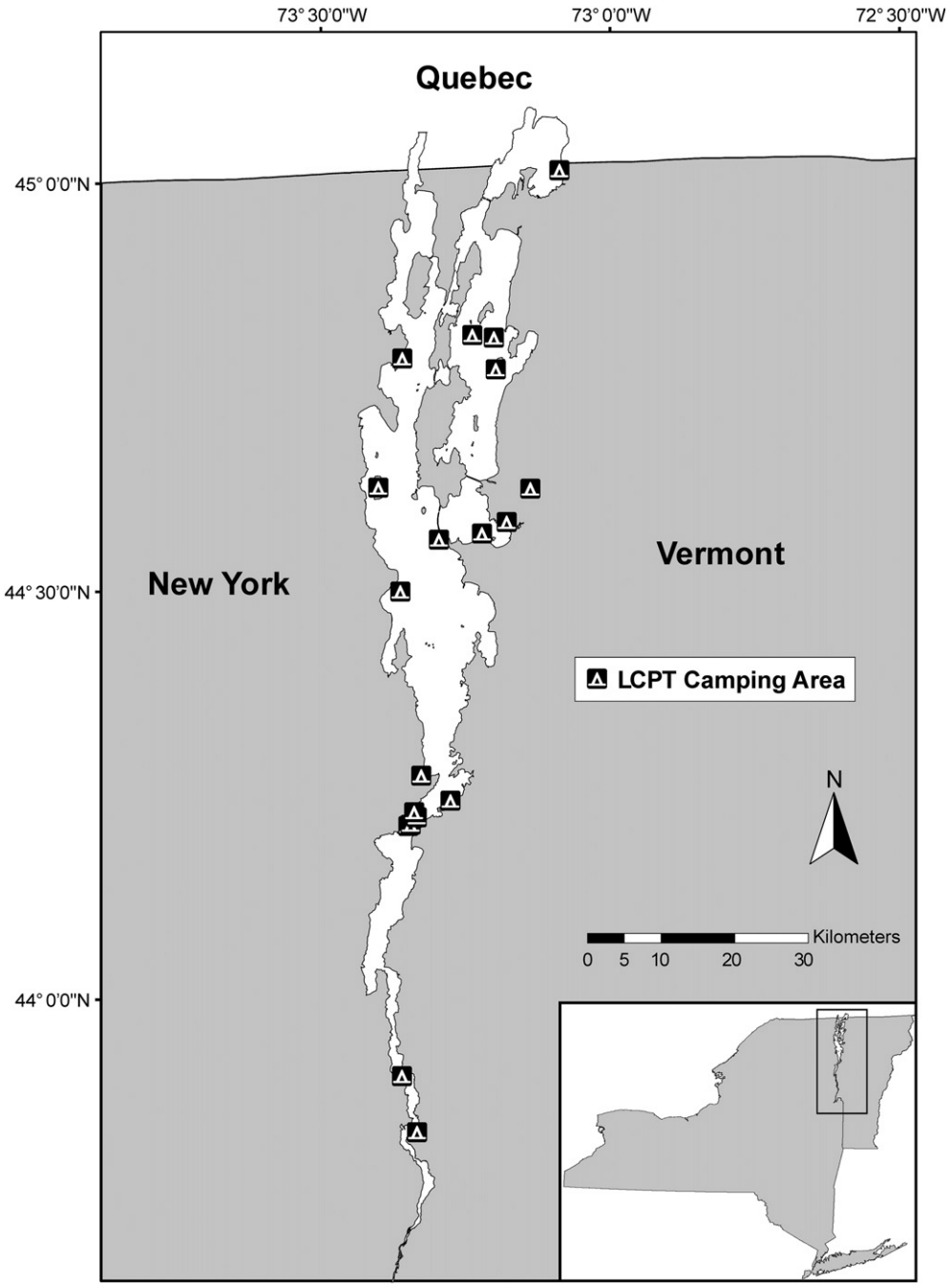

Fig. 1. Location of Lake Champlain Paddlers' Trail primitive camping areas.

minor modifications as noted (Table 2). Visits to all LCPT primitive camping areas listed in the 2008 edition of the Paddlers' Trail guidebook (Lake Champlain Committee, 2008) were conducted in June and July of 2009. 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 determined based on ocular ratings and followed a categorical approach. Condition class measurements followed a standard scale (Marion, 1995) of 1 through 5, with higher condition class ratings representing higher levels of impact. 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. For example, an LCPT camping sign was present at a camping area located on a cobble beach. However, there was no identifiable disturbance to the groundcover and no campsites were discernable. Other site attributes (Table 1) were assessed as suggested in Marion (1995).

Campsite locations were collected using a hand-held Trimble GeoXT submeter-capable global positioning system (GPS) unit (Trimble, Sunnyvale, California, USA) to aid in future relocation of sites. Photographs of each site were taken to document impacts, assist with site relocation, and aid in future monitoring of site conditions.

Paddler survey

A mail-back questionnaire was administered to LCC members in August and September of 2009. LCC members were selected to participate in the study based on whether they had received the

Table 2
Site attributes, assessment methods and measurement scale.

