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Sustainable Transportation for Tourism: Indicators and Standards

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1. Introduction

The overall project goal of guiding planning and management of transportation to serve the needs of sustainable tourism focused on three tourism-related transportation contexts. The first context was selected types of roads important to tourism in the northern New England: park and related roads (e.g., the Loop Road in Acadia National Park, Maine), rural roads/Scenic Byways (e.g., Route 100 in Vermont), and rural sections of interstate highways (e.g., Interstate 89 in Vermont). The second context was selected tourism destinations important in Vermont and other tourism-dependent northern communities: tourism villages (e.g., downtown destinations like Stowe and Burlington). The third context was transit public transit in park settings (e.g., the Island Explorer in Bar Harbor, Maine). Case studies from these three contexts served as the focus for the creation of a level of service framework.

Two tourism-related transportation contexts were the focus for examination of components necessary in a green certification program to affect change in tourist travel. The first context applied to transportation systems within parks and scenic roads. The second context was transportation options in tourism villages and ski resorts. Within these two contexts, “green” alternatives for mass transit and tourism-related motorcoach travel were examined.

Indicators and Standards for Sustainable Transportation

Creation of a level of service framework for tourism-related transportation was conducted over the course of four years, focusing on selected types of transportation that are especially important to tourism. Year One focused on identifying indicators for tourism-related transportation. This work employed literature review, quantitative and qualitative surveys, focus groups, and stated choice modeling to identify the most important and desirable attributes of selected tourism-related forms of transit. This work included both transportation/tourism professionals and tourists. Year Two focused on standards for the most important indicators identified in the first phase of research. Quantitative surveys were conducted to identify preferred and minimally acceptable conditions of indicator variables. This work utilized normative research methods derived from sociology and applied in many fields of study, including tourism/recreation and broader natural resources and environmental issues (Manning, 2011; Vaske and Whittaker, 2004). Visual research methods were also used where applicable to realistically represent and enable evaluation of a range of transportation-related attributes (Manning and Freimund, 2004).

Year Three integrated study findings into indicators and standards and related best practices guidelines that can be used to guide tourism-related transportation planning and management. The development of best practices was guided by the research from the previous two years. Recommendations were focused on tourism-related transportation and are holistic, in that they incorporate experiential and environmental considerations to help ensure that tourism is ultimately sustainable.

Year Four focused on preparing papers and publications, including this report.

2. Research Methodology

Indicators and Standards of Quality

Surveys of transportation users employing open and close-ended questions, normative theory and methods, and visual simulations were developed and administered during summer 2009. Study contexts included 1) a spectrum of recreation sites ranging from low to high levels of use and development and 2) multiple modes of transportation. Surveys were conducted in three contexts and included roads, greenways, and public transit. Three sites within the three contexts were used. The three road contexts included the Acadia National Park Loop Road, Vermont Route 100, and Interstate 89 in Vermont. The three greenways contexts included the Acadia National Park Carriage roads, the Stowe Recreation Path, and the Burlington Bike Path. The three public transit contexts included the Acadia National Park Island Explorer, the Muir Woods Shuttle Bus, and the Alcatraz Island Ferry.

Response rates for the surveys were as follows:

For roads: A total of 247 questionnaires (87% response rate) were collected at the Acadia Loop Road, another 311 questionnaires (69% response rate) were collected at Vermont Route 100, and 242 (77% response rate) were collected at Interstate 89 in Vermont.

For greenways: A total of 249 questionnaires (94% response rate) were collected at the Acadia Carriage Roads, another 274 (94% response rate) were collected at the Stowe Recreation Path, and 318 (88% response rate) were collected at the Burlington Bike Path.

For public transit: A total of 255 questionnaires (79% response rate) were collected on the Acadia National Park Island Explorer, 236 (44% response rate) were collected on the Muir Woods Shuttle, and 200 (95% response rate) were collected on the Alcatraz Island Ferry.

Stated Preference – Mode Choice Decision Modeling

Stated preference experiments engage respondents through a sequence of unique choice scenarios that illustrate competing arrangements of multi-attribute goods or services. For instance, a survey instrument may describe varying conditions of what it might be like to travel in a national park by car, shuttle bus, or bicycle. Each transportation option is described in terms of varying levels of crowding, convenience, corridor design, and cost and a number of choice scenarios are employed for each survey. Respondents rank order how they would prefer to travel based on each alternative scenario and the resulting data is aggregated. Statistical analysis of aggregate choice data reveals the importance of the attributes that define each travel mode. In the interest of informing congestion management systems for national parks, two study areas that receive high levels of visitation were selected. The two parks selected for study were Acadia National Park and Yosemite National Park. These sampling sites were chosen based upon their iconic nature as visitor attractions. These sites receive their highest levels of use during the summer months, and each site was is accessible by car, shuttle bus, and bicycle.

Selection of Attributes and Levels

Data from the 2009 travel surveys were used to inform the selection of attributes and levels for the state preference study. Furthermore, the selections were corroborated by other studies and consultation with outdoor recreation researchers and transportation planners. Ultimately, four multi-level attributes were selected for this study and each attribute characterized the three different modes of transportation available at the study sites. For instance, convenience was selected as an attribute to describe the relative ease of access to a destination for each transportation mode. This equated to availability of parking for the car mode, frequency of service for the shuttle bus mode, and availability of bicycles for the bike mode. The other transportation attributes (i.e., crowding, corridor design, and cost) and their associated levels are described in Table 1.

The levels for each attribute were selected to reflect realistic and reasonable conditions for travel to and around park attraction sites. For instance, travel corridors may be designed in a number of ways: (1) as two-lane highways with little or no road shoulder; (2) as two-lane highways with shoulders wide enough for a bike lane in both directions; or (3) as two-lane highways with dedicated bike paths separate from the road itself. Each of these design options is realistic and reasonable for park settings. Levels for each of the other transportation attributes were selected on a similar basis.

Survey Design and Analytical Model

An orthogonal fractional factorial design was used to organize the selected attributes and their associated levels into 36 choice sets comprised of 3 alternatives each. Fractional factorial design is widely used as a proxy for full factorial design because it reduces the number of choice sets respondents must address. However, because fractional factorial design has fewer runs than full-factorial designs, it also has some limitations. Some interaction effects may become confounded therefore this design did not include interaction effects and was limited to the estimation of a main effects only mode. The survey design used is also orthogonal because every level appears equally often for each attribute, this is also referred to as level balance. The choice sets for this study were blocked into four different versions of the questionnaire, each with 9 choice scenarios. The utility of every level of each attribute when presented together was designed to be modeled using multinomial logistic (MNL) regression. Effects coding was used to represent the travel attributes in the statistical model. This provides results, in terms of utility, about preferences for every level of each attribute.

Survey Instrument and Administration

Four versions of the questionnaire were developed for this study. Each version included nine different choice sets and combined narrative descriptions with digitally-edited images. Narrative descriptions were used to characterize various levels of convenience, corridor design, and cost, while the images were used to depict a range of crowding conditions. Data were collected during July and August of 2010 in both Yosemite National Park and Acadia National Park. The on-site questionnaires were distributed to frontcountry visitors traveling to or arriving at sampling sites within the parks.

Response rates for the surveys were as follows:

Acadia National Park: A total of 490 questionnaires (74% response rate) were collected.

Yosemite National Park: A total of 537 questionnaires (59% response rate) were collected.

Table 1: Transportation modes, attributes and levels

	Car	Shuttle Bus	Bicycle
Crowding	4 cars per 125m length of road	There is 1 rider for each seat	6 bicycles per 125m length of path.
	8 cars per 125m length of road	There are 5 riders for every 4 seats	15 bicycles per 125m length of path.
	12 cars per 125m length of road	There are 3 riders for every 2 seats	24 bicycles per 125m length of path.
Convenience	Parking is always available at attraction sites within the park.	Buses depart stops every 15 minutes.	Bicycles are available at multiple locations in the park.
	Parking is sometimes available at attraction sites within the park.	Buses depart stops every 30 minutes.	Bicycles are available at a single location in the park.
	Parking areas are often full at attraction sites within the park.	Buses depart stops every 45 minutes.	Bicycles are available outside the park.
Corridor Design	The travel corridor is designed as a two-lane highway with no bike lane.	The travel corridor is designed as a two-lane highway with no bike lane.	The travel corridor is designed as a two-lane highway with no bike lane.
	The travel corridor is designed as a two-lane highway with a bike lane on the road shoulder.	The travel corridor is designed as a two-lane highway with a bike lane on the road shoulder.	The travel corridor is designed as a two-lane highway with a bike lane on the road shoulder.
	The travel corridor is designed as a two-lane highway with a bike lane separate from the highway.	The travel corridor is designed as a two-lane highway with a bike lane separate from the highway.	The travel corridor is designed as a two-lane highway with a bike lane separate from the highway.
Cost	There is no additional fee to enter the park by car.	Shuttle bus is provided at no cost to visitors.	There is no fee to rent a bicycle.
	There is an additional fee of $10 to enter the park by car.	Shuttle bus costs $1 per person per ride.	There is a fee of $15 per day to rent a bicycle.
	There is an additional fee of $20 to enter the park by car.	Shuttle bus costs $2 per person per ride.	There is a fee of $30 per day to rent a bicycle.

3. Results

Indicators and Standards of Quality

This section includes selected results from indicators and standards survey research conducted in 2009. Complete results from the 2009 study can be seen in tabular form in Appendix A.

Trip Purpose

Respondents were asked to use a nine-point scale to rate the purpose of their trip ranging from 1 ("purely transportation") to 9 ("purely recreation"). Rather than dichotomizing trip purpose, this scale provided an opportunity for respondents to consider their trips as both functional and fun. Results from this question indicate that overall, transit riders in park and tourism settings are more transportation-oriented, while greenway users are primarily recreation-oriented; road travelers tend to be in the middle of the scale (Figure 1).

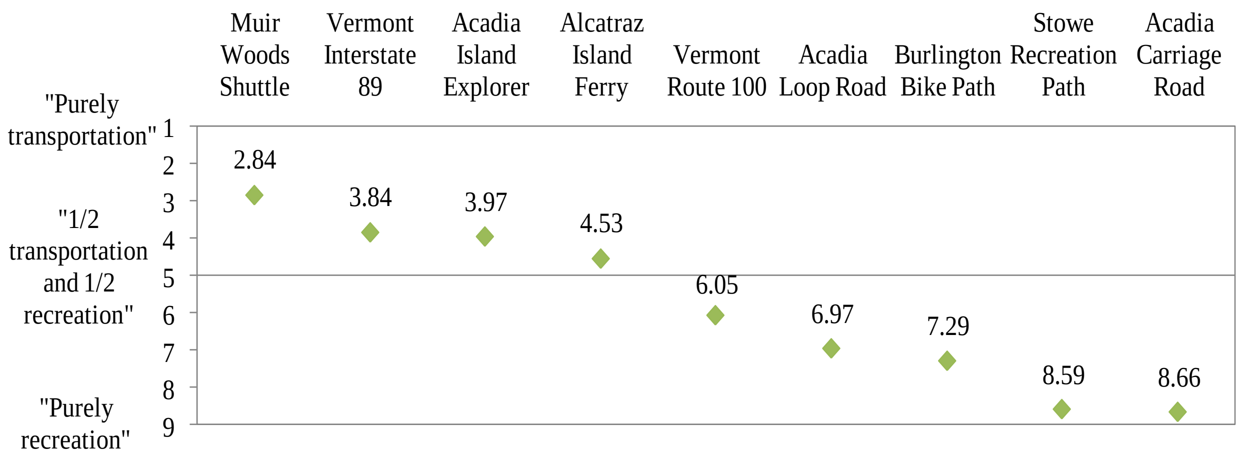


Figure 1: Transportation – Recreation Scale

Perceptions of Quality

Respondents were asked to report on items that may be considered potentially desirable or undesirable components of the transportation modes they used. Respondents were asked to rate the degree to which each item was considered desirable or undesirable using a scale that ranged from -2 ("very undesirable") to +2 ("very desirable"). Overall, scenic views were ranked by respondents as the most desirable attribute across all three travel contexts (Table 2). Other important attributes included "participating in a healthy form of transportation/recreation" for greenways, and "minimizing the impacts of travel" for transit users.

Table 2: Most desirable attributes across contexts and settings.

Attribute	Mean* (Rank)	Mean (Rank)	Mean (Rank)
	Vermont Interstate 89	Vermont Route 100	Acadia Loop Road
Scenic views…………….............	1.74 (1)	1.62 (1)	1.85 (1)
Lack of litter………………................	1.62 (2)	1.44 (3)	1.79 (3)
Lack of graffiti………………………	1.61 (3)	1.46 (2)	1.83 (2)
	Burlington Bike Path	Stowe Recreation Path	Acadia Carriage Roads
Scenic views…………………………	1.81 (1)	1.81 (2)	1.88 (3)
Participating in a healthy form of transportation/recreation………..	1.76 (2)	1.82 (1)	1.91 (1)
Participating in a form of transportation/recreation that is integrated into a natural setting.	1.72 (3)	1.81 (3)	--
Being away from motorized transportation…………...................	--	--	1.90 (2)
	Alcatraz Island Ferry	Muir Woods Shuttle	Acadia Island Explorer
Scenic views………………...............	1.73 (1)	1.21 (2)	--
Photographic opportunities……….	1.50 (2)	--	--
Able to move around freely within	1.49 (3)	--	--
Minimizing impacts of travel……..	--	1.36 (1)	1.72 (1)
Riders act in a courteous manner toward each other………………..	--	1.12 (3)	--
Access to recreation………………	--	--	1.59 (2)
Access to park highlights…............	--	--	1.51 (3)

***Mean values based on 5-point scale from -2 = "very undesirable" to +2 = "very desirable"**

Figures 2- 5 below show depict social norm curves for density of use for the number of cars on roads (Figure 2), the number of pedestrians on greenways (Figure 3), the number of bicycles on greenways (Figure 4), and the number people on public transit (Figure 5). These figures are expressed in terms of density. In the case of roads and greenways, the figures show the acceptability of different number of meters per car/pedestrian/bicycle, while in the case of public transit, they show the acceptability of the number of seats per rider. This allows for comparison across contexts.

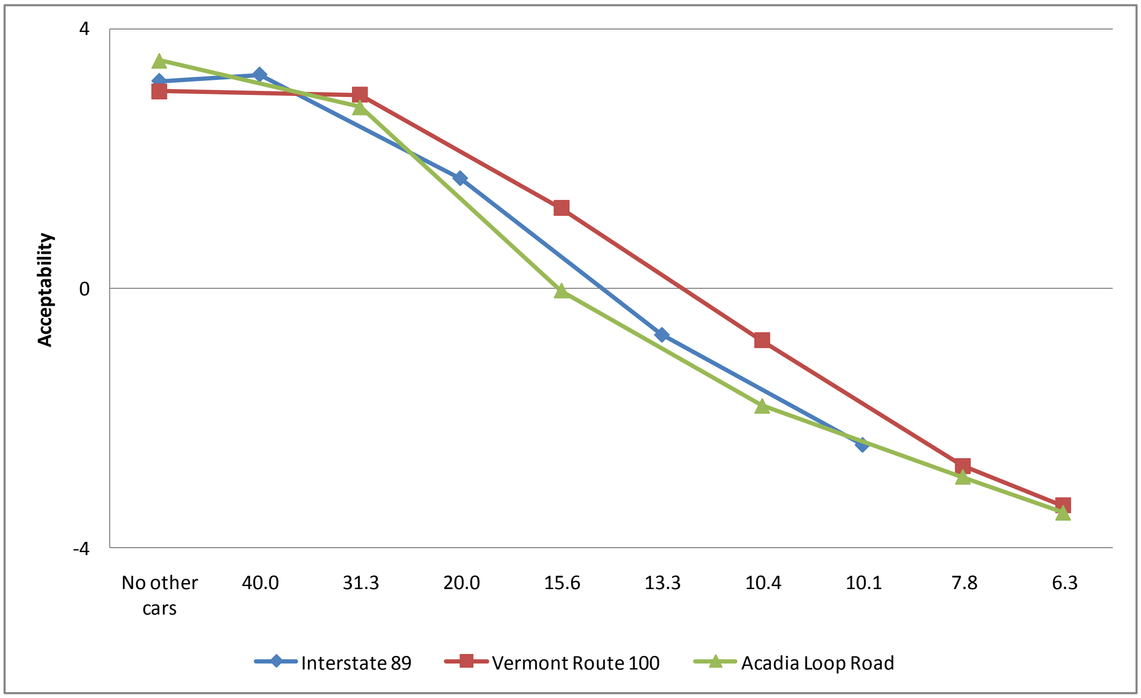


Figure 2: Social Norm Curve for Number of Cars on Roads (Meters/Car).

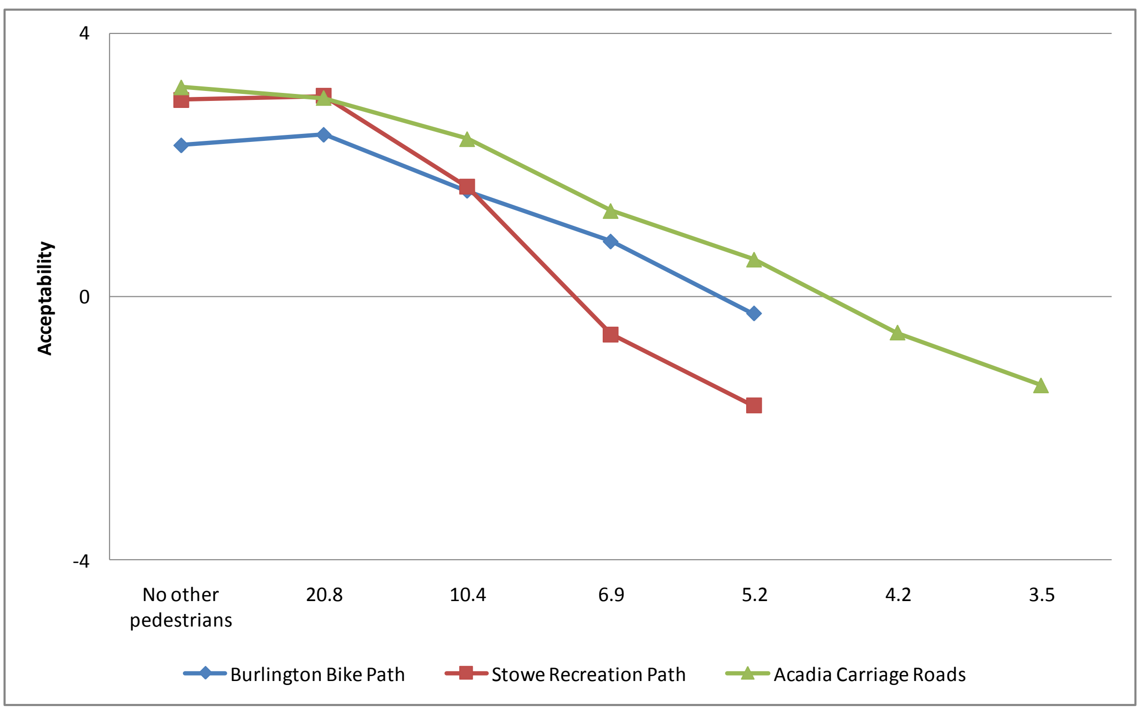


Figure 3: Social Norm Curves for Number of Pedestrians on Greenways (Meters/Pedestrian).