Site attribute	Method used	Measurement scale
Campsite size	Ocular estimation	Four level campsite size scale (<25 m^2, 30–60 m^2, 70–100 m^2, >100 m^2)
Condition class	Ocular estimation	Five level condition class scale (1–5)
Vegetation 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%)
Mineral soil exposure on site	Ocular estimation	Six level cover scale (0–5%, 6–25%, 26–50%, 51–75%, 76–95%, 96–100%)
Campsite substrate type	Observation	Cobble, organic soil, sand
Stumps/cut shrubs	Counts	Total number of cut stumps present
Root exposure	Ocular estimation	Three level root exposure scale (1 = none/slight; 2 = moderate; 3 = severe)
Damage to live trees	Ocular estimation	Three level tree damage scale (1 = none/slight; 2 = moderate; 3 = severe)
Fire sites	Counts	Total number of fire sites present
Trails	Counts	Total number of trails present
Human waste	Ocular estimation	Three level human waste scale (1 = no sites; 2 = 1–3 sites; 3 = more than 3 sites)
Litter and trash	Ocular estimation	Four level trash quantity scale (1 = none to a handful; 2 = handful to gallon; 3 = gallon to 5 gal; 4 = >5 gal)

annual Paddlers' Trail guidebook. This sampling approach was chosen for two reasons. First, LCC membership is required for paddling and camping along the LCPT. Second, paddling activities on Lake Champlain are distributed over a wide geographic area with multiple points of access. This presents a significant challenge for obtaining an adequate sample in the field. The LCC membership list provided an efficient way to reach a large number of paddlers. Sampling procedures followed methods for mail surveys described by Dillman (2000) with additional detail included in Anderson et al. (2012). The questionnaire was designed to identify indicators and standards of quality for the paddling experience on Lake Champlain. The survey incorporated visual and normative research methods to formulate standards for several indicator variables. This paper focuses on standards for campsite size and vegetation cover resulting from the survey and integrates these with the actual conditions found in the field. A more detailed discussion of indicators and standards of quality for paddling on Lake Champlain that can be drawn from the survey results is presented in a companion paper to this study (Anderson et al., 2012). Respondents were asked the following question: "When people use campsites, they can cause environmental impact. How much environmental impact do you think is acceptable to see at Lake Champlain Paddlers' Trail campsites?" A series of computer-generated photographs depicting varying levels of campsite impact accompanied this question, and respondents were asked to evaluate each photograph on a scale of −4 ("Very Unacceptable") to +4 ("Very Acceptable"), with 0 representing neutral. Nine study photographs were composed using a 3 × 3 factorial design combining campsite size and vegetation cover and presented to respondents in a random order. Small (30 m^2), medium (85 m^2), and large (125 m^2) campsites were depicted with 88%, 55%, and 12% vegetation cover (Fig. 2). These values correspond to the size and cover classifications used in the campsite impact assessments.

Data analysis

Vegetation cover loss was calculated using the following formula:

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

Data from the campsite assessments were summarized and synthetic variables calculated using ArcGIS 9.3 (ESRI, Redlands, CA, USA) and Microsoft Excel (Microsoft Corporation, Redmond, WA, USA). Survey data were analyzed using Microsoft Excel (Microsoft Corporation, Redmond, WA, USA) SPSS statistical package (v. 18, SPSS Inc., Chicago, IL, USA) using standard approaches.

Respondent ratings of campsite study photographs were analyzed to calculate the minimum acceptability of campsite conditions, defined as the point at which aggregate photo ratings fall below 0. "Acceptability" of was calculated in Excel using the following formula:

$$P_v + \frac{(c * \bar{x}_1)}{(c - \bar{x}_2)}$$

where:

- P_v the *value* for the photo above the axis (e.g. the *number* of people on the trail)
- c the *difference* between each level (e.g. number of people increases by 9 in each photo)
- $\bar{x}_1$ the *mean acceptability rating* for the photograph above the axis
- $\bar{x}_2$ the *mean acceptability rating* for the photograph below the axis

Additionally, an analysis of variance (ANOVA) was conducted to examine the relative influences of campsite size and vegetation cover on respondent ratings of the study photographs. Crystallization of respondent evaluations of campsite condition photographs was measured using Van der Eijk's measure of agreement (A), and calculated using Van der Eijk's (2001) Excel application.

Results

Campsite assessment

A total of 85 campsites were inventoried at the 18 primitive camping areas. A large range of campsite conditions occurred, with condition class ratings of 0–5 and a mean of 2.4 (Table 3). The impacted area of campsites ranged from less than 25 m^2 to greater than 100 m^2, with the median campsite size being in the 30–60 m^2 category. Overall, sites exhibited substantial vegetation cover loss (mean = 51.2%) when compared to adjacent control plots. In other words, there was about 51% less vegetation cover on campsites on average than on adjacent sites that had not been disturbed by camping. However some sites had a higher amount of vegetation cover relative to control sites, resulting in a negative value for cover loss (Table 3). Campsites exhibited a moderate degree of mineral soil exposure, with a mean of 15.9% of the total campsite area being exposed mineral soil.

Cut tree stumps, multiple trailing, and damage to live trees were the most frequent impacts observed, occurring at 66, 59, and 46% of the campsites inventoried, respectively (Table 4). Other impacts such as substantial root exposure, observable human waste, and the presence of trash at campsites were less prevalent, being found at 18,

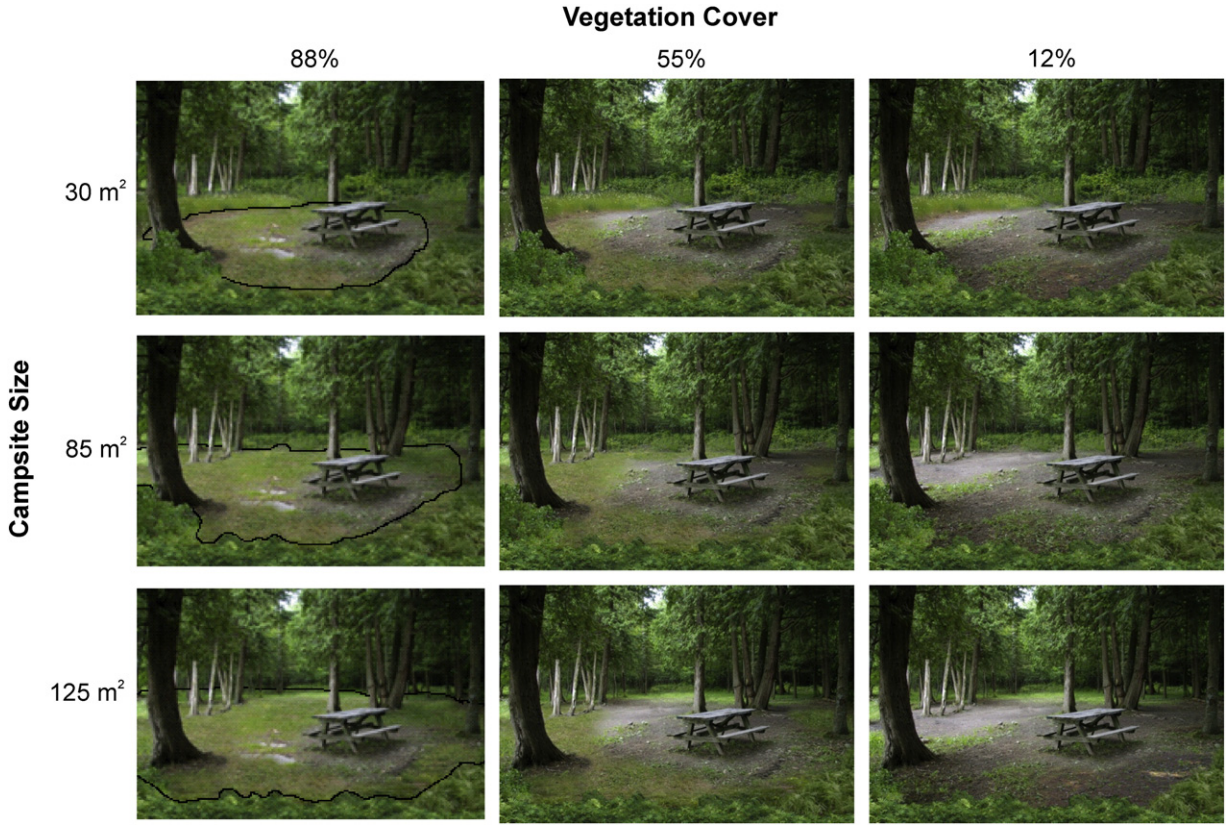

Fig. 2. Study photographs showing different levels of environmental impact at Lake Champlain Paddlers' Trail campsites.

9, and 4% of sites respectively. Large campsites, with areas greater than 70 m^2, were found at 44% of the sites inventoried.

Seven of the 18 primitive camping areas along the LCPT currently employ a confinement strategy to manage camping activities, allowing camping only in designated locations. The remaining eleven areas allow at-large camping. Areas using a confinement strategy account for 54 campsites, or 64% of the total inventoried. At-large camping areas account for 31 campsites, or 36% of the total. Several differences in site condition were observed between campsites in confined and at-large areas (Table 5). Overall, sites in at-large camping areas received significantly lower condition class ratings ($T=4.88$, $P=0.000$) than sites in areas under a confinement strategy. At-large campsites also had significantly fewer fire sites ($T=3.31$, $P=0.001$), access trails ($T=6.08$, $P=0.000$), and cut stumps and shrubs ($T=2.54$, $P=0.013$) than campsites in confined camping areas. Confined campsites were significantly larger than at-large sites ($X^2=32.2$, $P=0.000$) and had higher levels of tree damage ($X^2=13.8$, $P=0.000$). No significant differences in mineral soil exposure ($T=1.38$, $P=0.171$) or vegetation cover loss ($T=0.024$, $P=0.981$) were observed between confinement and at-large campsites.

Table 3
Summary of campsite conditions along the LCPT. Values are means ± SD for continuous measures and medians ± range for ordinal measures (N = 85).

Site attribute	Lake Champlain study area
Continuous measures	
Condition class	2.4 ± 1.3
Fire sites (#)	0.75 ± 0.67
Trails (#)	2.38 ± 1.62
Mineral soil exposure (%)	15.9 ± 23.61
Stumps/cut shrubs (#)	3.15 ± 3.62
Vegetation cover loss (%)	51.2 ± 38.65
Ordinal measures	
Size of impacted area	2 ± 3
Human waste	1 ± 1
Litter/trash	1 ± 3
Tree damage	1 ± 2
Root exposure	1 ± 2

Paddler survey

The mail-back survey obtained a 63.0% response rate, yielding 298 completed questionnaires. Since it was plausible that some LCC members who were not active paddlers may have requested to receive the Paddler's Trail guidebook, a screening question was included in the survey asking respondents if they had paddled on Lake Champlain within the last 10 years. Eighty-five surveys were returned from "inactive" paddlers, resulting in a total usable sample of 213 completed surveys. Of these 213 individuals, 92% had paddled on the lake at least once during the previous year.

A summary of responses to the study photographs illustrating campsite impacts is presented in Table 6 and presented graphically in

Table 4
Frequency of observed impact problems at LCPT sites (N = 85).

Impact parameter	Frequency	Percent of campsites with impact present
≥Moderate tree damage	39	46
≥Moderate root exposure	15	18
Cut tree stumps	56	66
Multiple trailing	50	59
Significant presence of litter	3	4
Observable human waste	8	9
Campsites larger than 70 m^2	37	44

Table 5
Comparison of site conditions and campsite management strategy.