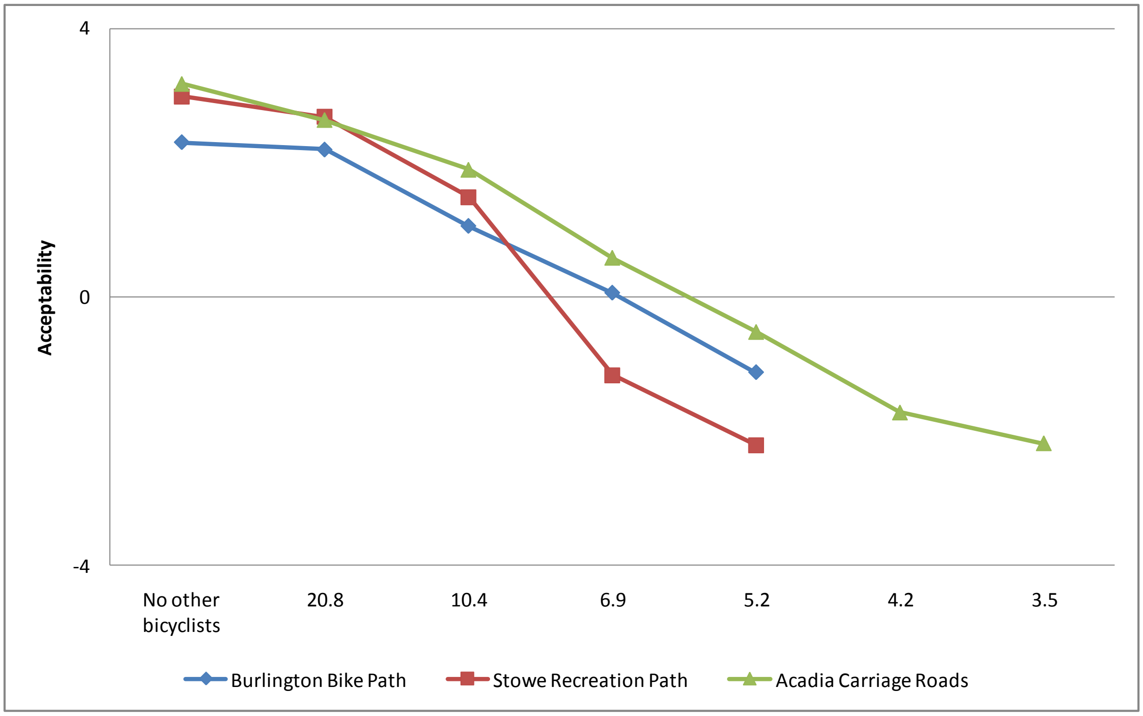


Figure 4: Social Norm Curve for Number of Bicyclists on Greenways (Meters/Bicyclist)

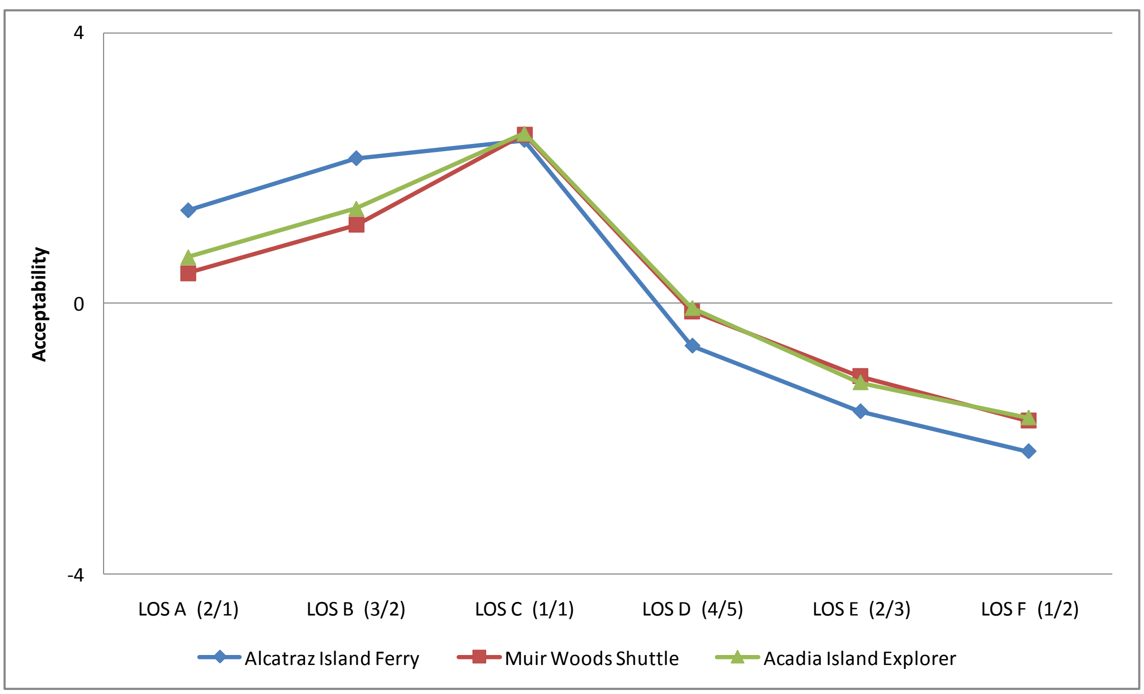


Figure 5: Social Norm Curve for Number of People on Public Transit (Seats/Rider).

Stated Preference – Mode Choice Decision Modeling

This section includes selected results from the stated preference research conducted in 2010.

As a first phase of analysis, data from each site were pooled into a single Multinomial Logit (MNL) model. The resulting estimates of coefficients, t-tests, and log-likelihoods are illustrated in Table 3 and demonstrate the intuitive nature of the study's findings. For instance, visitors generally preferred lower levels of crowding, higher levels of convenience, a separate bike lane, and lower travel costs.

Table 3: Coefficients for travel mode choice

	Acadia NP – Jordan Pond House		Yosemite NP – Yosemite Falls	
Constants	Coefficient	t-stat	Coefficient	t-stat
Car	0		0	
Shuttle Bus	.0196	.47	.145	3.44
Bicycle	-.126	-2.91	-.0602	-1.38
Crowding				
Medium crowding	-.00128	-.04	-.0386	-1.26
High crowding	-.277	-8.68	-.143	-4.58
Convenience				
Convenient	-.102	-3.27	-.0523	-1.71
Inconvenient	-.296	-9.52	-.432	-13.6
Corridor Design				
Bike lane on road shoulder	.0546	1.66	.041	1.26
Bike lane separate from road	.125	4.3	.0986	3.4
Cost				
Medium cost	-.0355	-1.1	-.0678	-2.11
High cost	-.396	-12.48	-.372	-11.83
Log-likelihood at Zero	-3904		-3955	
Log-likelihood at Constant	-3899		-3946	
Log-likelihood at Convergence	-3607		-3644	
Adjusted Rho-squared	.074		.076	
Sample size	3555		3600	
Likelihood ratio test	594.3		621.2	

The second phase of analysis used LLR chi-square tests to determine the relative importance of each travel attribute. To do so, the MNL model was run multiple times. Each time, one attribute was removed from the model and compared with the whole model using the LLR test. Each test provided a chi-square value for each attribute, and when compared among each other led to a rank order of importance in travelers' mode choice. At both sites, corridor design had the least influence on visitors' travel choices. The crowding attribute had the second to least impact on travel decisions. Cost and convenience were both more important to park visitors' travel mode choices, but their rank order of influence varied from site to site. At Acadia National Park, cost was found to be the most important factor in travelers' decision-making, while at Yosemite National Park, convenience was found to be the most influential. The LLR chi-square rankings for each site are portrayed in Table 4.

Table 4: Relative importance of each attribute

	Attribute	Unrestricted LL	Restricted LL	Chi-square	Rank
Acadia	Crowding	-3607	-3660	106.2	3
	Convenience	-3607	-3699	183.2	2
	Corridor Design	-3607	-3627	39.74	4
	Cost	-3607	-3735	255.3	1
Yosemit	Crowding	-3644	-3664	39.70	3
	Convenience	-3644	-3796	302.6	1
	Corridor Design	-3644	-3657	24.40	4
	Cost	-3644	-3770	250.4	2

4. Implementation/Information Transfer

The research presented in this report formed the core of an expanded and continuing program of research that examined and developed connections among the relationships between transportation, recreation, and tourism. The productivity of this research extended beyond the core elements to stimulate and inform a range of transportation, recreation, and tourism related research and management. A number of related research projects have origins, designs, analysis, and/or contextual interpretation grounded in the frameworks developed as part of the greater sustainable transportation for tourism project. These projects include:

- Integrated Transportation and Capacity Assessment, Yosemite National Park
- Monitoring and modeling the effects of alternative transportation planning on visitor experiences, Muir Woods National Monument
- Simulation modeling for guiding management of transportation and recreation in parks and on public lands
- Partnership Case Study: Cape Cod National Seashore Transit Partnership
- Using Indicators and Standards of Quality to Guide Transportation Management in Parks and Public Lands: A Best Practices Manual
- Transportation as a barrier to visitation for communities of color and other underserved populations, National Park Service
- Sustainable Transportation in the National Parks: From Acadia to Zion
- Full Circle Trolley Pilot Assessment
- Transportation Recreation Opportunity Spectrum (T-ROS)
- Member of the Paul S. Sarbanes Transit in Parks Technical Assistance Center (TRIPTAC)

The following section of this report summarizes, and for completed projects presents findings from, these projects that are intellectual and technical outgrowths of the core TRC funded sustainable transportation and tourism research.

Integrated Transportation and Capacity Assessment, Yosemite National Park

Yosemite National Park is one of the crown jewels of the national park system. Its remarkable convergence of natural features – iconic Yosemite Valley, vast wilderness, ancient giant sequoias – along with its importance in environmental history – its precedent setting establishment in 1864, close association with John Muir, public battle over damming Hetch Hetchy – contribute to its well-deserved legendary reputation. However, its high profile as a recreation resource and its proximity to large urban centers combine to make the park an exemplar of the issues that challenge many national park managers. Primary among these are balancing public access and park protection, determining recreational "carrying capacities," and managing visitor use in ways that protect the quality of park resources and visitor experiences. In this special issue of *The George Wright Forum* we describe a new approach to park planning and management that is designed to address these challenges. This approach recognizes and capitalizes on the relationships between transportation and recreation in parks.

Visitor Use and Management

With increasing visitation come corresponding visitor use management challenges. In Yosemite these challenges are posed by both visitor use and the park's capacity and have the potential to impact the quality of visitors' experiences. In 1970, when annual visitation was 2 million, overcrowding in the campgrounds and meadows in Yosemite Valley sparked the Stoneman Meadow Riot. In 1997, when annual visitation reached 4 million, the park's capacity to accommodate visitors was compromised when Yosemite Valley infrastructure was severely damaged by flooding. Today visitation hovers near 4 million individuals annually and the park confronts a litany of resource protection, visitor enjoyment, and operational challenges as a result (National Park Service, 2012). Like many parks and public lands, visitor use management challenges are often transportation related (Daigle, 2008). High levels of visitor use induce congestion along Yosemite's roads and at major attraction sites nearly all days of the park's summer use season. While traffic management and visitor protection staff struggle to deal with the ever increasing use, resource impacts continue to accumulate along roadways and extending from visitor access hubs throughout recreation sites.

Transportation and Recreation in National Parks

The prevalence of visitor use management challenges associated with transportation in Yosemite is emblematic of the connections between transportation and recreation in park and public land recreation. Transportation and recreation are connected in two basic ways. A first connection is the implicit unity of transportation and recreation (White, 2007). When visiting parks, transportation activities such as driving and walking are often the primary recreation activities of visitors (Cordell, 2008). Indeed, driving for pleasure and walking or hiking are among the most common recreational activities of visitors to Yosemite. As such, the quality of recreation experiences is analogous with the quality of transportation system performance. In this case, transportation *is* recreation.

A second connection between transportation and recreation is process oriented; transportation systems largely influence the distribution of visitors within parks (Lawson et al., 2009). To the extent that visitors primarily move about Yosemite along the park's road and trail networks, elements of the transportation system shape where visitors go and when they get there. The quality of recreation experiences, particularly with respect to crowding and congestion within recreation sites, is a function of the transportation system's delivery and distribution of visitors. If used to deliver the "right" number of visitors to the "right" places at the "right" times, transportation can be an important park and outdoor recreation management tool.

Planning for Visitor Use Management in Yosemite

Planning History

Managers at Yosemite National Park have long understood transportation to be a key element of visitor use planning and management. Transportation infrastructure and systems are present in the some of the earliest plans for the park. With the 1980 General Management Plan (GMP), transportation and its connections to recreation quality and visitor experiences became a central focus of park planning and management. This plan laid out an ambitious vision for promoting the quality of visitor experiences by removing day use vehicular traffic from the eastern portion of Yosemite Valley. While this radical initiative was never implemented, the planning effort was effective at focusing attention on the connections between transportation and recreation quality.

Following the 1980 GMP, the park consolidated a number of localized management plans into to comprehensive planning efforts in the form of the Yosemite Valley Plan and the Merced River Plan. These plans outline a number of objectives, including preservation of high quality natural and experiential resources and facilitation of public access and enjoyment. Transportation systems and their operation are positioned within the plans as both key components of recreation quality and important tools for managing visitor use. Subject to the public and legal process of the National Environmental Policy Act (NEPA), these plans have been challenged in court and remanded for refinement and further development.

Objectives for Future Planning and Management

The discussions and deliberations about planning and managing visitor use in Yosemite have suggested several management objectives including providing a diversity of recreation experiences, encompassing multiple spatial scales, being quantitatively rigorous, and being proactive and flexible. To accomplish these objectives to the satisfaction of legal requirements and public scrutiny, park managers must be able to document visitor use levels and the quality of recreation experiences associated with these levels of use.

Integrated Transportation and Capacity Assessment

Leveraging the connections between transportation and recreation to structure the relationships between visitor use and experiential quality, Yosemite embarked on a program of research that culminated in 2010 with the Integrated Transportation and Capacity Assessment (ITCA) project. Acknowledging transportation as recreation and transportation's influence on recreation, the ITCA project integrates monitoring and evaluation of visitor use and experiential quality for both vehicle-based and pedestrian recreation in a quantitatively explicit and proactive way.

Basic Conceptual Model

The ITCA project has its root in a basic conceptual model that links visitor use levels with experiential quality (Figure 6). This model is informed by indicators and standards of quality based management and empowered by computer based simulation modeling and visual simulation of indicators of quality. Indicators of quality are measurable, manageable variables that serve as proxies for management objectives – for Yosemite preserving natural resource and experiential quality while facilitating public access and enjoyment. Standards of quality are the minimum acceptable conditions of indicator variables; they are quantitative benchmarks by which accomplishment of management objectives can be evaluated. Computer-based simulations enable scenarios of visitor use and experiential quality to be experimented with, extending the range of ITCA beyond current use levels and patterns to incorporate many alternative future conditions. Within the basic conceptual model, conditions of visitor use are first described and then evaluated.