Impact parameter	Camping management strategy		*T*	*P*
	Confinement	At-large		
Continuous measures[a]				
Number of campsites	54	31		
Sites per area	7.3	2.8		
Condition class	2.89	1.58	4.88	0.000
Fire sites (#)	0.93	0.45	3.31	0.001
Informal trails (#)	2.98	1.32	6.08	0.000
Mineral soil exposure (%)	18.98	11.19	1.38	0.171
Stumps/cut shrubs (#)	3.83	1.97	2.54	0.013
Vegetation cover loss (%)	51.07	51.30	0.024	0.981
Scale measures[b]			Chi-Square	*P*
Campsite size	3.5	1	32.2	0.000
Human waste	1	1	2.19	0.139
Litter/trash	1	1	0.12	0.934
Tree damage	2	1	13.8	0.000
Root exposure	1	1	0.098	0.754

[a] Values are means.
[b] Values are medians.

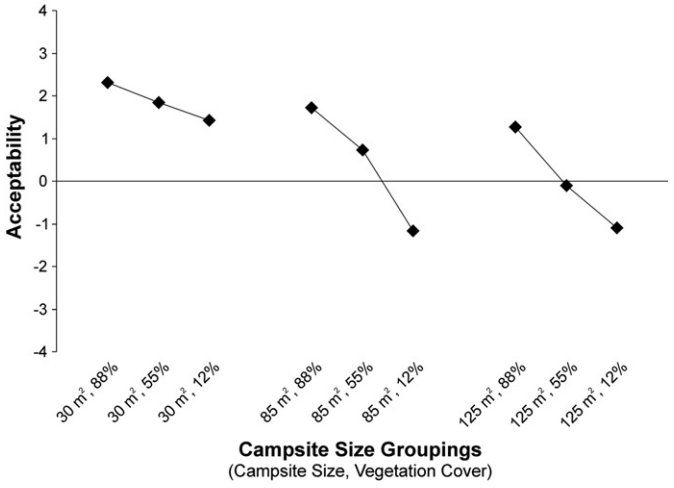

Fig. 3. Social norm curve for the acceptability of campsite impacts. * Van der Eijk's agreement scores are 0.58 (30 $m^2 \times 88\%$), 0.48 (30 $m^2 \times 55\%$), 0.38 (30 $m^2 \times 12\%$), 0.46 (85 $m^2 \times 88\%$), 0.32 (85 $m^2 \times 55\%$), 0.28 (85 $m^2 \times 12\%$), 0.33 (125 $m^2 \times 88\%$), 0.21 (125 $m^2 \times 55\%$), 0.27 (125 $m^2 \times 12\%$).

Fig. 3. Findings suggest that respondents consider increasing levels of impact to campsites to be increasingly unacceptable. However, norm intensity for campsite impacts was low to moderate. Van der Eijk's A ranged from 0.21 for large (125 m^2) campsites with moderate (55%) vegetation cover to 0.58 for small (30 m^2) campsites with high (88%) vegetation cover, indicating moderate levels of agreement among respondents. None of the study photographs depicting small (30 m^2) campsites received an overall negative rating by respondents. A minimum of 38% and 57% vegetation cover was found to be acceptable at medium (85 m^2) and large (125 m^2) campsites, respectively.

An analysis of variance (ANOVA) was conducted to examine the relative influences of campsite size and vegetation cover on respondent ratings of the study photographs. Size ($df = 2$, $F = 244.421$, $P = 0.000$) and cover ($df = 2$, $F = 247.142$, $P = 0.000$) both significantly influenced respondent evaluations for the acceptability of campsite study photographs. There was also a significant interaction between size and cover ($df = 4$, $F = 24.129$, $P = 0.000$).

Integration of field-based measurements and paddler standards

The current condition of LCPT campsites can be evaluated from a visitor perspective by integrating the results of the field assessment and survey results. The field assessment identified 48 small (≤60 m^2), 10 medium (70–100 m^2), and 27 large (>100 m^2) campsites. Fifteen of the large campsites, or 55%, have vegetation cover levels that fall below the paddler standard of 57% cover. Two of the medium campsites are out-of-standard and an additional four are approaching the standard, with current vegetation cover of 38% (Fig. 4). Campsites that are out-of-standard or approaching the standard for vegetation cover are concentrated at four camping areas at the northern end of Lake Champlain. A confinement strategy is currently in place at three of these areas.

Table 6
Summary of paddler responses to campsite impact study photographs.

Photographs: campsite size × vegetation cover	n	Mean acceptability rating[a]	SD	A[b]
30 $m^2 \times 88\%$	174	2.32	1.60	0.58
30 $m^2 \times 55\%$	176	1.84	1.73	0.48
30 $m^2 \times 12\%$	174	1.43	1.92	0.38
85 $m^2 \times 88\%$	175	1.72	1.79	0.46
85 $m^2 \times 55\%$	171	0.73	1.92	0.32
85 $m^2 \times 12\%$	176	−1.16	2.43	0.28
125 $m^2 \times 88\%$	175	1.12	2.07	0.33
125 $m^2 \times 55\%$	174	−0.10	2.22	0.21
125 $m^2 \times 12\%$	176	−1.10	2.47	0.27

[a] Measured on scale of +4 ("Very acceptable") to −4 ("Very unacceptable").
[b] Level of crystallization using Van der Eijk's measure of agreement (A).