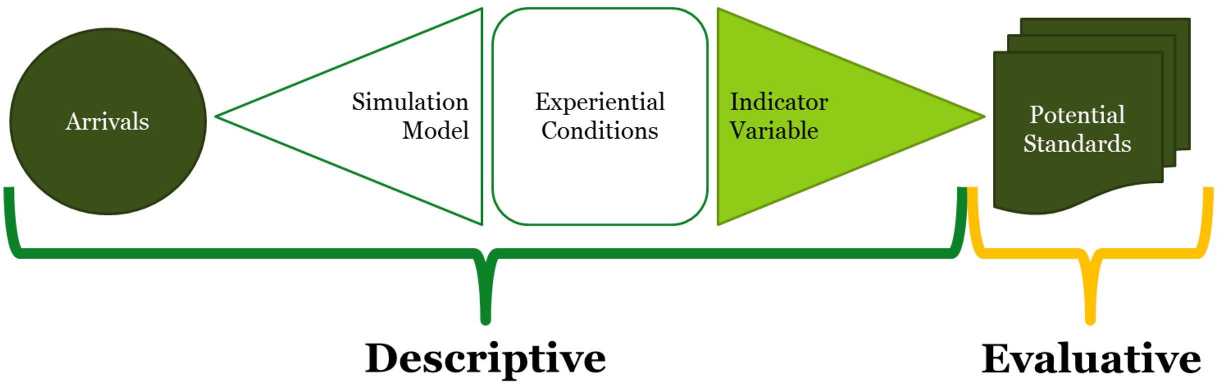


Figure 6: ITCA Conceptual Model

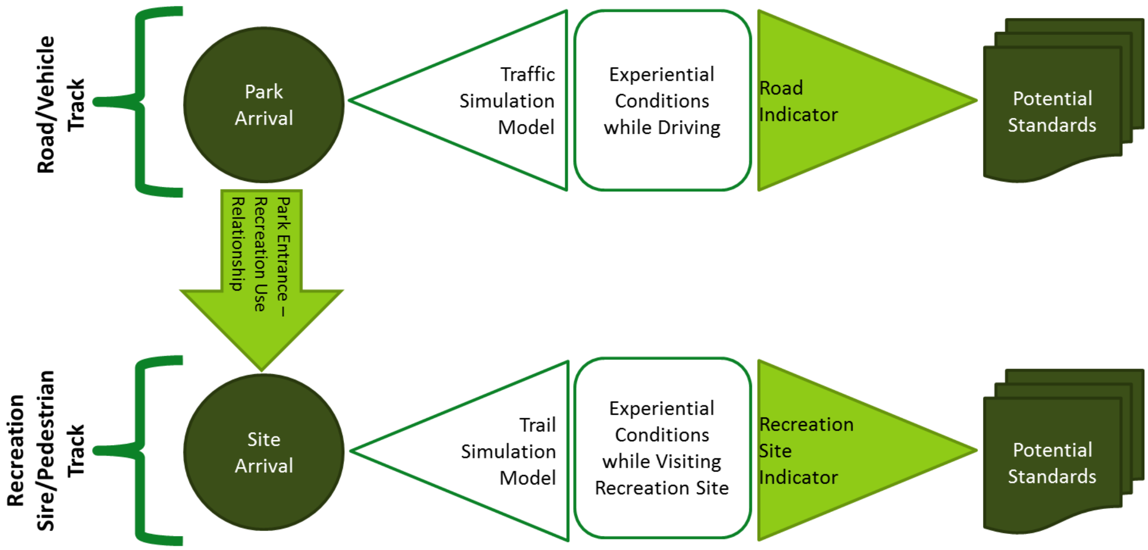
The basic ITCA conceptual model begins with counting visitors as they arrive at the park, road segments, or recreation sites to describe and monitor the level of visitor use. This level of use is then distributed throughout the park's road and trail networks by simulation models in ways representative of the observed patterns of visitor behavior and movement. These simulation models estimate the experiential conditions visitors would experience. Translated into indicator variables like the time needed to travel road segments, the number of vehicles in view along the road, the number of people at one time at attraction sites or the number of other visitors encountered along trails, these experiential conditions can be evaluated against a range of standards of quality derived from surveys of park visitors. This progression of monitoring, modeling and evaluation transforms counts of visitor use through predictions of experiential conditions to assessments of recreation quality with flexibility and the power to proactively consider alternative park use and management scenarios.

Applied Conceptual Model

While the basic conceptual model has served visitor use planners and managers well, ITCA's unique contribution is its application of the basic model to the connections between transportation and recreation. The applied conceptual model illustrates how the basic progression of monitoring, modeling and evaluation is applied 1) on roads for vehicular based recreation and 2) at recreation sites for pedestrian based recreation (

Figure 7). These dual tracks of the ITCA applied model acknowledge the connections between transportation and

The road and vehicle track addresses the transportation as recreation connection. The numbers of vehicles entering the park and traveling along specific road segments are counted. Simulation models of vehicle use on park roads estimate the conditions of roadway congestion visitors may experience while driving throughout the park. These estimates are translated into indicators of quality for visitors' road-based experience – a key element of visitors' recreation experience as scenic and pleasure driving is a nearly ubiquitous and important recreation activity. Finally, road based recreation quality is evaluated



against standards of quality elicited from park visitors.

Figure 7: ITCA Applied Conceptual Model

The recreation site and pedestrian track addresses transportation's connection to recreation visitor distribution. Based on statistical relationships between the number of vehicles entering the park and traveling specific road segments, the number of visitors expected to arrive at selected recreation sites and trailheads is estimated. The distribution and behavior of these arriving pedestrians is simulated and the experiential conditions, in terms of indicators of quality, are estimated and evaluated against a range of potential standards of quality elicited from park visitors.

Special Issue

This research is described in a multi-article special issue of *The George Wright Forum*. They outline the ITCA model in detail, discuss its application to visitor use management in Yosemite National Park, and consider the historic intersections of transportation and recreation. The material presented here constitutes the introduction, authored by Meldrum and DeGroot with support from Reigner and Manning. White, Tschuor and Byrne present the vehicle based road monitoring, modeling and evaluation in which transportation is recreation. This is followed by Reigner, Kiser, Lawson and Manning's presentation of the recreation site pedestrian monitoring, modeling and evaluation that addresses transportation's influence on recreation use. Whittaker, Shelby and Meldrum extend discussion of the ITCA model to its application in park management, specifically the Merced River Plan. Johnson and Louter conclude the special edition with reflections on the historical and ongoing relationships between transportation and recreation in America's parks and public lands.

Implications for Visitor Use Management

The ITCA conceptual models leverage the connections between transportation and recreation for the purpose of informing park planning and management. Understanding that transportation is indeed recreation for visitors in parks and that transportation systems influence recreation use enables the park managers to employ transportation planning and operations as recreation management tools. Starting with counts of vehicle and visitor arrivals, the ITCA model supports these efforts with empirical and quantitatively explicit data. Simulation lends flexibility and proactivity to the process by enabling alternative and hypothetical scenarios to be considered. Translation of visitor use and experiential conditions into indicators and standards of quality allows both monitoring and evaluation of recreation use and quality. By integrating transportation and recreation, roads and recreation sites, and monitoring and evaluation of visitor use, the ITCA model can provide Yosemite and other parks with a transparent, scientifically sound, and legally defensible process for examining and determining recreational carrying capacities at multiple scales and for diverse activities. Complete information about this program of work can be found at the following link:

http://www.uvm.edu/parkstudieslaboratory/publications/GWF_YoseTransport_Special.pdf

Monitoring and modeling the effects of alternative transportation planning on visitor experiences, Muir Woods National Monument

Muir Woods National Monument, managed as part of Golden Gate National Recreation Area (GGNRA) by the National Park Service (NPS), preserves a primeval redwood forest in Marin County just north of San Francisco. The monument receives intensive public use, with more than one million people visiting annually. NPS is revising GGNRA's General Management Plan (GMP) and developing Implementation Plans for management of visitor use in Muir Woods. This planning is guided by a management-by-objectives framework, with a key component being the development of indicators and standards of quality for visitor experiences.

The NPS has commissioned a study with the University of Vermont (UVM) and Resource Systems Group (RSG) to collect visitor use information to support the development of indicators and standards of quality for GGNRA's GMP and Implementation Plans. As part of the study, visitor use counts and observations were conducted during summer 2009 to establish the current condition of crowding-related indicators of quality. From these observations and additional data characterizing the arrival and routing of visitors, a simulation model of Muir Woods' visitor was developed. In estimating the value of crowding-related indicators under different conditions of volume and arrival the model both facilitates ongoing indicator monitoring and enables analysis of alternative management schemes. A primary purpose of the simulation model is to analyze the potential effects of GMP alternatives for transportation and visitor management in the monument.

The results presented in this report are intended to provide an empirical basis to support NPS decisions about indicators and standards of quality for visitor experiences. It is organized in four primary sections. Section 2 reviews descriptive characterizing the existing conditions of crowding-related indicators. Section 3 outlines the data and methods used to develop the simulation model. Section 4 reports results of modeling the current conditions of crowding-related indicators. Section 5 reports results of GMP alternatives analysis.

Indicators Monitoring

The purpose of this study is to support the implementation of indicators based management of visitor use in Muir Woods. The three indicators monitored and modeled here are: people at one time (PAOT), people per view (PPV), and trail encounter rate. PAOT is a measure of density within an area – the number of visitors in an area. PPV is a measure of visual density within a linear corridor – the number of others visible from a visitor's perspective along a trail. Unlike PAOT and PPV, trail encounter rate is an event based measure of visitor use. Trail encounter rate describes the number of others a subject visitor encounters during an analytical period – the number of other hikers passed and met while hiking a trail. PAOT, being an areal density measure, was monitored at the recreation sites within Muir Woods: the Redwood Cross Section and the Pinchot Tree. PPV, as a measure of linear density, was monitored along two sections of the valley floor trails, one section with interpretive signs and benches and one section without such features. Trail encounter rate was monitored on the Hillside Trail. In lower use setting, like the Hillside Trail, the experience of closeness with others occurs as a series discrete events rather than a continuous condition. Trail encounters, being an event based variable, is suited for this location.

This section of the report presents the results of visitor use counts and observations conducted in Muir Woods during summer 2009. The results provide detailed information about the current condition of the following crowding-related indicators of quality in Muir Woods:

- PAOT in the Redwood Cross Section area
- PAOT in the Pinchot Tree area
- PPV on valley floor trails
- Trail encounter rate on the Hillside Trail

Analyses presented in this section include statistical comparisons of weekend versus weekday conditions of the crowding-related indicators noted, where weekends include Friday through Sunday and weekdays include Monday through Thursday.

Simulation Modeling for Alternative Transportation Planning

Using Extend multi-function simulation software, a simulation model of social conditions, visitor experiences, and transportation system function and service was developed. This model was used to estimate the effects of alternative transportation scenarios on crowding and experiential quality in Muir Woods. The scenarios simulated are presented in Table 5

Table 5: Muir Woods Simulation Modeling Scenarios

	No Action	Alt 1	Alt 2	Alt 3
Parking capacity at MUWO	379	219	20	179
Parking capacity at intercept area	500	500	500	500
Bus capacity	35	35	35	35
Bus Headway		Min headway 10 min. First-come, first-serve, limit to number of buses they'll wait for	Min headway 10 min. First-come, first-serve, limit to number of buses they'll wait for	Reservations and Paid Parking; Spread it evenly through the day
Meadow Linger (discussed with Mia)	Mean= 5 mins	Visitors' average linger times in the restored meadow will be similar to the average linger times observed in the café/gift shop during summer 2009.	Visitors' average linger times in the restored meadow will be similar to the average of linger times observed in Redwood Crosscut, Pinchot Tree, and Bohemian Grove during summer 2009.	Visitors' average linger times in the restored meadow will be similar to the average linger times observed in the potential restored meadow during summer 2009.

Simulation modeling for guiding management of transportation and recreation in parks and on public lands

The goal of this project is to build foundational research expertise in integrated land use and transportation modeling for tourism travel and outdoor recreation quality and efficiency. Tourism and recreation are major and increasingly important components of the Vermont, New England, national, and international economies. Transportation is a vital element of tourism and recreation, and includes not only delivering visitors to and from their destinations but also circulation while at their destination. Moreover, in many contexts, transportation, tourism and recreation activities can be synonymous. For example, in parks and on public lands, transportation, including auto-touring and walking for pleasure, is a major form of tourism and recreation, offering visitors the opportunity to see, experience, and appreciate natural and cultural landscapes.

Transportation and recreation are complex systems. Particularly when these activities take place in parks and on public lands, visitors and tourists move across large landscapes and along distributed networks. Often the diffusion, rather than concentration, of use is a primary goal of recreation related transportation activities. Additionally, many recreationists and tourists specifically seek freedom of behavior and from intensive administration. The complexity of recreation and transportation, born of behavioral diffusion, diversity and intensity, makes monitoring and evaluating transportation and recreation in parks and on public lands difficult and expensive. Managers simply cannot observe use over the entirety of their jurisdiction, and recreation visitors and tourists are unwilling or unable to report their activities to managers. Further, actions taken to manage transportation and/or recreation systems have real consequences for resources and visitors that cannot be fully understood prior to implementation and may not be reversible should they prove to be ineffective or even detrimental. As a consequence, the difficulty of monitoring conditions and predicting management effects exacerbates the complexity of transportation and recreation systems in parks and on public lands.

Simulation models provide a tool for researchers and managers to address and overcome the complexity inherent in transportation and recreation in parks and on public lands. Simulation models replicate the arrival, distribution and behavioral patterns of transportation and recreation system users, predicting the quality of experiences given various conditions of use and management scenarios. These models combine conceptual organizations of facilities and infrastructure with representative samplings of visitor use to play out an hour, day, or season’s worth of use in an electronic environment. In doing so, simulation models can serve a number of indispensable and otherwise impractical functions for researchers and managers. Consequently, simulation modeling has been the subject of a growing body of research and has been applied in both the transportation and recreation disciplines. While current modeling techniques certainly benefit managers, visitors, and transportation and recreation systems, new theories and methodologies have the potential to advance simulation modeling’s application, improving it efficacy and further empowering researchers and mangers. These models, particularly the VISSIM Social Force model, can integrate land use and transportation planning and management in new and useful ways.

The University of Vermont's (UVM) Park Studies Laboratory (PSL) and Transportation Research Center (TRC) propose to undertake a program of cooperative research with the purpose of building foundational transportation research expertise using advanced technologies for integrated transportation and land use modeling to examine the complex systems linking and supporting the sustainability of transportation, tourism travel, and recreation in parks and on public lands. The development of this expertise will allow UVM to help satisfy the large and growing needs of transportation and recreation researchers and managers for state of the art simulation modeling. Building foundational expertise in transportation and recreation simulation modeling, particularly with the Social Force model, will require researchers from the PSL and the TRC to work closely in all phases of the work from planning, through execution, to communication of findings and lessons learned. This collaboration both manifests the intimate connections between transportation and recreation in parks and on public lands and seeks the synergies that can be realized by integrating planning and management of transportation and recreation. Simulation modeling efforts undertaken as part of this collaboration will identify, test, and optimize indicators of quality for both transportation and recreation systems and opportunities. That is, simulation models will be designed and operated to examine both the functional and experiential qualities of transportation and recreation facilities and operations representative of parks and public lands.

In building foundational research expertise with the Social Force model and its application to integrated transportation and recreation management, the proposed research will contribute both to UVM's mission and the Spires of Excellence Initiative, particularly the complex systems spire, as well as to research and practice in the transportation and recreation fields. The development and demonstration of expertise in integrated transportation and recreation simulation modeling, particularly with the Social Force model, will be a unique and desirable capability among universities. The process of building this expertise will provide material for extensive research and publication of interest to a breadth and diversity of professionals and lay persons. By focusing on transportation and recreation in parks and on public lands, the research is embedded in facilities (roads, trails and transit) and activities (driving and walking for pleasure) familiar to and popular among most Vermonters and Americans. Simultaneously, the research illustrates and explores deeply complex systems. The practical knowledge and experience in Social Force modeling will be directly applicable for and appreciated by managers of transportation and recreation systems in parks and on public lands.

Transportation and Recreation

The goal of this project is to build foundational research expertise in integrated land use and transportation modeling for tourism travel and outdoor recreation quality and efficiency. Tourism and recreation are major and increasingly important components of the Vermont, New England, national, and international economies. Transportation is a vital element of tourism and recreation, and includes not only delivering visitors to and from their destinations but also circulation while at their destination. Moreover, in many contexts, transportation, tourism and recreation activities can be synonymous. For example, in parks and on public lands, transportation, including auto-touring, riding transit systems, and pedestrian and bicycle travel, is a major form of tourism and recreation, offering visitors the opportunity to see, experience, and appreciate natural and cultural landscapes and associated features.

Parks and public lands provide a primary supply of tourism and recreation opportunities, particularly via the transportation facilities they provide. Over 900,000 acres of Vermont, 15.1% of the state's land area, are publicly owned and devoted to conservation and nature-based tourism and recreation (Vermont Geography Alliance, 2002). Nationally, one-third of the United States' land area is dedicated as parks or public lands open to and managed for recreation and tourism (Zaslowsky and Watkins, 1994). Lands administered by the National Park Service, U.S. Forest Service, and Fish and Wildlife Service, representing just over 50% of public recreation lands, are home to over 44,000 miles of road and hundreds of thousands of miles of trails (Office of Federal Lands Highway, 2011; Vincent, 2004). Recreational use of these motorized and non-motorized transportation facilities can account for approximately 7% of all tourism related economic expenditures in the United States (Vincent, 2004). Parks and public lands are a dominant source of opportunities and facilities for transportation, tourism and recreation.

There are many important manifestations of the connections among transportation, tourism and recreation. Activities traditionally thought of as transportation often have inherent tourism and recreation related meanings; and facilities designed to serve transportation purposes are commonly used for tourism and recreation (Anderson, et al, 2011; Vincent, 2004). For example, a long series of national studies in outdoor recreation and tourism has consistently found that transportation activities, including driving and walking for pleasure, as well as riding transit systems in parks and on public lands, are among the most popular recreation activities in the United States (Manning, 2011). This confluence of transportation and recreation is demonstrated more explicitly by the findings of the National Survey on Recreation and the Environment, which found that transportation facilities are the primary provider of recreation opportunities, and that transportation activities are among the most popular forms of recreation. Each year, nearly 90% of Americans recreate on roads, streets and trails, more than on any other type of facility (NSRE, 2000-2003). Of all recreational pursuits, the transportation based activities of walking and driving for pleasure are the first and fifth most popular, engaged in by 88% and 62% of the public, respectively (NSRE, 2000-2003). These patterns of activity, which imply that transportation is often synonymous with recreation, are confirmed by recent research findings that document intermingling of transportation and recreation purposes among users of a variety of travel modes in a diversity of urban, rural and park settings (Anderson, et al, 2011). Thus, transportation must be understood as a form of recreation, and recreation as often taking the form of transportation.

In addition to the synonymous nature of transportation and recreation in parks and on public lands, these activities and their management are marked by complexity born from their extensiveness, intensity and diversity of use. Integrated transportation and recreation systems on public lands, including roads, trails and transit systems, commonly traverse large areas with relatively basic infrastructure. Indeed, distance from urban development and difficult access are often attractive characteristics that lend a recreational character to transportation (Louter, 2006; Driver and Brown, 1975). The geography of parks and public lands is not only often vast, but also frequently diverse. A goal of park and land managers is to provide a diversity of opportunities to the public, both in terms of recreation and transportation opportunities (ORRRC, 1962). This leads many parks to have both intensively developed and used centers of activity and relatively undeveloped areas where use is more dispersed. In addition to spatial diversity, recreation use of parks, public lands, and their transportation systems is temporally diverse at a multitude of scales (Manning, 2011). Such diversity includes dramatic peaking throughout a visitor day and substantial differences in use and visitor needs from season to season.

While recreation use in parks and on public lands is diversely spread across expansive areas, it is interconnected by transportation systems. Roads connect airports and communities to parks and public lands as well as facilitate visitor movement within and experience of park settings. Trails connect roads and developed areas to more remote and natural settings that are often the focus of park visits. Transit systems allow visitors to travel about unfamiliar, crowded or fragile parks and public lands with a minimum of effort and impact. The configuration of transportation facilities, services and modes in many ways determines where visitors to public lands go, when they arrive, and even what they do while visiting (Pettengill and Manning, 2011). Recognizing that visitor use patterns are, at least in part, the product of transportation systems adds another layer of complexity to coupled recreation—transportation systems in parks and on public lands.

While the multitude of transportation opportunities within a recreation area compounds the complexity of tourism and recreation management, transportation systems can also serve as a powerful tool for minimizing the impact of recreation use on fragile resources and landscapes while maximizing the quality of tourism and recreation (Lawson, et al, 2009). By managing the supply of transportation opportunities, the demands placed on recreation resources can be managed. By changing the behavior of visitors via the systems by which they are delivered to, moved about, and removed from recreation areas, transportation can have a major influence on the quality of recreation experiences and the natural resources upon which they are based (Lawson, et al, 2009). Transportation systems can be indispensable tools to help park and public land managers deliver the "right" number of people to the "right" place at the "right" times, ultimately promoting the ecological, economic and social sustainability of recreation and tourism activities.

Transportation and recreation are intimately connected. Transportation activities, including driving and walking, are often the primary forms of recreation engaged in by tourists and visitors to parks and public lands. Tourism, by definition, involves some forms of travel and transportation. Further, much of the tourism and recreation participated in by Americans occurs on transportation facilities including roads, streets and trails. Transportation systems provide not only activities and facilities for recreation, but also a means by which the demands and impacts of tourism and recreation can be effectively and efficiently managed. These connections suggest that transportation is recreation, and vice-versa, and that transportation systems shape recreation and tourism behavior. Along with their extensiveness, intensity and diversity inherent transportation and recreation, the connections mark transportation and recreation as inherently complex systems.

Simulation Modeling

Transportation and recreation are complex systems. Particularly when these activities take place in parks and on public lands, visitors and tourists move across large landscapes and along distributed networks. Often the diffusion, rather than concentration, of use is a primary goal of recreation related transportation activities in parks. Additionally, many recreationists and tourists visiting parks and public lands specifically seek freedom of behavior and from intensive administration. The complexity of recreation and transportation, their diffuse nature, and intolerance for administrative burden makes monitoring and evaluating transportation and recreation in parks and on public lands difficult, expensive and sometimes practically impossible. Managers simply cannot observe use over the entirety of their jurisdiction, and recreation visitors and tourists are unwilling or unable to report their activities to managers. Further, actions taken to manage transportation and/or recreation systems have real consequences for resources and visitors that cannot be fully understood prior to implementation and may not be reversible should they prove to be ineffective or even detrimental to resource or experiential quality. As a consequence, the difficulty of monitoring conditions and predicting the management effects exacerbates the complexity of transportation and recreation systems in parks and on public lands.

Simulation models provide a tool for researchers and managers address and overcome the complexity inherent in transportation and recreation in parks and on public lands (Lawson, Hallo and Manning, 2008). Simulation models replicate the arrival, distribution and behavioral patterns of transportation and recreation system users, predicting the quality of experiences given various conditions of use and management scenarios. These models combine conceptual organizations of facilities and infrastructure with representative samplings of visitor use to play out an hour, day, or season's worth of use in an electronic environment. In doing so, simulation models can serve a number indispensable and otherwise impractical functions for researchers and managers. Consequently, simulation modeling has been the subject of a growing body of research and applied in both the transportation and recreation disciplines (Cole, 2005). While current modeling techniques certainly benefit managers, park and public land visitors, and the quality of transportation and recreation systems, new theories and methodologies have the potential to advance simulation modeling's application, improving it efficacy and further empowering researchers and mangers.

Simulation modeling allows researchers and mangers to address the complexity of transportation and recreation in parks and on public lands in a number of ways. Transportation and recreation on public lands occurs at scales, both in geographic extent and intensity of use, too vast and diffuse for researchers and managers to directly observe. In condensing and replicating such complex systems, simulation models bring entire parks or public lands within view, describing existing conditions in a holistic way. Simulation modeling can also provide specific, but difficult to monitor estimates of use and quality conditions (Lawson, Hallo and Manning, 2008). Examples include the number of other hikers encountered along a trail and the percent of time drivers on a scenic auto-tour spend following other vehicles. Beyond describing existing conditions, simulation models can serve proactive functions. By extrapolating upon existing conditions, simulation models can provide estimates of the levels of use that can be accommodated by transportation and recreation systems without violating standards or minimum conditions of quality. They can also test various management scenarios in a comprehensive way. Changes to the configuration or operation of transportation and recreation systems can be comprehensively examined within the simulated environment, mitigating the cost, impact, and political risk of trial and error implementation of management action. Finally, simulation modeling can assist in the design of more effective and realistic research on perceptions of quality and attitudes toward management of transportation and recreation in parks and on public lands. Through these multiple mechanisms, simulation modeling can help researchers and managers understand and cope with the inherent complexity of park and public land transportation and recreation.

Because of its ability to address the complexity and interconnections of transportation and recreation simulation modeling has been the topic of a growing body of research and application in parks and on public lands. Initial efforts to develop and apply simulation models for recreation management on public lands began in the 1970's (Smith and Krutilla, 1976). While technically successful, these efforts were compromised by the expense and expertise required to operate the models, which required the programing and use of specialized mainframe computers. Following advances in computer technology realized during the 1990's, specifically more powerful desk-top hardware and flexible, user-friendly software, adoption of simulation modeling as a research and management tool has become more common and successful, particularly as it relates to the convergence of transportation and recreation. Indeed the functions of simulation models described have all been exercised in service of integrated transportation and recreation management in parks and on public lands.

A basic function simulation models can serve park and public land managers is describing conditions of transportation and recreation systems, either as a whole or for specific, difficult to measure location or indicators of interest. Management of visitor use in the John Muir Wilderness, California, provides a good example of how simulation models can monitor system use and operation that would otherwise be practically impossible. The John Muir Wilderness covers nearly 600,000 acres of alpine terrain and contains a network of more than 500 miles of maintained trails. The wilderness is accessed by multiple modes including walking and horseback. Direct observation to monitor and measure use dispersed across such a vast and difficult to traverse area would be exceedingly difficult and expensive. However, via simulation modeling, basic input data including arrival counts, routes traveled, and time spent in the wilderness, estimates of the use received by each link in the trail network were made (Lawson, et al, 2006). The number of encounters with others sharing a road or trail is a measure of quality common to both transportation and recreation, yet it is exceedingly difficult to measure. Unless a researcher follows each user or trusts the often inaccurate reports from users, encounter rates cannot be observed directly. Simulation models, however, can estimate such difficult to monitor indicators, as was done in Zion National Park. Here, park managers were concerned that use levels on popular walking trails were compromising the system's performance for transportation and recreation purposes. A simulation model was able to estimate encounter rates for current and projected future use levels without requiring direct observation or visitor reporting of encounters. Using the model, managers can continue to monitor encounter rates by updating the daily use level parameters upon which the simulation is based (Lawson, Hallo and Manning, 2008). Application such as these enable park and public land managers to know the condition and service quality of the transportation and recreation networks in greater detail and with less expense than would be possible via direct observation.

Beyond describing existing and hard to measure conditions, simulation models can assist transportation and recreation management by proactively testing system performance, evaluating alternative scenarios and informing research. Yosemite National Park has been the subject of simulation modeling to test transportation and recreation system performance. Each year some four million visitors move through the confined space of Yosemite Valley by multiple modes and along a variety of facilities. Yet within this complex and crowded milieu, these visitors seek some degree of peace, freedom, and closeness to nature. Simulation models integrated with survey data and observations of behavior have helped to illustrate for Yosemite managers the upper limits of visitor use with respect to resource and experiential quality (Lawson, et al, 2009). Because these models were developed to integrate transportation and recreation, they can facilitate use of the transportation system as a tool to manage recreation quality. A similar simulation modeling exercise was undertaken at Muir Woods National Monument outside of San Francisco. Here, park managers were considering expanding shuttle bus service to the monument and reducing access by private vehicles. Such changes in transportation delivery could, however, result in undesirable impacts to the fragile natural and experiential resource the monument is charged to protect (Reigner, et al, 2011). Rather than testing for the limits of use, a simulation model was used evaluate the alternatives presented in the monument's transportation and general management plans, revealing the potential for unintended impacts prior to selecting and implementing a management alternative. Among the primary attractions in Acadia National Park are the carriage roads, now used for walking and biking. Social research has demonstrated that use levels and perceptions of crowding are key indicators of the transportation and recreation network's quality of service. From the visitor perspective, these indicators are manifest in the number of other visitors visible along a trail. From the manager perspective, the indicators are more easily expressed as number of visitors per day. A simulation model was constructed to translate use levels from visitors per day to visitors per view on a specific section of trail. Using this translation, researchers were able to standardize the variables relevant to visitors and managers, enabling more realistic and representative research on visitor perceptions and standards as well as more effective management for recreation and transportation quality (Wang and Manning, 1999). While these applications, and the simulation models that underlie them, advanced the management of parks and public lands, recent theoretical and methodological developments promise to further understanding of the complexity inherent in the connections between transportation and recreation.

Social Force Model

Simulation modeling approaches have developed to serve many functions and account for many connections and complexities of transportation and recreation in parks and on public lands. They monitor and predict conditions of use and quality via measurable and manageable indicators. Modeling techniques are emerging that may improve efforts to simulate transportation and recreation systems. These models, particularly the VISSIM Social Force model, can integrate land use and transportation in new and useful ways. Park and public land use occurs at many scales. Road, trail and transit networks operate at a macro scale. Individual vehicles and pedestrians use land at a micro scale. Transportation and recreation connect at a range of scales as well. Transportation systems connect recreationists from origins to destinations, influencing recreation supply, demand and behavior. Individuals engaged in transportation activities are often recreating and recreation often involves transportation functions. To be effective, simulation models must reflect these connections in their structure and data inputs and outputs.

Transportation, recreation, land use, and parks and public lands all have spatial dimensions – the area of facilities and landscapes, the distances between destinations, vehicles and individuals, etc. (Lewin, 1951). The Social Force model fully integrates spatial information through its inputs, at both the macro and micro scales. Among the macro scale inputs required to simulate transportation and recreation are travel networks and environmental features. Simulated travel networks, be they roads, trails, rivers, attraction sites, transit vehicles, or facilities, are generated via spatial data drawn according to specifications or collected directly via GPS or remote sensing making them spatially accurate, explicit, and comparable. These networks can be laid out in standard geographic projections and datum or in site specific coordinate systems, allowing integration with GIS for mapping and analysis. These coordinates are used to locate and characterize environmental features, including land forms and facilities, within the model. The spatially explicit travel network and environmental features provide a foundation, spatially attributing all elements of Social Force models.

The Social Force model's spatial foundation is exploited fully in its approach to behavioral microsimulation. Microsimulation models the behavior of individual vehicles or pedestrians. The Social Force model advances microsimulation in a productive and potentially revolutionary level not yet achieved by previous transportation and recreation modeling efforts. Heretofore, the behaviors of simulated park or public land visitors have been rudimentary and fixed. Simulated entities travel at fixed speeds and along defined paths, generally insensitive to behavior, density or distribution of others. While these methods have served modelers well, they ignore important social forces, for which the model is named, that strongly influence transportation and recreation behavior. The behavior, density and distribution of others influence transportation choices, for example to drive, walk or ride, and behaviors, including travel speed and passing movement, and are key elements in transportation service quality. Likewise, social interactions are salient factors for park and public land recreation quality, particularly with regard to in-group bonding and crowding and conflict among visitors. The Social Force model uses its spatial foundation to simulate interactions among entities to an extent not previously done in transportation and recreation models. In simulating and estimating the consequences of interactions among individual pedestrians and between individual pedestrians and other features, the Social Force model can better guide planning and management of transportation and recreation.

The University of Vermont's (UVM) Park Studies Laboratory (PSL) and Applied Trails Research (ATR) propose to undertake a program of cooperative research with the purpose of building foundational transportation research expertise using advanced technologies for integrated transportation and land use modeling to examine the complex systems linking and supporting the sustainability of transportation, tourism travel, and recreation in parks and on public lands. The development of this expertise will allow UVM to help satisfy the large and growing needs of transportation and recreation researchers and managers for state of the art simulation modeling.

Plan of Work & Timeline Description

Building foundational expertise in transportation and recreation simulation modeling, particularly with the Social Force model, will require researchers from the PSL and the ATR to work closely in all phases of the work from planning, through execution, to communication of findings and lessons learned. This collaboration both manifests the intimate connections between transportation and recreation in parks and on public lands and seeks the synergies that can be realized by integrating planning and management of transportation and recreation. Simulation modeling efforts undertaken as part of this collaboration will identify, test, and optimize indicators of quality for both transportation and recreation systems and opportunities. That is, simulation models will be designed and operated to examine both the functional and experiential qualities of transportation and recreation facilities and operations representative of parks and public lands.

To build expertise in Social Force modeling, the PSL and ATR will undertake a three phased research approach. The attached timeline illustrates how these three phases will progress. The approach begins with orientation of researchers to the transportation and recreation activities and park and public land contexts as well as exploration of the Social Force model's requirements and capabilities. The second phase of research will advance the understandings developed in phase one and apply them to build and test a full scale case study simulation model. The third phase of the research plan is to assess and communicate the benefits and challenges of Social Force models for transportation and recreation research and management in parks and on public lands. While these three phases are generally sequential, they are not exclusively so. Orientation to transportation and recreation contexts and exploration of the model will continue through development of phase two's case study. Likewise, researchers will privately and publicly consider the Social Force model's relative merits throughout the proposed work process.

The initial phase of research focuses on orienting researchers from the PSL and ATR to basic concepts, methods and contexts of the transportation and recreation disciplines, respectively, and exploring the requirements and capabilities of the Social Force model. Orientation of the research team elaborates on the connections between transportation and recreation and will help to establish measures and frameworks that are common and salient to both fields of study. Exploring how these measures and frameworks can be integrated and operationalized in the Social Force model, particularly in terms of input data, parameter configuration, and output analysis, is another primary focus of the initial phase of research. Thoughtful orientation and exploration are critical to the successful execution of this research project and efforts are already underway. In the spring of 2011, researchers from UVM's PSL and TRC initiated a collaborative relationship with the mission of building expertise in integrated transportation and recreation modeling. Through presentations, literature sharing and workshops each disciplinary contingent has become conversant and appreciative of the others' approaches. Additionally, the team developed a demonstration simulation as a means to familiarize themselves with the Social Force model's operation and experiment with basic functions. The progress of phase one will continue throughout the course of the research project as team members continue to learn and build experience together.

Phase two of the proposed program of research will develop and operate a full scale and integrated transportation and recreation simulation model for a park or similar tourism destination. This phase will serve as a case study in the application of the Social Force model. The case study will be selected and model designed to examine the complexities of transportation and recreation and demonstrate the functions a simulation model can serve for park and public land researchers and managers. To reflect the complexity of transportation and recreation, the modeled domain will include diverse areas and behaviors with varying geographic extents and intensities of use. Following construction, the case study model will be applied to five general functions that simulation models can serve for researchers and managers: documenting existing conditions, monitoring elusive indicators, testing for limits, evaluating alternative scenarios, and refining research methods. The PSL and TRC have several funded research projects extending through the period of this grant that could provide fruitful case study locations. Simulation models are an innovative and promising research tool for integrated transportation and recreation management in parks and on public lands and they have been successfully applied at a number of sites. However, many transportation and recreation challenges remain for which simulation modeling is a good and feasible technical and administrative fit. Examples of such systems with integrated transportation and recreation can be found in Denali National Park, Muir Woods National Monument, Alcatraz Island, Yosemite National Park, and on Mount Desert Island, ME. The case study conducted in the second phase of the proposed research will tap this reservoir of latent demand, learn effective and efficient modeling techniques, and demonstrate the expertise needed to serve transportation and recreation management in parks and on public lands.

The third phase of the proposed research focuses on evaluation and communication of the previous two phases of activity. Social Force models have yet to be applied to park and public land transportation and recreation management. The case study proposed in phase two of this research may be the first full scale model of this type. In developing and operating it, the research team will learn not only about the transportation and recreation systems modeled, but also about the Social Force model itself. How must input data and parameters be configured for the model? What output data are best suited to assess quality and inform management of integrated transportation and recreation systems? What are the hardware, software and human capabilities required to be successful with a Social Force model? How do these factors compare with simulation modeling approaches previously used to study transportation and recreation in parks and public lands? Phase three of the research will focus not only on answering these questions, but also broadly disseminating the lessons learned. The Social Force model has great potential to advance both research and management of transportation and recreation. As such, the expertise built must be shared with both researchers and practitioners from the academic, government, private, and non-profit sectors. To reach this multitude of interested parties, the project team will present research findings at both academic and applied professional meetings, publish articles in scholarly and professional journals, and conduct demonstration and training sessions. Examples of the organizations and institutions with whom the project team has interest in sharing results and demonstrating expertise include the Vermont Agency of Transportation, Department of Tourism & Marketing, and Department of Forest, Parks & Recreation, National Park Service, Transportation Research Board, George Wright Society for Research in Parks and Protected Lands, and the International Association for Society and Natural Resources. By disseminating and demonstrating the expertise built by the proposed research, project team members specifically, and UVM generally, will be well positioned to conduct further research projects, satisfy the latent demand for integrated transportation and recreation modeling, and advance the theories and methods underlying such modeling.

The program of research proposed here will take place over the course of one year, beginning April 1, 2012. While primary efforts directed toward the three phases of work will be roughly sequential, researchers will be engaged in elements of the first and third continuously throughout the project's course. Work on phase one, orientation of project team members and exploration of the Social Force model, has already begun via a collaborative partnership between the PSL and TRC and will continue into the foreseeable future. Upon initiation of the formally proposed program of research, work will generally proceed according to the timeline attached.

In building foundational research expertise with the Social Force model and its application to integrated transportation and recreation management, the proposed research will contribute both to UVM's mission and the Spires of Excellence Initiative as well as to research and practice in the transportation and recreation fields. The development and demonstration of expertise in integrated transportation and recreation simulation modeling, particularly with the Social Force model, will be a unique and desirable capability among universities. The process of building this expertise will provide material for extensive research and publication of interest to a breadth and diversity of professionals and lay persons. By focusing on transportation and recreation in parks and on public lands, the research is embedded in facilities (roads, trails and transit) and activities (driving and walking for pleasure) familiar to and popular among most Vermonters and Americans. Simultaneously, this research illustrates and explores deeply complex systems. The practical knowledge and experience in Social Force modeling will be directly applicable for and appreciated by managers of transportation and recreation systems in parks and on public lands.