Discussion

The overall quality of primitive LCPT campsites as indicated by this study is relatively high (Table 3). However, certain avoidable impacts are prevalent (Table 4). Damage to live trees, cut stumps and shrubs, sites with multiple access trails, and excessively large sites are common. Several options for addressing these impacts are available. Low impact education programs have been shown to be successful in limiting undesirable visitor behaviors and associated impacts in primitive natural areas (e.g. Manning, 2003; Marion and Reid, 2007). On-site management actions such as group size limits, campsite maintenance (Marion and Farrell, 2002), delineation of site boundaries (Daniels and Marion, 2006; Leung and Marion, 1999), and site restoration (Boyers et al., 2000) are also options for areas with higher use or impact levels, and could be appropriate at some LCPT sites. It is important to note that different management actions may be needed for different kinds of sites (Leung and Marion, 1999), and often the use of multiple methods is more successful in achieving management goals. Establishing a campsite inventory and monitoring program for primitive LCPT sites would allow managers to evaluate the relative success of different site management methods in minimizing impacts.

Primitive camping areas along the LCPT employ a mix of confinement and at-large strategies for managing camping activities. Several significant differences were observed between these areas (Table 4), with at-large campsites tending to have lower levels of impact than campsites in areas utilizing a confinement strategy. It is not surprising that sites in confinement camping areas exhibit higher levels of impact, as all use is concentrated in the same area. While this study did not examine the distribution of use at LCPT campsites or specific management treatments, the observed differences in campsite condition could be related to higher use levels at confined camping areas than at-large camping areas. Most of the confined camping areas are located in state parks, and many of these are popular camping areas visited by motorboat and sailboat users in addition to paddlers. In contrast, at-large LCPT camping areas tend to be in locations that are less accessible to motorboats or sailboats. Thus it is likely that at-large sites are visited primarily by paddlers and receive less use than confinement camping areas. At-large areas may provide for a more primitive and unconfined recreation experience,

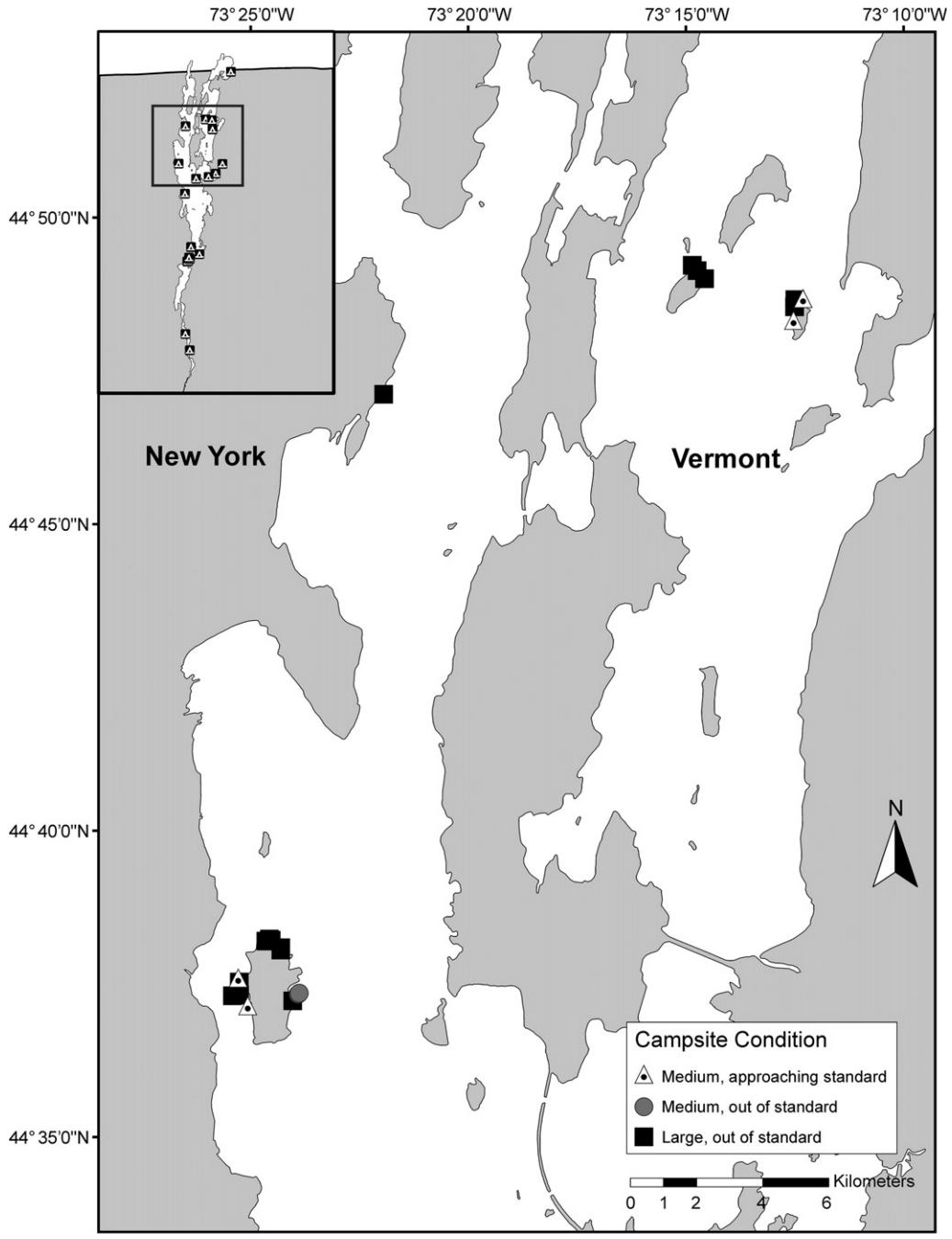

Fig. 4. Locations of Lake Champlain Paddlers' Trail campsites that have exceeded or are approaching vegetation cover standards.

and are valuable components of the LCPT from a visitor experience perspective. However, maintaining such low levels of impact at these areas may require more active management efforts such as minimum impact education and information programs targeted to LCPT campers. The implementation of a formal dispersal strategy (i.e. discouraging visitors from camping in previously impacted areas) could maintain low impact levels by allowing sites to recover from use. However, very low use levels are generally necessary for dispersed camping to be effective at minimizing biophysical impacts, and may not be appropriate if use at LCPT at-large camping areas increases. Monitoring of visitation and use levels can help managers select appropriate management techniques.