Partnership Case Study: Cape Cod National Seashore Transit Partnership

Established in 1961, Cape Cod National Seashore (CACO) is a unit of the National Park System that encompasses six towns along the outer portion of Cape Cod, Massachusetts. The seashore receives nearly five million recreational visitors annually, with much of this visitation occurring during the summer season. Many visits occur over relatively short periods of time (e.g., over a weekend), and are characterized by dependency upon a personal vehicle. Such patterns of visitation have raised concerns about damage to natural habitats, traffic congestion, and noise pollution.

CACO has established a number of partnerships and this has led to development of two new transit services—the Provincetown/ North Truro Shuttle (The Shuttle) and the "Flex". Shuttle service began in 2000 through a partnership between CACO and the Cape Cod Regional Transit Authority (CCRTA). The Shuttle connects visitors and residents with boat tours and ferry, bus, and air service in the greater Provincetown area. Following the success of the Shuttle, Flex bus service began on the Outer Cape in 2006. The Flex offers a hybrid of fixed route and on-demand service, connecting points of interest and transit hubs along the length of the Outer Cape. Buses for both services were purchased through the Paul S. Sarbanes Transit in Parks Program. Beyond establishing two new transit services, the CACO partnerships have led to the publication of a guide for travelers seeking a car free vacation on the Outer Cape (the Outer Cape Smart Guide), the building of context appropriate bus shelters, and continuing efforts to address Intelligent Transportation System (ITS) planning, bicycle, parking, and bus maintenance needs.

CACO formed partnerships with state, county and local governments, regional planning organizations, and private businesses to address issues of mobility and congestion for residents and visitors on Outer Cape Cod. Development of the Shuttle involved an initial partnership between CACO, the CCRTA, and the towns of Truro and Provincetown. In 2000, representatives from CACO, CCRTA, Cape Cod Commission, and a number of other state agencies and transportation associations were appointed to the Cape Cod Transit Task Force (CCTTF). Operating under the goals of 1) reducing auto dependency, 2) mitigating seasonal traffic, 3) meeting the needs of the year-round population, 4) developing coordination, communication, and cooperation, and 5) incorporating smart growth and land use planning, the CCTTF created the original proposal for the Flex. Currently, the relationship between CACO and the Cape Cod Commission continues through ongoing study of transportation issues on and around the national seashore. The CACO partnerships have also led to establishment other "spinoff" transportation partnerships on the Cape.

Partnership members attribute the success of their efforts to a number of factors, including:

1. a history of collaboration between CACO and surrounding communities,
2. willingness on the part of the seashore to engage in planning,
3. community and town leader interest in addressing transportation problems,
4. effective public outreach and marketing, and
5. a pro-active and legitimate transportation task force.

Challenges faced during partnership activities have largely been addressed and include:

1. addressing concerns about impacts to existing services,
2. weathering budget shortfalls,
3. providing adequate accommodation for bicycles, and
4. expanding partnership activities to a wider region.

It is expected that the Cape Cod Transit Task Force will re-convene in conjunction with the development of new 5-Year and Long-Range public transportation plans. Further, CACO and the Cape Cod Commission plan to continue to work together on studies and planning efforts that will further improve the quality of transportation on the Outer Cape. The complete case study report can be found at the following link:

http://www.triptac.org/Documents/RepositoryDocuments/Cape_Cod_CS_final.pdf

Using Indicators and Standards of Quality to Guide Transportation Management in Parks and Public Lands: A Best Practices Manual

Transportation and recreation in parks and public lands are closely linked. Transportation provides access to parks and public lands and is often a form of recreation itself, offering visitors the opportunity to see and experience the diverse system of public lands that comprise nearly a third of the nation. Moreover, transportation can be an important tool in park and public land management, helping to deliver the "right" number of visitors to the "right" places at the "right" times. For all these reasons, managing transportation in parks and public lands warrants greater attention. This manual describes and applies the framework of indicators and standards of quality to transportation management in parks and public lands.

Indicators and standards of quality have emerged as an important framework in park and outdoor recreation management. This framework can help define and manage high quality outdoor recreation opportunities. Indicators and standards of quality are also implicit in the management framework of levels of service that has conventionally been used in field of transportation management. This manual describes how these complimentary frameworks can be integrated to manage transportation in parks and public lands.

Following this brief introduction, the second chapter of the manual describes the relationship between outdoor recreation and transportation more fully, including recent legislation and policy that makes this relationship more explicit and formal. Chapter Three describes and illustrates the frameworks of indicators and standards of quality as used in outdoor recreation management and levels of service as used in transportation management, and suggests how these frameworks can be integrated. The fourth chapter of the manual reviews several frameworks in contemporary outdoor recreation management that can be used to understand, define, and manage outdoor recreation in parks and public lands. Indicators and standards of quality are important in applying these frameworks. Chapter five describes research approaches that can be used to help managers identify and formulate indicators and standards of quality that can be used to manage outdoor recreation and transportation.

Chapter Six comprises a large portion of the manual and presents a series of case studies in which indicators and standards of quality are used to help guide management of outdoor recreation and transportation in parks and public lands. In some of these cases, transportation is used as a tool to manage outdoor recreation related indicators and standards of quality, and in others indicators and standards of quality are used to manage transportation as a recreation opportunity or activity. Multiple modes of transportation are addressed, including automobiles, public transit, bicycles, and pedestrian use. While many of these case studies address transportation-related indicators and standards of quality in areas managed by the National Park Service, these examples are equally applicable across the spectrum of public lands. Chapter Seven addresses current research designed to "standardize" indicators and standards of quality by exploring the extent to which standards of quality might be measured in common units and generalized across recreation areas. The manual concludes with a chapter that offers several principles that can guide use of indicators and standards of quality in managing transportation in parks and public lands.

This Best Practices Manual demonstrates the relationship between transportation and parks, outdoor recreation and public lands. The scientific and professional literature in transportation and parks and outdoor recreation have developed separately, but the material presented in this manual suggests that there are strong relationships between these professional areas of study and that integration between them can lead to important advances in understanding and managing transportation in the context of parks, outdoor recreation and public lands. The material presented in this manual can be summarized and highlighted in the following principles that can be used to help guide transportation in parks and outdoor recreation.

1. Transportation is an important component of the visitor experience in parks and outdoor recreation. Visitors rely on many modes of transportation to travel to, from, and through parks and related outdoor recreation areas and this travel is often a vital part of the ways in which most visitors experience and appreciate these public lands. Transportation in parks and related public lands should be planned and managed in ways that protect park resources and enhance the quality of the visitor experience.

2. Transportation is an important tool in managing parks and outdoor recreation. Parks and related public lands must be managed to protect important natural and cultural resources and the quality of the visitor experience. Transportation can be used to help manage parks and outdoor recreation by delivering the “right” number of visitors to the “right” places and the “right” times.

3. The relationship between transportation and parks and outdoor recreation has been emphasized in contemporary transportation and parks and outdoor recreation related legislation and policy. Important manifestations of these relationships include cooperative agreements and related programs between the Department of Transportation and the National Park Service, the Paul S. Sarbanes Transportation in Parks Technical Assistance Center (TRIPTAC), the need for a vehicle congestion management system in the national parks, and the Transportation Equity Act for the 21st Century (TEA-21, 1998) and the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU, 2005).

4. Indicators and standards of quality represent an important framework for managing parks and outdoor recreation. Indicators and standards of quality are an important component of contemporary management-by-objectives frameworks that are used to manage parks and outdoor recreation. Indicators and standards of quality are used to quantify management objectives. Indicators of quality are measurable, manageable variables that are proxies for management objectives and standards of quality define the minimum acceptable condition of indicator variables. Once indicators and standards of quality are formulated, indicators are monitored and management actions taken to ensure that standards of quality are maintained.

5. Indicators and standards of quality are an integral part of several conceptual frameworks that can help guide management of parks and outdoor recreation, including transportation. For example, 1) quality in outdoor recreation can be defined as the degree to recreation opportunities meet the objectives for which are designed, 2) indicators and standards of quality help define the relationship between park and outdoor recreation settings and associated visitor motivations and benefits, 3) indicators and standards of quality quantify management objectives and help define the limits of acceptable change and recreation carrying capacity, 4) indicators and standards of quality can be defined for each of the three basic components of parks and outdoor recreation: park resources, the quality of the visitor experience, and the type and extent of recreation management, and 5) indicators and standards of quality are used to

help define a diverse system of park and outdoor recreation opportunities as represented in the Recreation Opportunity Spectrum (ROS).

6. Indicators and standards of quality are highly compatible with the management framework of levels of service conventionally used in the field of transportation. The concept of levels of service (LOS) is conventionally used to help guide transportation management. LOS defines a range of service levels (represented by “letter grades” from A to F) for a series of variables that are thought to be important in defining the quality of transportation facilities and services. These variables and the associated range of service levels are analogous to indicators and standards of quality as used in parks and outdoor recreation.

7. Levels of Service used in conventional transportation management should be extended and re-registered in the context of parks, outdoor recreation, and public lands. In keeping with conventional concerns in the field of transportation management, LOS is focused on issues of speed, safety, efficiency, and convenience. While these issues may be of importance to transportation in parks and outdoor recreation, other issues related to protection of park resources and enhancing the quality of the visitor experience are also important. Moreover, LOS guidelines on matters such as speed of travel and convenience may have to be re-registered in important ways to meet the demands of park and outdoor recreation visitors.

8. Indicators and standards of quality can be formulated and defined through a program of research. A number of research methods have been used to help define indicators and standards of quality in parks and outdoor recreation. These research methods include qualitative and quantitative surveys of visitors and other stakeholders, importance-performance analysis, a threats matrix, and normative theory and methods. These research approaches are beginning to be applied to transportation in parks, outdoor recreation, and public lands.

9. Research has identified a diverse range of indicators and standards of quality. Indicators and standards of quality have been identified for a diverse range of recreation settings. These indicators and standards of quality address park resources, the quality of the visitor experience, and the type and extent of management. A growing number of indicators and standards of quality have been identified for transportation in parks and outdoor recreation.

10. The case studies included in Chapter 6 of this manual suggest how indicators and standards of quality can be used in managing transportation in the context of parks and outdoor recreation. These case studies address 1) the issues of transportation as a form of recreation and transportation as a tool for managing outdoor recreation, 2) multiple modes of transportation including cars, public transit, biking, and hiking, and 3) a variety of park, recreation and transportation contexts including urban through rural settings.

11. Research has recently begun to address the topic of “standardizing” indicators and standards of quality. Research on indicators and standards of quality has conventionally been conducted at the site level and in isolation from other parks and public land units and this has made it difficult to test the degree to which indicators and standards of quality might be generalized across areas. Testing for the generalizability of indicators and standards of quality requires using comparable research methods. Several recent studies of transportation in parks and outdoor recreation have been designed to test the degree to which indicators and standards of

quality can be “standardized.” Findings from these studies are promising, but more work is needed.

The complete manual can be found at the following link:

http://www.triptac.org/Documents/RepositoryDocuments/BestPractices_Manning_Final3.pdf

Scope of Work to Study Transportation as a Barrier to Visitation for Communities of Color and other Underserved Populations

Objective

The primary objective of this project is to conduct research to better understand transportation as a barrier to park visitation among communities of color and other underserved populations and to identify potential ways to improve transportation to parks for these communities.

Background and Purpose

The Director of the National Park Service (NPS) has recently identified “relevancy” as a priority for policy and planning in the NPS. This directive, along with other recent NPS reports (Gramann 2003, Mitchell, et al. 2006, Rodriquez and Roberts 2002, Tuxill et al. 2009), places relevancy and engagement of diverse audiences at the forefront for the NPS, particularly given the changing demographics of the U.S. population (Murdock 1995, U.S. Census 2000). While issues of relevancy and diversity are complex, research has shown transportation to be a barrier to visitation to parks and public lands for many communities of color and other underserved populations (Solop et al. 2003, Cambridge Systematics 2004). Research that examines transportation issues for communities of color and other underserved populations can assist parks in removing barriers to access, allowing parks to better engage traditionally underserved populations.

This project will use case study methodology to identify and explore how transportation options and knowledge impact access to national parks for underserved populations. Case studies are a methodological approach for gathering data about a particular group, event, or social setting to understand how it operates (Berg 1997). Three phases of research will be conducted. Phase one will involve an inventory of transportation options to and around selected national park units. In phase two, a survey of underserved populations will be conducted to identify knowledge about and limitations of current transportation options. In phase three, findings from the first two phases of the project will be integrated to identify potential ways to improve transportation to parks and increase visitation by people of color and other underrepresented groups. Recommendations from the study will provide parks with options for developing a transportation system that meets the needs of local underserved communities.

Sustainable Transportation in the National Parks: From Acadia to Zion

Introduction

Transportation, national parks and outdoor recreation are intimately and inextricably linked. For example, nearly 300 million visitors per year travel to, from, and within the U.S. national parks. Moreover, American national parks comprise over 80 million acres of public land and include extensive networks of transportation corridors – roads, trails, bike paths, waterways, public transit – that link a vast array of iconic attraction sites – viewpoints, historical and cultural sites, visitors centers, campgrounds, gateway communities. The inherent complexities of this intersection between transportation, parks and outdoor recreation demand explicit management attention that includes a coordinated and systematic approach, and planning that extends beyond park boundaries to other public lands and surrounding communities.

But transportation is more than a means of access to national parks and outdoor recreation – it can be a form of recreation itself, offering most visitors their primary opportunities to experience and enjoy the natural and cultural landscapes embodied by national parks. For example, the iconic roads of many of the "crown jewel" national parks – Going-to-the-Sun Road in Glacier National Park, Tioga Road in Yosemite National Park, Trail Ridge Road in Rocky Mountain National Park, and the Park Loop Road in Acadia National Park, for example – were designed for visitors to experience the parks in their cars and are important manifestations of the historic and contemporary linkages between transportation and recreation (Carr, 2007). In fact, entire units of the national park system, such as Blue Ridge Parkway, have been designed specifically for this purpose. All of these roads were a response to demand for "driving for pleasure", what is historically one of America's most popular recreation activities (Manning, 2011).

And transportation can be even more than this; it is also an important tool for managing parks and outdoor recreation. The transportation networks and linkages in parks help determine where park visitors travel (and where they don't) and can be used by park managers to help deliver the "right" number of visitors to the "right" places at the "right" times (Manning 2007; Lawson et al. 2009; Manning 2009; Lawson et al. 2011). In this way, transportation can be used to manage outdoor recreation in parks in a sustainable way by protecting park resources and the quality of the visitor experience (Manning, 2007; Manning, 2011).

Transportation Management in the National Parks

Because of its growing importance, transportation in national parks and related areas has been the beneficiary of substantial management attention, legislation, and investment over the last few decades. The nearly 30-year partnership between the Department of Transportation (DOT) and the National Park Service (NPS) is an important manifestation of this cooperative approach. For example, in 1982 the interests of these agencies were joined by the Surface Transportation Assistance Act which directed that transportation in national parks and other federal lands meet the conventional accessibility and safety interests of the DOT while also addressing the scenic and environmental concerns of the NPS. A year later, a formal partnership between DOT and NPS was established in the form of a Memorandum of Agreement that created the Park Roads and Parkways Program and was supplemented fourteen years later by a more extended Memorandum of Understanding (MOU). The MOU's overarching goal was to improve transportation to and in national parks through five activities: 1) developing and implementing innovative transportation plans; 2) establishing personnel exchanges and information sharing systems;

3) establishing interagency project agreements for developing and implementing transportation improvement initiatives; 4) developing innovative transportation planning tools; and 5) developing innovative policy, guidance and coordination procedures for the implementation of safe and efficient transportation systems that are compatible with the protection and preservation of natural and cultural resources in national parks. The MOU led to the development of the Alternative Transportation in Parks and Public Lands Program (that evolved into the Paul S. Sarbanes Transit in Parks Program) which has funded many transportation improvements in the national parks and led to development and publication of the NPS “Transportation Planning Guidebook” in 1999.

Two more recent legislative acts have furthered transportation planning and management in parks and public lands in important ways. The Transportation Equity Act for the 21st Century (TEA-21, 1998) required the DOT and Department of Interior to conduct a comprehensive study of transportation needs on federal lands, and the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU, 2005) initiated funding for multi-modal transportation projects including transit, bicycle, pedestrian, ferry, visitor, and intermodal facilities. Furthermore, park transportation planning and management has been integrated into the Code of Federal Regulations. For instance, the NPS has been directed to develop criteria to determine when a “congestion management system” (CMS) is to be implemented. In the development of a CMS, “consideration shall be given to strategies that promote alternative transportation systems, reduce private automobile travel, and best integrate private automobile travel with other transportation modes.” It also suggests that studies on alternative modes of transportation be integrated as components of a CMS, and that methods should be determined to evaluate and monitor the effectiveness of multi-modal transportation systems. When reflecting upon the results of a CMS, the NPS must also consider congestion mitigation strategies that “add value (e.g., protect/rejuvenate resources, improve visitor experience) to the park.”

Conceptual and Organizational Frameworks for Managing Transportation, Parks and Outdoor Recreation

Given the importance of transportation, national parks, and associated outdoor recreation, we should think carefully about how to manage these places and activities. While transportation, parks, and outdoor recreation are intimately connected, too much recreation or inappropriate recreation activities can threaten the integrity of parks and can degrade the quality of the recreation experience. Similarly, transportation in parks must be planned and managed to help ensure high quality visitor experiences and to help protect park resources. How can we provide for transportation and associated recreational use of parks and related areas without threatening the natural and cultural resources they were created to protect? How can we provide opportunities for outdoor recreation that are high in quality and that meet the diverse demands of society? How can transportation help protect the quality of park resources and the visitor experience? A number of conceptual and organizational frameworks have been developed in the scientific and professional literature in the fields of both transportation and parks and outdoor recreation that can help sharpen our thinking about managing transportation in parks and outdoor recreation.

The Dual Mission of National Parks

National Parks are established for two, sometimes competing, purposes: 1) to protect important natural and cultural resources and 2) to offer opportunities for the public to use, enjoy, and appreciate these areas. When parks are used for outdoor recreation, vital natural and cultural resources can be impacted and degraded, as can the quality of the visitor experience. Even though Yellowstone National Park was established in 1872, the NPS (the agency charged with managing the national parks) wasn't created by Congress until 1916. In a classic phrase, the legislation creating the NPS states that the national parks are to be managed "…to conserve the scenery and the natural and historic objects and the wildlife 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" (USC, title 16, sec. 1). How can national parks be managed for these two, sometimes competing, objectives?

Common Property Resources

A classic paper in the environmental literature, titled "The Tragedy of the Commons," was published in the prestigious journal *Science* (Hardin, 1968). This paper identified a set of environmental problems – issues of the "commons" or lands and associated resources owned by society at large – that must be resolved through public policy and associated management action. Without explicit management, there is an inherent tendency to overuse common property resources. Hardin's ultimate prescription for managing the commons was through "mutual coercion, mutually agreed upon": without such collective action, environmental (and related social) tragedy is inevitable.

Hardin began his paper with an illustration using perhaps the oldest and simplest example of an environmental commons, a shared pasture. Each herdsman is tempted to graze additional cattle on the commons because he reaps all the benefits, but pays only a portion of the costs of resulting environmental degradation. Hardin went on to identify and explore other examples of environmental commons, including national parks:

The National Parks present another instance of the working out of the tragedy of the commons. At present, they are open to all without limit. The parks themselves are limited in extent – there is only one Yosemite Valley – whereas population seems to grow without limit. The values that visitors seek in parks are steadily eroded. Plainly, we must soon cease to treat the parks as commons or they will be of no value to anyone. (p. 1245)

Management of parks and outdoor recreation represents an example of "mutual coercion, mutually agreed upon" that Hardin suggests is needed to protect parks and the quality of the recreation experience. While this coercion – for example, restrictions on when and where visitors may go in national parks, limits on use of automobiles – may be distasteful because they limit freedom of choice, they are ultimately needed to protect parks, the recreation experience, and the greater welfare of society (Manning 2007).

Carrying Capacity

The term "carrying capacity" has been an important part of natural resources and environmental management for decades. Its emergence can be traced to a historic publication entitled An *Essay on the Principle of Population* (Malthus, 1798). This essay reasoned that human population tends to grow at an exponential rate, but that production of food and other resources tends to grow only linearly. In this way, the supply of food and other resources presents an ultimate limit to population growth, and if this limit is not respected, the carrying capacity of the earth (or selected geographic regions) may be exceeded. Malthus's ideas about carrying capacity and the limits of the earth to support human population growth have become foundational concepts of the contemporary environmental movement.

Scientific applications of carrying capacity were first advanced in the fields of fisheries, wildlife, and range management (Hadwen and Palmer, 1922; Leopold, 1934; Odum, 1953). For example, how many animals can ultimately be supported by a given area of range? Carrying capacity was first applied to parks and outdoor recreation in the 1960s (Wagar, 1964; Lucas, 1964). In this context, carrying capacity is defined as the amount and type of recreation that can be accommodated in a park without unacceptable impacts to park resources and the quality of the visitor experience (Manning 2007).

Early research on carrying capacity sought to apply this concept exclusively as it concerns the environmental impacts of outdoor recreation. In the preface of his influential monograph on carrying capacity, Wagar wrote:

> The study reported here was initiated with the view that the carrying capacity of recreation lands could be determined primarily in terms of ecology and the deterioration of areas. However, it soon became obvious that the resource-oriented point of view must be augmented by consideration of human values (Wagar, 1964; preface)

Wagar's point was that as more people visit a park or related outdoor recreation area, not only are the environmental resources of the area affected, but also the quality of the recreation experience, and informed park and outdoor recreation management must address both resource and experiential concerns. Moreover, there are potentially important interactions between these components. For example, impacts to park resources can degrade the aesthetic quality of the recreation experience. Informed management of the carrying capacity of parks and related areas must take into account both components of parks and outdoor recreation and the potential interactions between them.

Finally, there's an important managerial component of carrying capacity (Wagar 1964; Manning 2007). Carrying capacity can be affected by the type and intensity of management. For example, the durability of natural resources might be enhanced by fertilizing and irrigating vegetation, and the quality of the recreation experience might be enhanced by more evenly distributing recreation use across both space and time.

Carrying capacity, or "visitor capacity" as it is sometimes called, has remained an important but challenging and often contentious issue in the field of parks and outdoor recreation (Graefe et al., 1984; Shelby and Heberlein, 1986; Stankey and Manning, 1986; Manning, 2007; Manning, 2011; Whittaker et al., 2011). What is the ultimate capacity of parks for outdoor recreation? How can outdoor recreation be managed to ensure that it does not exceed a park's carrying capacity? What is the carrying capacity of transportation systems in national parks? How can transportation contribute to the management of carrying capacity in parks and outdoor recreation? These are important questions that must inform management of transportation in parks and outdoor recreation.

Limits of Acceptable Change

Research on the application of carrying capacity to parks and outdoor recreation has documented a number of impacts that recreation can have on park resources and the quality of the visitor experience (Hammitt and Cole 1998; Manning 2011). For example, park visitors may trample fragile soils and vegetation, and disturb wildlife. And as the number of visitors increase, parks may become crowded. With increasing use of parks comes increasing environmental and social impacts, and at some point these impacts may become unacceptable. But what determines the limits of acceptable change?

To emphasize and further clarify the limits of acceptable change and its relationship to carrying capacity, some writers have suggested distinguishing between the descriptive and prescriptive components of carrying capacity (Shelby and Heberlein, 1984; Shelby and Heberlein, 1986). The descriptive component of carrying capacity focuses on factual, objective. For example, what is the relationship between the amount of visitor use and perceived crowding? The prescriptive component of carrying capacity addresses the seemingly more subjective issue of how much impact or change is acceptable. For example, what level of perceived crowding should be allowed? Determining acceptable limits of change must form a foundation for park and outdoor recreation management.

Indicators and Standards of Quality

Contemporary approaches to determining the limits of acceptable change in parks and outdoor recreation are based largely on formulation of management objectives and associated indicators and standards of quality (Manning, 2007; Manning, 2011; Whittaker et al., 2011; Manning and Anderson, 2012). Management objectives are statements about the desired conditions of parks and outdoor recreation, including the level of protection of park resources and the type and quality of the recreation experience. Indicators of quality are more specific, measurable, and manageable variables that reflect the meaning or essence of management objectives; they are quantifiable proxies of management objectives. Standards of quality are numerical expressions of desired conditions for indicator variables.

As noted earlier, many of the iconic roads in the national parks were designed and constructed for visitors to see and appreciate the parks in their cars. Thus, the management objective for this type of recreation opportunity might be called “scenic driving” or “driving for pleasure.” Associated indicators and standards of quality might focus on assuring a lack of traffic congestion on these roads as is implied by scenic driving and driving for pleasure. For example, an indicator of quality might be the number of other vehicles that can be seen at any one time over a given length of road, and a standard of quality might specify what that maximum number of other vehicles should be.

Levels of Service

The transportation literature employs a conceptual framework called levels of service (LOS) to help guide transportation management across the United States. LOS is reflective of the management objectives of the Department of Transportation “[to] Serve the United States by ensuring a fast, safe, efficient, accessible and convenient transportation system” (80 Stat. 931, 49 U.S.C. 101). LOS is derived from the Transportation Research Board’s Highway Capacity Manual (HCM) and describes operational conditions of a traffic system using variables such as speed, travel time, freedom to maneuver, comfort, and convenience (Transportation Research Board, 2000). It defines a range of transportation conditions based upon a letter system (A through F) where A represents the best operating conditions and F the worst. LOS is similar to the framework of indicators and standards of quality described above in that it identifies a series of indicator variables that help define transportation quality (e.g., speed, travel time) and then recognizes a range of standards of quality labeled A through F.

A Park and Outdoor Recreation Management Framework

The organizational and conceptual frameworks outlined above have contributed to development of a management-by-objectives framework that can be used to guide management of transportation in the context of parks and outdoor recreation. This approach relies on a series of three primary steps:

1. Management objectives and associated indicators and standards of quality are formulated for a park or site within a park. As noted above, management objectives describe desired conditions – the level of resource protection and the type and quality of recreation experiences – and indicators and standards of quality define these objectives in quantitative, measurable form.

2. Indicators of quality are monitored to see if standards of quality are being maintained.

3. If standards of quality are violated, or are in danger of being violated, then management action is required.

This management framework takes somewhat different forms in alternative contexts. For example, the US Forest Service uses a framework called Limits of Acceptable Change (LAC) (Stankey et al., 1985), while the NPS uses Visitor Experience and Resource Protection (VERP) (National Park Service, 1997; Manning, 2001). While there are some differences in terminology and sequencing of steps, these and related frameworks rely on the three basic steps described above and illustrated in Figure 1.2 (Manning, 2004; Whittaker et al., 2011). This approach represents a long-term commitment to management that requires maintaining standards of quality, periodic monitoring of indicators of quality, and reconsideration of management practices based on monitoring data. When circumstances warrant – for example, when a management plan has reached the end of its useful life and needs to be revised, or when new information becomes available – management objectives and associated indicators and standards of quality can be reconsidered.

This management framework is built on the conceptual and organizational frameworks outlined in the previous section. It uses management objectives and associated indicators and standards of quality as quantitative expressions of the limits of acceptable change. This expression of quality through indicators and standards is directly analogous to the LOS framework used in the field of transportation management. Management objectives and associated indicators and standards of quality can and should be considered for both components of parks and outdoor recreation – resource and experiential conditions. The limits of acceptable change define the carrying capacity of parks and related areas, and address the inherent tension between recreational use of parks and protection of park resources and the quality of the visitor experience. The framework requires management action – "mutual coercion, mutually agreed upon" – as demanded in the context of common property resources and as a mechanism to maintain standards of quality.

From Conventional to Sustainable Transportation Management in National Parks

Conventional transportation management might most appropriately be termed "demand-driven" transportation management. In this approach, transportation planning and management responds to increasing demand (e.g., more cars, more vehicle miles driven) with more expansive facilities and services – wider and straighter roadways, added lanes of traffic, more stoplights and other traffic control mechanisms, expanded parking, mass transit. These are often reasonable responses in many contexts, but they can also lead to unsustainable conditions in national parks, including unacceptable impacts to park resources (e.g., conversion of valuable park land to transportation facilities and services, excessive air pollution, degradation of park wildlife) and the quality of the visitor experience (e.g., traffic congestion, diminished quality of park resources, inappropriate facilities and services). Conventional transportation planning may lead to enhanced transportation facilities and services, but may also unintentionally lead to a degraded park and a diminished park experience.

In a more sustainable approach, management objectives and associated indicators and standards of quality for park resources and the visitor experience are formulated. Then transportation planning and management is conducted within this park management context or framework. This leads to intentional improvements in both transportation and park and associated experiential conditions. Moreover, transportation can be used as a tool to help manage parks in a more sustainable manner.

Objectives and Organization of the Book

A substantive body of research on transportation in parks and outdoor recreation has developed in the scientific and professional literature over the past two decades. However, this literature is widely scattered over a variety of academic and professional journals in the fields of transportation management (e.g., *Transportation Research Record, Journal of Sustainable Transportation*), parks and outdoor recreation (e.g., *Journal of Park and Outdoor Recreation Administration, Leisure Sciences*), and related areas of study (e.g., *Transport Geography, Environmental Management, Society & Natural Resources).* The primary objective of this book is to collect, organize, integrate, and synthesize representative and important components of this work.

The book is organized into five major parts. Part 1 is the current chapter that outlines the history and associated issues of transportation in the national parks. Part 2 addresses the relationship between transportation and 1) park resources and 2) the recreation experience. It includes an assessment of the impacts of transportation and indicators and standards of quality for transportation in the context of parks and outdoor recreation. Part 3 addresses transportation as a tool for managing parks and outdoor recreation, including managing visitor use in a sustainable manner to minimize the environmental and social impacts of outdoor recreation. It includes issues of alternative transportation systems (ATS), intelligent transportation systems (ITS), multiple modes of transportation and how visitors choose among these modes, transportation modeling, and application of the management-by-objectives framework described earlier. Part 4 presents a series of case studies that illustrate many of the issues addressed in Parts 2 and 3. Part 5 develops a set of emerging principles or best practices that are derived from the papers and case studies included in the book and that can guide planning and management of sustainable transportation in the context of national parks.

The book has been prepared to serve the needs of both the academic and practitioner communities. University courses in transportation and parks and outdoor recreation are beginning to focus on the nexus between these fields, and this book can serve as a text for these courses. Moreover, the book could be a supplemental text in conventional courses in transportation planning and park and outdoor recreation management. The book is also intended as a desk reference for practitioners (planners, managers, administrators) in transportation, parks and outdoor recreation, and related fields.

Full Circle Trolley Pilot Assessment

Building on the growing popularity of ATS and its potential environmental and experiential benefits, a small shuttle bus system was implemented at Marsh-Billings-Rockefeller National Historical Park (Marsh-Billings-Rockefeller) in Woodstock, Vermont in 2010. Marsh-Billings-Rockefeller is a 643-acre unit of the national park system that is located on the outskirts of the small, historic village of Woodstock. The shuttle bus system consists of one electric-powered bus that operates on a roundtrip route between the park and the Woodstock town green (located at the center of the town) with defined stops along the route. The bus is operated on weekends and holidays during the summer and fall seasons, with occasional service on week days during periods of peak visitor use. “Headways” or intervals between buses is about 20 minutes and service is free to riders. The bus’ batteries are charged through the Green Mountain Power Company’s “Cow Power” program which generates electricity from the methane gas that is collected from the decomposition of manure from local dairy farms. The bus is colorfully designed to suggest features of an historic vehicle.

The shuttle bus system was designed to meet several objectives. First, roads in the village of Woodstock can be heavily congested during the peak tourist season. It was hoped that the shuttle bus would encourage visitors to ride the bus instead of using their cars for short trips (e.g., visiting Marsh-Billings-Rockefeller) in and around the village and park. Second, parking is limited in the village and there is often more demand for parking than available spaces. There is a large public parking lot associated with Marsh-Billings-Rockefeller on the outskirts of town. It was hoped that visitors would use the parking lot adjacent to Marsh-Billings-Rockefeller and use the shuttle bus to travel into and around the village. Third, the shuttle bus was deliberately designed to be “green” by encouraging visitors to use the shuttle instead of their cars and using an alternative, less-polluting fuel to power the bus. It was hoped that visitors would choose to use the shuttle bus because it was a green alternative to automobile usage, that they would gain some positive experience with ATS, and that they would learn about alternative energy. Fourth, design and operation of the shuttle bus system was a collaborative effort between Marsh-Billings-Rockefeller and local organizations and agencies. It was hoped that this would result in a successful partnership that would serve the needs of all entities and would be a model for future collaboration.

To assess how well the shuttle bus system works and the degree to which the four objectives described above are being met, a study was designed and implemented by the University of Vermont’s Park Studies Laboratory. The study was conducted in the summer and fall of 2012.

Transportation Recreation Opportunity Spectrum (T-ROS)

Given the close relationship between transportation and recreation in parks and public lands, a Transportation Recreation Opportunity Spectrum (T-ROS) could be useful in planning and managing transportation in the context of parks and public lands. Recent research has found that roads in parks and public lands are often more than just an access system. In fact, driving for pleasure is a historically important form of recreation. Furthermore, roads in some contexts may be inherently more recreational than others. Therefore, the T-ROS considers transportation systems as more than just a means of access, but rather as a range of recreation opportunity settings defined by a series of indicators and a range of associated standards.

A prototype example of the T-ROS concept emerged from a recent program of transportation-related research. This research was designed to solicit knowledge of how people perceive, assess, and value transportation systems using an indicators and standards framework. Indicators and standards, widely used in the field of outdoor recreation management, consider visitor perspectives and incorporate them into management. As outlined earlier, indicators are measureable, manageable variables that help define the quality of parks and outdoor recreation areas and opportunities, and standards define an acceptable range of conditions of indicator variables. Varying combinations of indicators and standards define a range of settings for transportation in the context of parks and public lands.

Building and Applying T-ROS

A more fully developed T-ROS framework is now under development as part of a program of work conducted under the auspices of Federal Lands Highway and its cooperators. This program of work will include pilot applications of T-ROS in three widely ranging geographic areas: 1) the complex of public lands and transportation facilities and services in the greater Rocky Mountain National Park region, 2) the complex of public lands and transportation facilities and services in the greater Lake Tahoe region, and 3) Grand Canyon National Park.

The complete report for the initial phase of this work can be found at the following link:

http://www.triptac.org/Documents/RepositoryDocuments/TROS_Lit_rev.pdf.pdf

5. Conclusions

Indicators and Standards

The overall findings from the Indicators and Standards portion of this program of research provide useful insights into the link between tourism/recreation and transportation. In fact, transportation in some settings is part of the tourism/recreation experience. Transportation has made access to recreation and tourism resources easier, and less expensive. But ease of access has led to a number of contemporary issues regarding impacts created by growing use, primarily in the form of automobiles. The research presented in this report can help recreation and tourism planners and managers take a more deliberative approach to planning transportation systems to service tourism venues, including places like national parks and forest, tourism attractions and communities of all sizes.

Under conditions of growing demand, transportation can be used as a tool to mitigate issues of crowding and negative impacts to resources. However, this must be done carefully. Use of a model of efficiency when designing and implementing transportation systems may conflict with the goal of providing high quality visitor experiences in recreation and tourism settings. The research presented in this report provide methods for planners and managers in these settings to register traditional transportation planning methods to better fit into the recreation and tourism contexts they service. Examples of this can include use of Alternative Transportation Systems like shuttle buses that deliver appropriate numbers of visitors to the places they wish to visit. Provision of multi-modal transportation facilities like hiking and walking trails and other greenways that promote forms of transportation (i.e. walking and bicycling) that have fewer negative impacts on recreation and tourism resources and visitor experiences are one way to use transportation systems.

Research also demonstrates that there is substantial support for Alternative Transportation Systems in many recreation and tourism settings. A growing body of evidence indicates that visitors are willing to experience the places they visit by using forms of transportation other than their automobiles, and there may be ways to increasingly shift visitors to alternative modes of transportation.