Overall, the results of this study suggest that the mixed confinement and at-large strategy of LCPT campsite management is working. However, managers should be mindful of the potential for impacts to increase. Primary concerns at confined camping areas are increases in the intensity of impacts (e.g., reduced vegetation cover, increases in mineral soil and root exposure), the proliferation of impacts to campsite margins (i.e., increases in the size of campsites), and impacts resulting from depreciative visitor behavior (e.g., damage to live trees). While the intensity of impacts and depreciative impacts have the potential to increase in at-large camping areas, a primary concern is the formation of new sites and the areal expansion of existing sites. Future monitoring of primitive LCPT sites is necessary to determine resource condition trends and highlight the need for management action.

Results from the paddler survey provide evaluative assessments for vegetation cover on campsites of various sizes. While none of the conditions for small campsites were found to be unacceptable, standards for vegetation cover were determined for medium and

large campsites. A total of 17 campsites were found to be out of compliance with the paddler standard for vegetation cover, with an additional four sites approaching the standard. All of these sites were located in one of four camping areas at the northern end of Lake Champlain. Three of these areas utilize a confinement strategy, with camping allowed only at designated sites. However many of these sites are excessively large, putting them at a higher risk of being evaluated unfavorably by paddlers as the standard for vegetation cover is higher for larger campsites.

Results from the paddler survey indicate that respondents are able to distinguish among the amount of vegetation loss and the area over which this loss occurs in evaluating campsite impacts, a consideration which has been emphasized by recreation ecology research (Cole, 1989). Social norm curves for campsite condition measured by the paddler survey also suggest that paddlers may be more sensitive to the size of the impacted area than to the amount of vegetation cover present. The standard for the minimum acceptable amount of vegetation cover was highest for large campsites, whereas a small campsite with almost no vegetation cover was found to be acceptable. This observation is supported by further analysis of the data showing significant effects of size and vegetation cover on respondents' ratings of study photographs, and a significant interaction between these two variables. Previous studies of visitors' perceptions of biophysical impacts of recreation in natural settings have found that visitors may be willing to tolerate some level of impact and perceive certain impacts as adding to the desirability of an area for specific activities. For example, a study of wilderness campers found that large core areas denuded of vegetation, nails in trees, and fire rings added to the desirability of campsites (White et al., 2001). Evaluative comments campers provided relating to campsite conditions were largely positive, with many relating to the functional benefits afforded by impacts such as the loss of vegetation in core site areas. However, several studies have found that visitors are less accepting of impacts that are excessive or could easily be avoided with proper minimum impact practices (Farrell et al., 2001; Monz, 2009; Roggenbuck and Watson, 1993; White et al., 2008). In the case of LCPT primitive camping areas, paddlers may be less accepting of excessively large campsites than they are of vegetation cover loss present within the site.

While this study was focused specifically on Lake Champlain, the findings have several implications for primitive campsite management in general, especially on similar large lake ecosystems. First, paddlers' sensitivity to the spatial extent of camping impacts supports the perspective that aggregate impact may be more of a management concern than the level of degradation on individual sites (e.g. Cole, 1993; Cole and Hall, 1992; Cole et al., 2008). Second, the current at-large management strategy in place at some camping areas appears to be fairly successful from both an ecological and visitor experience perspective, as the total level of impact at these sites is low. It is possible that paddlers may prefer these areas for a more primitive experience. However, in order to maintain these conditions use must be dispersed, and visitors should avoid camping in previously impacted areas. If use of these camping areas increases sufficiently, the implementation of a confinement strategy may be necessary in order to minimize impacts. However, a confinement policy could also affect the paddler experience by creating a more “developed” camping experience.

Finally, these results suggest that future campsite assessment and monitoring efforts should focus more on the areal extent of vegetation impacts and less on the amount of vegetation loss at a particular site. Not only do changes in the extent of impacts tend to be more pronounced than the intensity of impacts in established sites, but also the majority of the impact occurs with initial use. Monitoring the areal expansion of impacts to previously undisturbed areas and the growth of campsites may do more to serve resource management goals than monitoring vegetation cover loss at established sites.

Acknowledgments

The authors thank the Lake Champlain Committee for their assistance and support throughout this project. We also thank Rachel Valliere, Peter Pettengill, and Seton Gruneisen for their assistance with fieldwork. The Lake Champlain Sea Grant Emerging Threats Vessel Fund and Cpt. Dick Furbush and Chris Fox of the *Melosira* provided considerable help with logistical support and travel in the field. This study was supported by funding from the Lake Champlain Sea Grant. The second author thanks the Utah State Agricultural Experiment Station for funding support for this project. We also thank the reviewers and guest editor of the *Journal of Great Lakes Research* for providing helpful feedback in the preparation of this manuscript.

References

Anderson, L.E., Manning, R.E., Monz, C.A., Goonan, K.A., 2012. Indicators and standards of quality for paddling on Lake Champlain. J. Great Lakes Res. 38 (Supplement 3), 150–156.