Taken together, the results from this program of research indicate ways in which transportation planning and management can become more sustainable. Programs of research like this one can provide a strong theoretical and empirical foundation for a more sustainable approach to transportation planning and management.

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Appendix A

Indicators and Standards of Quality Project Results

A1. Roads

-Acadia National Park Loop Road

-Vermont Route 100

-Vermont Interstate 89

A2. Greenways

-Acadia National Park Carriage Roads

-Stowe Recreation Path

-Burlington Bicycle Path

A3. Transit

-Acadia Island Explorer

-Muir Woods Shuttle

-Alcatraz Ferry

Appendix A1

Roads

Survey Details

Context	*Location*	*n*	*Percent*
Vermont Interstate 89	Sharon Visitor Center	103	44.4
	Williston North Visitor Center	59	25.4
	Williston South Visitor Center	44	19.0
	Richmond Park & Ride	21	9.1
	Colchester Park & Ride	5	2.2
	Total	233	100.0
Vermont Route 100	Cabot Cheese Annex	129	39.8
	Ben & Jerry's Factory	106	32.7
	Cold Hollow Cider Mill	65	20.1
	Citgo Gas Station	24	7.4
	Total	323	100.0
Acadia Loop Road	Bubble Rock	163	64.9
	Jordan Pond	56	22.3
	Bubble Pond	32	12.7
	Total	253	100.0

Question 1. What type of vehicle are you traveling in today?

Context	*Vehicle Type*	*n*	*Percent*
Acadia Loop Road	Passenger vehicle	210	83.7
	Truck	19	7.6
	Bicycle	14	5.6
	Bus	5	2.0
	Recreational vehicle	2	0.8
	Motorcycle	1	0.4
	Total	251	100.0
Vermont Route 100	Passenger vehicle	284	89.0
	Truck	19	6.0
	Recreational vehicle	10	3.1
	Motorcycle	3	0.9
	Bus	2	0.6
	Bicycle	1	0.3
	Total	319	100.0
Vermont Interstate 89	Passenger vehicle	187	81.3
	Public bus	19	8.3
	Truck	13	5.6
	Recreational vehicle	5	2.2
	Motorcycle	4	1.7
	Other	1	0.4
	Total	230	100.0

Question 2. During your time on (Vermont Interstate 89, Vermont Route 100, Acadia Loop Road), which of the following were you?

Context	*Driver or Passenger?*	*n*	*Percent*
Acadia Loop Road	Driver	153	61.0
	Passenger	98	39.0
	Total	251	100.0
Vermont Route 100	Driver	211	66.1
	Passenger	108	33.9
	Total	319	100.0
Vermont Interstate 89	Driver	162	71.1
	Passenger	66	28.9
	Total	228	100.0

Question 3. Approximately how far are you traveling on (Vermont Interstate 89, Vermont Route 100, Acadia Loop Road) today?

Context	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Acadia Loop Road	207	0 miles	105 miles	15.27 miles	10.739
Vermont Route 100	293	1 mile	195 miles	21.35 miles	22.586
Vermont Interstate 89	201	9 miles	1000 miles	87.46 miles	85.169

Context	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Acadia Loop Road	191	5 minutes	12 hours	1 hour & 56 minutes	121.286
Vermont Route 100	249	2 minutes	8 hours	50 minutes	62.571
Vermont Interstate 89	189	10 minutes	7 hours	1 hour & 34 minutes	62.949

Question 4. Have you traveled along (Vermont Interstate 89, Vermont Route 100, Acadia Loop Road) before? If yes, approximately how many times have you traveled along this road in the past 12 months?

Context	*Traveled Before?*	*N*	*Percent*
Acadia Loop Road	Yes	188	75.2
	No	62	24.8
	Total	250	100.0
Vermont Route 100	Yes	217	68.2
	No	101	31.8
	Total	318	100.0
Vermont Interstate 89	Yes	214	92.6
	No	17	7.4
	Total	231	100.0

Context	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Acadia Loop Road	171	0	52 times	5.20	9.707
Vermont Route 100	194	0	1,000 times	54.65	131.004
Vermont Interstate 89	197	0	750 times	88.49	150.649

Question 5. The purpose of using (Vermont Interstate 89, Vermont Route 100, Acadia Loop Road) can range from purely "transportation" (for example, to get from one place to another) to purely "recreation" (e.g., to enjoy the journey), or it can be some combination of these purposes.

Using the scale below, please indicate the purpose of your use of (Vermont Interstate 89, Vermont Route 100, Acadia Loop Road) today.

Context	*Rating*	*n*	*Percent*
Acadia Loop Road	1	13	5.2
	2	5	2.0
	3	10	4.0
	4	7	2.8
	5	41	16.3
	6	11	4.4
	7	27	10.7
	8	27	10.7
	9	111	44.0
	Total	252	100.0
Vermont Route 100	1	43	13.4
	2	9	2.8
	3	21	6.6
	4	15	4.7
	5	62	19.4
	6	6	1.9
	7	25	7.8
	8	19	5.9
	9	120	37.5
	Total	320	100.0
Vermont Interstate 89	1	75	32.5
	2	21	9.1

	3	25	10.8
	4	12	5.2
	5	48	20.8
	6	8	3.5
	7	5	2.2
	8	9	3.9
	9	28	12.1
	Total	231	100.0

Context	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Acadia Loop Road	252	1	9	6.97	2.413
Vermont Route 100	320	1	9	6.05	2.915
Vermont Interstate 89	231	1	9	3.84	2.756

Question 6. What did you most enjoy about your travel along (Vermont Interstate 89, Vermont Route 100, Acadia Loop Road) today?*

Context	*Item*	*n*	*Percent*
Acadia Loop Road	Scenery/views	245	39.0
	Good route quality/condition/design	113	18.0
	Recreation/natural destination	82	13.1
	Lack of traffic/crowding	38	6.1
	Good weather	20	3.2
	Other	140	21.9
	Total	638	100.0
Vermont Route 100	Scenery/views	276	49.3
	Tourism/developed destination	135	19.7
	Lack of traffic/crowding	73	10.6
	Good route quality/condition/design	50	7.3
	Time with family and friends	12	1.8
	Other	139	20.3
	Total	685	100.0
Vermont Interstate 89	Scenery/views	158	33.7
	Lack of traffic/crowding	94	20.0
	Good route quality/condition/design	62	13.2
	Visitor services	49	10.4
	Good weather	22	4.7
	Other	84	17.9
	Total	469	100.0

*Respondents could list up to three items that they most enjoyed.

Question 7. What did you <u>least</u> enjoy about your travel along (Vermont Interstate 89, Vermont Route 100, Acadia Loop Road) today?*

Context	*Item*	*n*	*Percent*
Acadia Loop Road	Traffic/crowding/level of service	57	19.9
	Lack of parking/unauthorized car parking	54	18.9
	Nothing	31	10.8
	Poor road quality/condition/design	22	7.7
	Lack of signage/facilities/interpretation	20	7.0
	Other	102	35.7
	Total	286	100.0
Vermont Route 100	Poor road quality/condition/design	99	25.8
	Traffic/crowding/level of service	91	23.7
	Nothing	53	13.8
	Miscellaneous	41	10.7
	Other users	27	7.0
	Other	73	23.5
	Total	311	100.0
Vermont Interstate 89	Poor road quality/condition/design	71	31.8
	Nothing	41	18.4
	Miscellaneous	34	15.2
	Lack of signage/facilities/interpretation	18	8.1
	Bad weather	16	7.2
	Other	43	19.3
	Total	223	100.0

*Respondents could list up to three items that they least enjoyed.

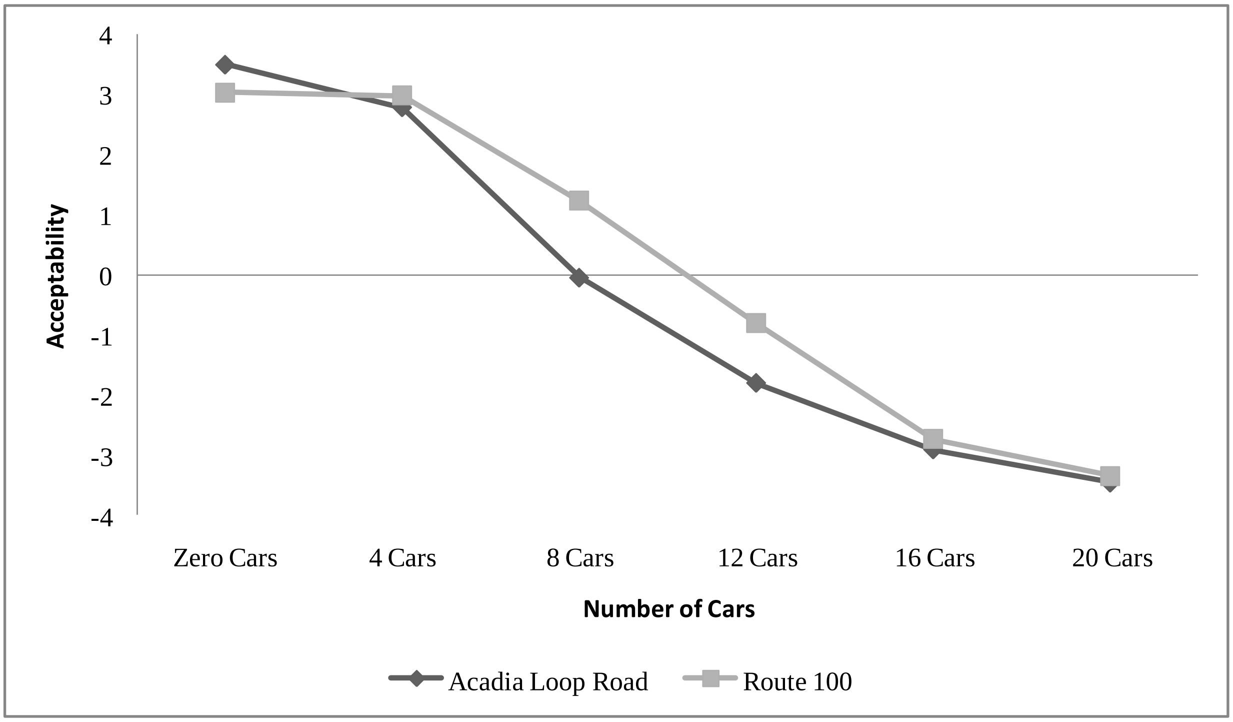
Question 8. Please rate the desirability of the following items for (Vermont Interstate 89, Vermont Route 100, Acadia Loop Road).

Scale -2 → +2	Acadia Loop Road		Vermont Route 100		Vermont Interstate 89	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Scenic views	1.85	.445	1.62	.619	1.74	.577
Lack of litter	1.79	.463	1.44	.814	1.62	.660
Lack of graffiti	1.83	.404	1.46	.845	1.61	.791
Ability to get from one place to another quickly	.90	.867	.89	.859	1.50	.728
A predictable travel time	.63	.849	.79	.883	1.46	.680
Infrequent accidents	1.40	.840	1.17	.906	1.45	.832
Ability to maintain a constant speed	.64	.878	.69	.870	1.42	.717
Smooth pavement	1.36	.726	.91	1.014	1.36	.877
Good weather/driving conditions	1.38	.746	1.28	.890	1.35	.891
Absence of "aggressive drivers"	1.58	.744	1.27	.891	1.35	.980
Ability to maneuver as you drive (change lanes, slow/stop)	.95	.849	.65	.927	1.34	.721
Wide road shoulder	.82	1.082	.71	.986	1.29	.836
Limited development (houses, businesses) along the road	1.72	.741	.88	.920	1.27	.910
Divided roadway (center median/barrier)	.02	1.287	.05	1.120	1.27	.841
Adequate spacing between vehicles	.95	.775	.75	.865	1.25	.829
Few vehicles on the road	1.11	.851	.80	.941	1.22	.833

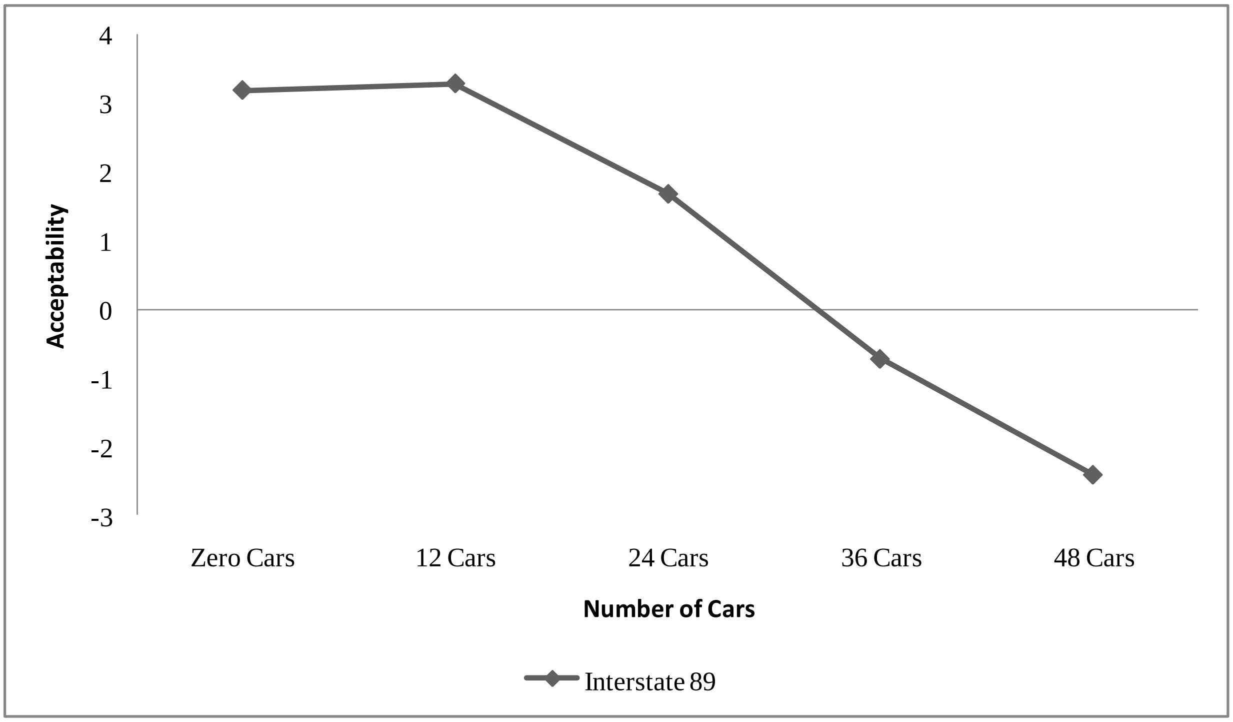
Limited intersections/merging traffic	1.25	.718	.83	.922	1.21	.887
Access to rest areas/restrooms	.87	.860	.49	1.051	1.18	1.029
Access to recreation/tourism attractions	1.47	.752	1.35	.734	1.16	.812
Scenic overlooks/pull-offs	1.63	.648	.83	.931	1.16	.858
Limited traffic noise	1.20	.892	.76	.907	1.01	.910
Guard rails along the road	.30	1.168	.43	.916	.99	.900
Absence of road construction	1.40	.757	1.07	.986	.98	1.115
Access to gas stations	-.29	1.137	.71	.797	.94	.871
Access to local businesses	-.01	1.143	.93	.868	.77	.891
Signs for tourist attractions, commercial services	.63	1.258	.88	.989	.69	1.089
Hilliness/curviness of road	.90	.884	.55	.902	.67	.956
High speed limit (to speed up traffic)	-.54	1.292	.12	.980	.66	1.069
Being close to "civilization" (i.e., access to roadside assistance, local business)	.00	1.194	.47	.978	.63	.885
More than two lanes of road	.07	1.316	.05	1.173	.59	1.260
Frequent police/safety patrols	.19	.976	.20	.959	.44	1.103
Seeing wildlife	1.26	.902	.73	1.011	.43	1.173
Low speed limit (to slow traffic)	1.12	.963	.26	1.040	-.04	1.080

Question 9. Use Levels.

Scale -4 → +4	Photo	n	mean	SD
Acadia Loop Road	Zero cars	240	3.51	1.399
	4 cars	239	2.79	1.402
	8 cars	236	-.04	2.271
	12 cars	235	-1.81	2.107
	16 cars	240	-2.91	1.661
	20 cars	239	-3.46	1.489
Vermont Route 100	Zero cars	299	3.04	1.777
	4 cars	296	2.98	1.403
	8 cars	287	1.23	1.876
	12 cars	286	-.81	1.948
	16 cars	294	-2.74	1.533
	20 cars	296	-3.35	1.466
Vermont Interstate 89	Zero cars	216	3.19	1.882
	12 cars	215	3.29	1.128
	24 cars	212	1.69	1.757
	36 cars	215	-.72	2.199
	48 cars	216	-2.41	2.096



Social norm curve for the acceptability of encountering cars along Acadia Loop Road and Vermont Route 100.



Social norm curve for the acceptability of encountering cars along Vermont Interstate 89.