Boyers, L., Fincher, M., van Wagtendock, J., 2000. Twenty-eight years of wilderness campsite monitoring in Yosemite National Park. In: Cole, D.N., McCool, S.F., Borrie, W.T., O'Loughlan, J. (Eds.), Wilderness Science in a Time of Change Conference. Vol. 5. Wilderness Ecosystems, Threats and Management. Proceedings RMRS-P-15-Vol-5, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, Utah, pp. 105–109.

Capen, D., Kuentzel, W., Higgins, B., Richards, Z., 2010. Distribution of lake users and recreational activities on Lake Champlain. Presentation at Lake Champlain 2010: Our Lake, Our Future conference, June 8, 2010.

Cole, D.N., 1983a. Monitoring the condition of wilderness campsites. Res. Pap. INT-302. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.

Cole, D.N., 1983b. Campsite conditions in the Bob Marshall Wilderness, Montana. Res. Pap. INT-312. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.

Cole, D.N., 1989. Area of vegetation loss: a new index of campsite impact. Res. Note INT-389. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT.

Cole, D.N., 1993. Campsites in three western wildernesses: proliferation and changes in condition over 12 to 16 years. Res. Pap. INT-463. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT.

Cole, D.N., 1995. Experimental trampling of vegetation I. Relationship between trampling intensity and vegetation response. J. Appl. Ecol. 32 (1), 203–214.

Cole, D.N., 2004. Impacts of hiking and camping on soils and vegetation: a review. In: Buckley, R. (Ed.), Environmental Impacts of Ecotourism. CAB International, Wallingford, UK, pp. 41–59.

Cole, D.N., Hall, T.E., 1992. Trends in campsite condition: Eagle Cap Wilderness, Bob Marshall Wilderness, and Grand Canyon National Park. Res. Pap. INT-453. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT.

Cole, D.N., Monz, C.A., 2003. Impacts of camping on vegetation: response and recovery following acute and chronic disturbance. Environ. Manag. 32 (6), 693–705.

Cole, D.N., Monz, C.A., 2004. Spatial patterns of recreation impact on experimental campsites. J. Environ. Manag. 70 (1), 73–84.

Cole, D.N., Foti, P., Brown, M., 2008. Twenty years of change on campsites in the backcountry of Grand Canyon National Park. Environ. Manag. 41 (6), 959–970.

Daniels, M.L., Marion, J.L., 2006. Visitor evaluations of management actions at a highly impacted Appalachian Trail camping area. Environ. Manag. 38, 1006–1019.

Dillman, D., 2000. Mail and Internet Surveys: The Tailored Design Method, second ed. John Wiley, Hoboken.

Farrell, T., Hall, T.E., White, D.D., 2001. Wilderness campers' perception and evaluation of campsite impacts. J. Leis. Res. 33 (3), 229–250.

Fodor, P.A., 1990. Backcountry campsite management and monitoring in Sequoia and Kings Canyon National Parks. In: Lime, David W. (Ed.), Managing America's Enduring Wilderness Resource. University of Minnesota, Agricultural Experiment Station and Extension Service, Minneapolis, MN, St. Paul, pp. 188–191.

Frissell, S.S., 1978. Judging recreational impacts on wilderness campsites. J. For. 76, 481–483.

Gettinger, D.S., Krumpe, E.E., Wright, R.G., 1998. Recreational impacts to wilderness campsites at North Cascades National Park. Natural Resources Report NPS/CCSOUI/NRTR-98/14. USGS Biological Resources Division, University of Idaho Wildlife Management Institute, Moscow, ID.

Hammitt, W.E., Cole, D.N., 1998. Wildland Recreation: Ecology and Management, second ed. John Wiley & Sons, New York.

Krymkowski, D., Manning, R., Valliere, W., 2009. Norm crystallization: measurement and comparative analysis. Leis. Sci. 31, 403–416.

Lake Champlain Basin Program, 2010. Draft Management Plan/Environmental Assessment. Champlain Valley National Heritage Partnership. Retrieved January 17, 2011, from http://www.champlainvalleynhp.org/plan.htm.

Lake Champlain Committee, 2008. The Lake Champlain Paddlers' Trail 2008 Guidebook and Stewardship Manual, tenth ed. Repro Digital, Burlington, VT.

Lake Champlain Committee, 2010. The Lake Champlain Paddlers' Trail 2010 Guidebook & Stewardship Manual, twelfth ed. Repro Digital, Burlington, VT.

Leung, Y., Marion, J.L., 1999. Characterizing backcountry camping impacts in Great Smoky Mountains National Park, USA. J. Environ. Manag. 57 (3), 193–203.
Leung, Y., Marion, J.L., 2000. Recreation impacts and management in wilderness: a state-of-knowledge review. In: Cole, D.N., McCool, S.F., Borrie, W.T., O'Loughlan, J. (Eds.), Wilderness Science in a Time of Change Conference. Vol. 5. Wilderness Ecosystems, Threats and Management. Proceedings RMRS-P-15-Vol-5. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, Utah, pp. 23–48.
Lynn, N.A., Brown, R.D., 2003. Effects of recreational use impacts on hiking experiences in natural areas. Landsc. Urban Plan. 64, 77–87.
Manning, R.E. 2003. Emerging principles for using information/education in wilderness management. Int. J. Wilderness 9 (1), 20–27, 12.
Manning, R.E., 2007. Parks and Carrying Capacity: Commons Without Tragedy. Island Press, Washington, D.C.
Manning, R.E., 2011. Studies in Outdoor Recreation, third ed. Oregon State University Press, Corvallis.
Manning, R.E., Freimund, W.A., 2004. Use of visual research methods to measure standards of quality for parks and outdoor recreation. J. Leis. Res. 36 (4), 557–579.
Manning, R., Lawson, S., 2002. Carrying capacity as "informed judgment": the values of science and the science of values. Environ. Manag. 30 (2), 157–168.
Manning, R.E., Lawson, S.R., Newman, P., Budruk, M., Valliere, W., Laven, D., Bacon, J., 2004. Visitor perceptions of recreation-related resource impacts. In: Buckley, R. (Ed.), Environmental Impacts of Ecotourism. CABI International, Oxford, pp. 259–271.
Marion, J.L., 1995. Capabilities and management utility of recreation impact monitoring programs. Environ. Manag. 19 (5), 763–771.
Marion, J.L., Cole, D.N., 1996. Spatial and temporal variation in soil and vegetation impacts on campsites. Ecol. Appl. 6 (2), 520–530.
Marion, J.L., Farrell, T.A., 2002. Management practices that concentrate visitor activities: camping impact management at Isla Royale National Park, USA. J. Environ. Manag. 66 (2), 201–212.
Marion, J.L., Merriam, L.C., 1985. Recreational Impacts on Well-established Campsites in the Boundary Waters Canoe Area Wilderness. Agricultural Experiment Station, University of Minnesota, St. Paul.
Marion, J.L., Reid, S.E., 2007. Minimising visitor impacts to protected areas: the efficacy of low impact education programmes. J. Sustain. Tourism 15 (1), 5–27.
Marion, J.L., Sober, T., 1987. Environmental impact management in the Boundary Waters Canoe Area Wilderness. North. J. Appl. For. 4 (1), 7–10.
Merriam, L.C., Peterson, R.F., 1983. Impact of 15 years of use on some campsites in the Boundary Waters Canoe Area. Minn. For. Res. Notes. no. 282.
Merriam, L.C., Smith, C.K., 1974. Visitor impact on newly developed campsites in the Boundary Waters Canoe Area. J. For. 72 (10), 627–630.
Monz, C.A. 1998. Monitoring recreation resource impacts in two coastal areas of western North America: an initial assessment, in: Watson, A.E. et al. (compilers), Personal, Societal and Ecological Values of Wilderness: Sixth World Congress Proceedings on Research, Management, and Allocation, Vol. 1. Proceedings RMRS-P-4. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, Utah.
Monz, C.A., 2000. Recreation resource and monitoring techniques: examples from the Rocky Mountains, USA. In: Godde, P., Price, M., Zimmerman, F. (Eds.), Tourism and Development in Mountain Regions. CAB International, Wallingford, pp. 47–68.
Monz, C., 2009. Climbers' attitudes toward recreation resource impacts in the Adirondack Park's Giant Mountain Wilderness. Int. J. Wilderness 15 (1), 26–33.
Monz, C.A., Twardock, P., 2004. Campsite impacts in Prince William Sound, Alaska. In: Buckley, R. (Ed.), The Environmental Impacts of Ecotourism. CABI, Wallingford, pp. 309–319.
National Park Service, 1997. The Visitor Experience and Resource Protection (VERP) Framework: A Handbook for Planners and Managers. U.S. Department of the Interior, National Park Service, Denver Service Center.
Newman, P., Manning, R., Dennis, D., McKonly, W., 2005. Informing carrying capacity decision making in Yosemite National Park, USA using stated choice modeling. J. Park. Recreat. Adm. 23 (1), 75–89.
Reid, S.E., Marion, J.L., 2004. Effectiveness of a confinement strategy for reducing campsite impacts in Shenandoah National Park. Environ. Conserv. 31 (4), 274–282.
Roggenbuck, J.W., Watson, A.E., 1993. Defining acceptable conditions in wilderness. Environ. Manag. 17 (2), 187–197.
Spildie, D.R., Cole, D.N., Walker, S.C. 2000. Effectiveness of a confinement strategy in reducing packstock impacts at campsites in the Selway–Bitterroot Wilderness, Idaho, in: D.N. Cole, S.F. McCool, W.T. Borrie, J. O'Loughlin, (comps.), Wilderness Science in a Time of Change Conference—Volume 4: Wilderness Visitors, Experience, and Visitor Management, Threats, and Management, RMRS-P-15-VOL-5, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, UT, pp.199–208.
Stankey, G.H., Cole, D.N., Lucas, R.C., Peterson, M.E., Frissell, S.J., 1985. The Limits of Acceptable Change (LAC) system for wilderness planning. General Technical Report INT-176. U.S. Department of Agriculture, Forest Service. U.S. Government Printing Office, Washington, D.C.
Twardock, P., Monz, C., Smith, M., Colt, S., 2010. Long-term changes in resource conditions on backcountry campsites in Prince William Sound, Alaska, USA. Northwest Sci. 84 (3), 223–232.
Van der Eijk, C., 2001. Measuring agreement in ordered rating scales. Qual. Quant. 35, 325–341.
Vaske, J.J., Whittaker, D., 2004. Normative approaches to natural resources. In: Manfredo, M.J., Vaske, J.J., Bruyere, B.L., Field, D.R., Brown, P. (Eds.), Society and Natural Resources: A Summary of Knowledge. Modern Litho, Jefferson, pp. 283–294.
White, D.D., Hall, T.E., Farrell, T.A., 2001. Influence of ecological impacts and other campsite characteristics on wilderness visitors' campsite choices. J. Park. Recreat. Adm. 19 (2), 83–97.
White, D.D., Virden, R.J., van Riper, C.J., 2008. Effects of place identity, place dependence, and experience-use history on perceptions of recreation impacts in a natural setting. Environ. Manag. 42 (4), 647–657.