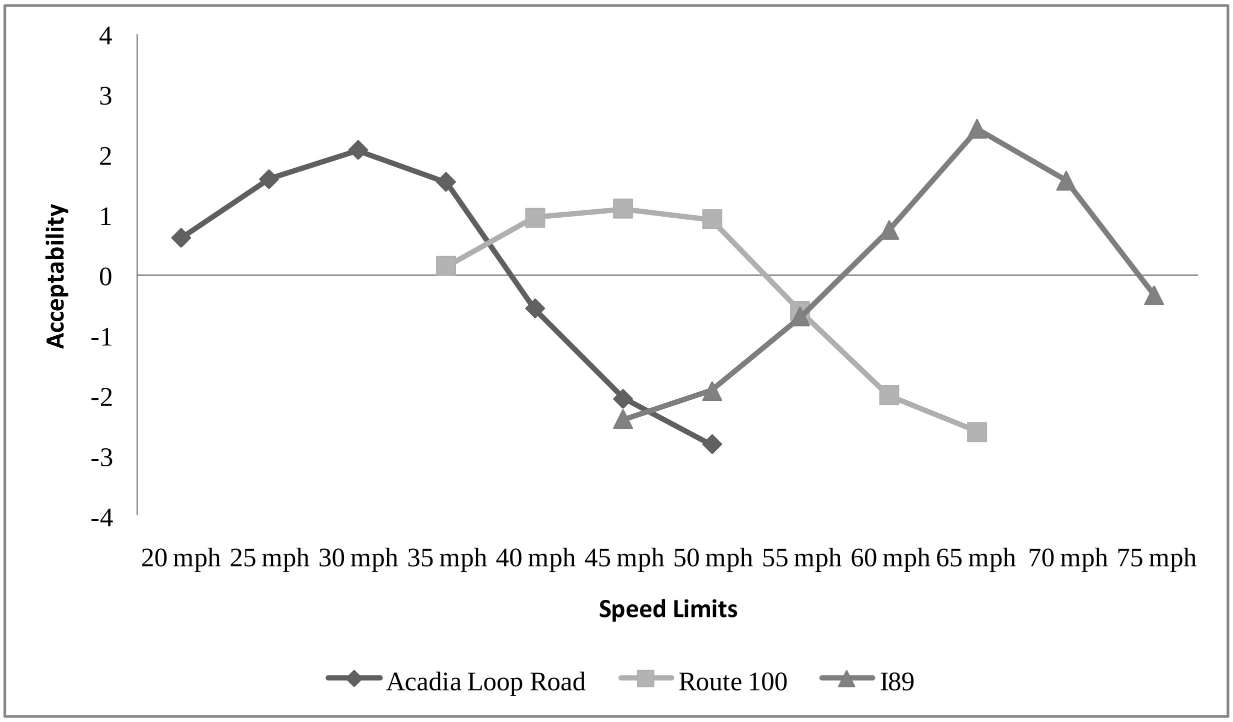
Use Levels Summary Table

	Acadia Loop Road		Vermont Route 100		Vermont Interstate 89	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Preference	2.6 cars	2.6	4.3 cars	3.3	10.3 cars	7.9
Displacement*	15.6 cars	4.5	17.1 cars	3.8	45.1 cars	7.7
Typically Seen	4.0 cars	2.3	6.9 cars	3.4	14.6 cars	6.2
Crowding**	3.0	1.6	3.4	1.7	2.6	1.5

*Percent of individuals indicating that none of the phohtographs are so unacceptable that they would no longer use road: Vermont Interstate 89 (29.5%, n=59), Vermont Route 100 (8.1%, n=23), Acadia Loop Road (8.0%, n=18). **Measured in 9-point scale from “not at all crowded” to “extremely crowded.”

Question 10. Speed Limits

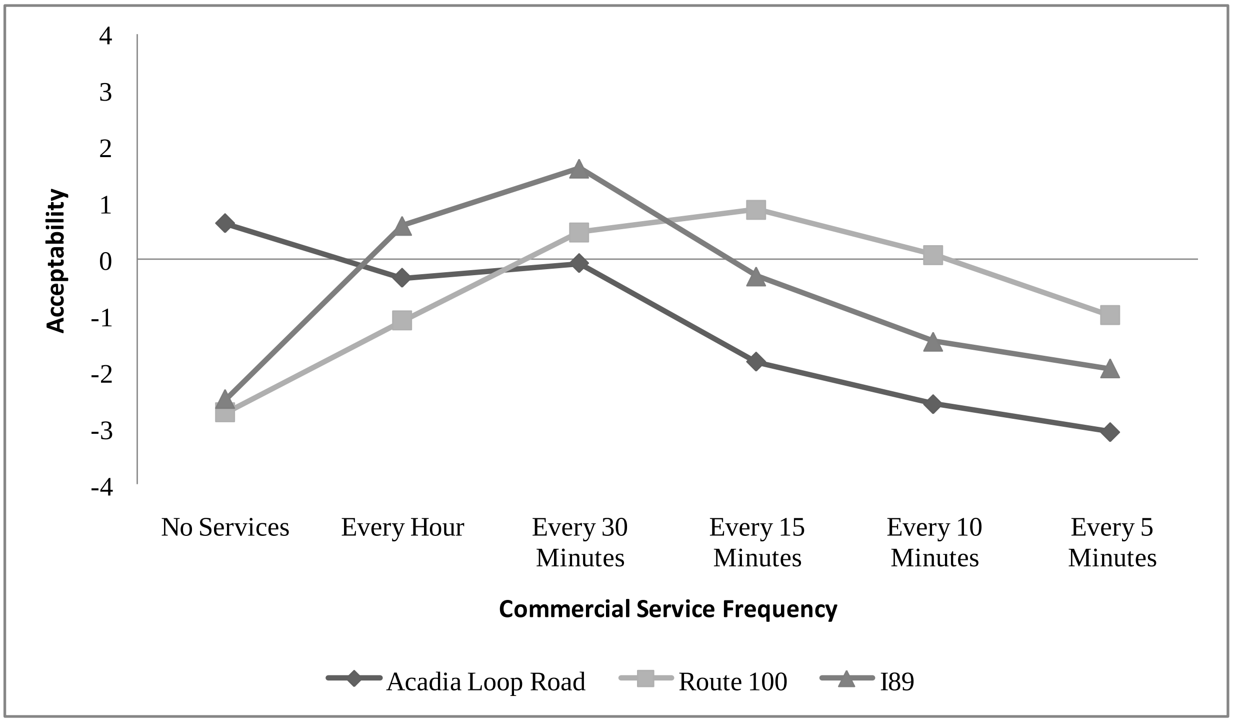
Scale -4 → +4	Speed	n	mean	SD
Acadia Loop Road	20 mph	230	.61	2.730
	25 mph	235	1.60	2.385
	30 mph	234	2.08	1.804
	35 mph	233	1.54	2.224
	40 mph	230	-.56	2.479
	45 mph	232	-2.06	2.302
	50 mph	233	-2.82	2.135
Vermont Route 100	35 mph	284	.15	2.743
	40 mph	282	.96	2.399
	45 mph	281	1.10	2.236
	50 mph	285	.92	2.390
	55 mph	277	-.61	2.586
	60 mph	280	-2.01	2.183
	65 mph	282	-2.61	2.068
Vermont Interstate 89	45 mph	201	-2.40	2.219
	50 mph	201	-1.93	2.255
	55 mph	197	-.70	2.426
	60 mph	197	.74	2.274
	65 mph	202	2.43	1.884
	70 mph	196	1.58	2.601
	75 mph	196	-.34	2.940



Social norm curve for the acceptability of speed limits along roads.

Question 11. Frequency of Commercial Services

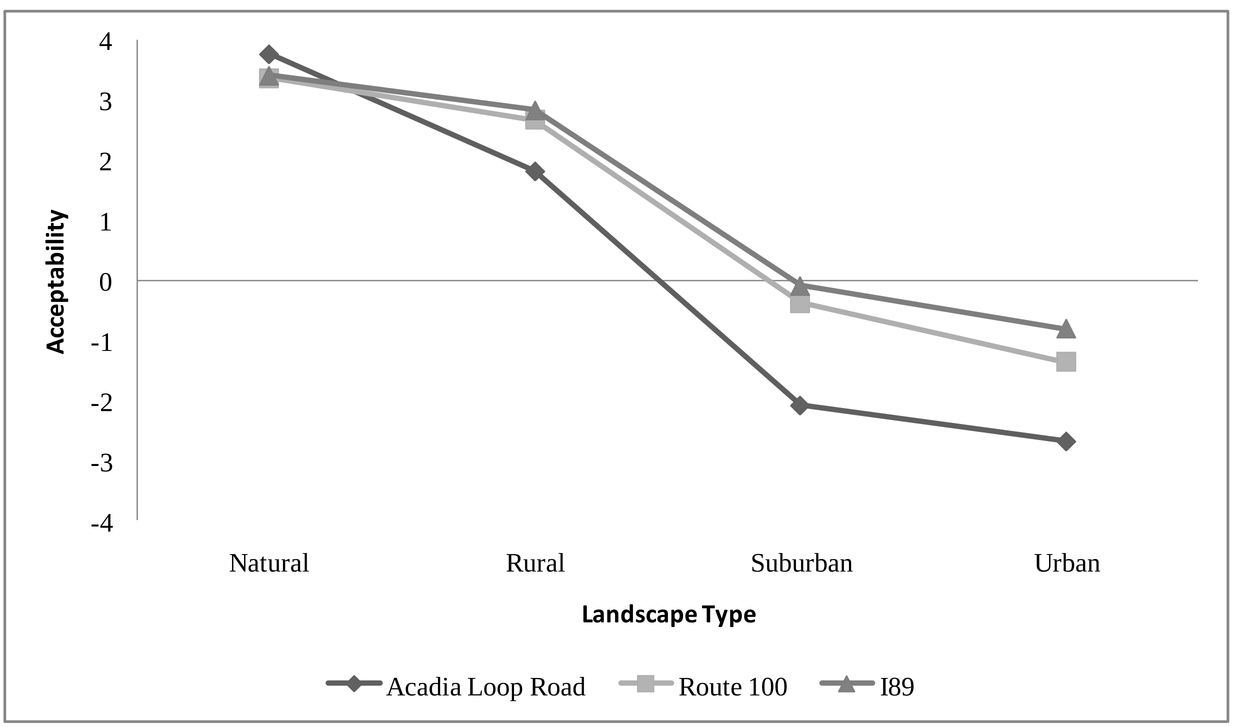
Scale -4 → +4	Frequency	n	mean	SD
Acadia Loop Road	5 min	226	-3.07	1.901
	10 min	225	-2.57	2.129
	15 min	220	-1.82	2.448
	30 min	226	-.07	2.720
	1 hour	227	.33	2.566
	None	226	.64	3.036
Vermont Route 100	5 min	278	-.99	2.619
	10 min	274	.08	2.573
	15 min	280	.89	2.257
	30 min	271	.49	2.339
	1 hour	277	-1.09	2.514
	None	269	-2.72	2.077
Vermont Interstate 89	5 min	192	-1.94	2.377
	10 min	191	-1.45	2.485
	15 min	198	-.29	2.742
	30 min	197	1.62	2.273
	1 hour	199	.61	2.666
	None	188	-2.48	2.398



Social norm curve for the acceptability of commercial service frequencies along roads.

Question 12a. Landscapes

Scale -4 → +4	Landscape	n	mean	SD
Acadia Loop Road	Urban	234	-2.68	2.099
	Suburban	235	-2.08	2.174
	Rural	235	1.82	1.981
	Natural	235	3.77	.865
Vermont Route 100	Urban	285	-1.36	2.571
	Suburban	285	-.38	2.305
	Rural	287	2.68	1.372
	Natural	291	3.37	1.243
Vermont Interstate 89	Urban	208	-.81	2.368
	Suburban	209	-.09	2.134
	Rural	210	2.84	1.369
	Natural	212	3.42	1.242



Social norm curve for the acceptability of landscape types along roads.

Question 12b. Landscape Percentage

Context	*Landscape*	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Acadia Loop Road	Urban	211	0	50	2.67	6.674
	Suburban	210	0	40	3.75	6.679
	Rural	220	0	80	16.95	14.004
	Natural	232	10	100	78.09	19.750
Vermont Route 100	Urban	276	0	100	6.21	10.722
	Suburban	278	0	100	11.57	13.464
	Rural	285	0	100	34.86	18.857
	Natural	286	0	100	49.68	23.042
Vermont Interstate 89	Urban	166	0	100	8.91	11.975
	Suburban	172	0	60	10.69	9.639
	Rural	194	0	100	33.85	19.992
	Natural	205	0	100	54.24	24.240

Question 13. How many people are in your vehicle today, including yourself?

Context	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Acadia Loop Road	234	1	7	3.00	1.385
Vermont Route 100	305	1	20	3.12	1.877
Vermont Interstate 89	208	1	40	3.94	6.964

Question 14. Do you live in the United States or Canada?

Acadia Loop Road		
	N	Percent
Maine	50	22.1
Massachusetts	34	15.0
New York	26	11.5
Pennsylvania	21	9.3
New Jersey	13	5.8
Ohio	8	3.5
Vermont	8	3.5
Connecticut	7	3.1
Maryland	6	2.7
Michigan	6	2.7
Virginia	6	2.7
California	4	1.8
Florida	4	1.8
North Carolina	4	1.8
Georgia	3	1.3
New Hampshire	3	1.3
Louisiana	2	0.9
Rhode Island	2	0.9
Colorado	1	0.4
Hawaii	1	0.4
Illinois	1	0.4
Missouri	1	0.4
New Mexico	1	0.4
South Dakota	1	0.4
Tennessee	1	0.4

Texas	1	0.4
Washington DC	1	0.4
Wisconsin	1	0.4
Canada	7	3.1
China	1	0.4
England	1	0.4
Total	226	100.0

Route 100		
	N	Percent
Vermont	74	25.5
Massachusetts	33	11.4
New York	25	8.6
Connecticut	21	7.2
New Jersey	14	4.8
Florida	13	4.5
Pennsylvania	12	4.1
Rhode Island	10	3.4
New Hampshire	9	3.1
Virginia	9	3.1
Ohio	6	2.1
California	5	1.7
Illinois	5	1.7
Maine	5	1.7
Maryland	5	1.7
Georgia	2	0.7
Michigan	2	0.7
North Carolina	2	0.7
Alabama	1	0.3
Arizona	1	0.3
Colorado	1	0.3
Indiana	1	0.3
Kentucky	1	0.3
Louisiana	1	0.3
Nevada	1	0.3
Oklahoma	1	0.3

South Carolina	1	0.3
Tennessee	1	0.3
Washington	1	0.3
Wisconsin	1	0.3
Canada	19	6.6
U.S. Virgin Islands	2	0.7
United Kingdom	2	0.7
Holland	1	0.3
Israel	1	0.3
Spain	1	0.3
Total	290	100.0

Vermont Interstate 89		
	N	Percent
Vermont	96	44.7
Massachusetts	37	17.2
New Hampshire	22	10.2
New York	12	5.6
Connecticut	9	4.2
Maine	4	1.9
Florida	4	1.9
New Jersey	2	0.9
Pennsylvania	2	0.9
Virginia	2	0.9
Illinois	2	0.9
Washington DC	1	0.5
Georgia	1	0.5
Ohio	1	0.5
Michigan	1	0.5
Minnesota	1	0.5
Washington	1	0.5
Alaska	1	0.5
Canada	15	7.0
France	1	0.5
Total	215	100.0

Question 15. What is your gender?

		n	%
Acadia Loop Road	Female	118	49.4
	Male	121	50.6
Vermont Route 100	Female	152	49.7
	Male	154	50.3
Vermont Interstate 89	Female	95	43.2
	Male	125	56.8

Question 16. What is your age?

	N	Minimum	Maximum	Mean	Std. Deviation
Acadia Loop Road	234	18	99	45.09	14.291
Vermont Route 100	300	18	86	47.29	14.000
Vermont Interstate 89	217	18	78	51.20	13.493

Question 17. Are there any children traveling with you today?

	Children	Frequency	Percent
Acadia Loop Road	Yes	94	39.3
	No	145	60.7
Vermont Route 100	Yes	112	36.8
	No	192	63.2
Vermont Interstate 89	Yes	33	15.2
	No	184	84.8

Question 18. What is the highest level of education you have completed?

	Education	Frequency	Percent
Acadia Loop Road	High school graduate or GED	13	5.4
	Some college, business or trade school	28	11.7
	College, business or trade school graduate	70	29.3
	Some graduate school	26	10.9
	Master's degree or professional degree	102	42.7
Vermont Route 100	Some high school	5	1.6
	High school graduate or GED	14	4.6
	Some college, business or trade school	38	12.4
	College, business or trade school graduate	101	32.9
	Some graduate school	30	9.8
	Master's degree or professional degree	119	38.8
Vermont Interstate 89	Some high school	2	.9
	High school graduate or GED	11	5.1
	Some college, business or trade school	32	14.7
	College, business or trade school graduate	70	32.3
	Some graduate school	25	11.5
	Master's degree or professional degree	77	35.5

Appendix A2

Greenways

Survey Details

Context	*Location*	*n*	*Percent*
Acadia Carriage Road	Eagle Lake	146	60.8
	Jordan Pond House	46	19.2
	Duck Brook	48	20.0
	Total	240	100.0
Stowe Recreation Path	Church Access	97	36.3
	Luce Hill	72	27.0
	Brook Road	98	36.7
	Total	267	100.0
Burlington Bike Path	Waterfront Park	137	44.2
	Skatepark	173	55.8
	Total	310	100.0

Question 1. What was your primary activity on the greenway today?

Context	*Vehicle Type*	*N*	*Percent*
Acadia Carriage Road	Biking	193	77.5
	Walking	33	13.3
	Running	20	8.0
	Other	3	1.2
	Total	249	100.0
Stowe Recreation Path	Biking	185	69.5
	Walking	60	22.6
	Running	14	5.3
	Other	7	2.6
	Total	266	100.0
Burlington Bike Path	Biking	166	52.9
	Walking	102	32.5
	Running	22	7.0
	Other	24	7.6
	Total	314	100.0

Question 2. Approximately how far are you traveling on the greenway today (miles)?

Context	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Acadia Carriage Road	234	1 mile	65 miles	12.53 miles	8.759
Stowe Recreation Path	246	1 mile	23 miles	7.60 miles	3.938
Burlington Bike Path	264	0 miles	50 miles	7.28 miles	7.720

Context	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Acadia Carriage Road	229	10	300	145.48	84.995
Stowe Recreation Path	228	10	300	88.56	50.333
Burlington Bike Path	265	1	495	72.29	60.828

Question 3. Have you traveled along the greenway before? If yes, approximately how many times have you traveled along this road in the past 12 months?

Context	*Traveled Before?*	*N*	*Percent*
Acadia Carriage Road	Yes	159	64.4
	No	88	35.6
	Total	247	100.0
Stowe Recreation Path	Yes	204	75.8
	No	65	24.2
	Total	269	100.00
Burlington Bike Path	Yes	278	88.5
	No	36	11.5
	Total	314	100.00

Context	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Acadia Carriage Road	108	1	365	26.04	53.606
Stowe Recreation Path	157	1	365	15.3	37.969
Burlington Bike Path	222	1	390	52.09	82.064

Question 5. How did you arrive at the greenway today?

Context	*Rating*	*n*	*Percent*
Acadia Carriage Road	By foot	4	1.6
	Bicycle	59	23.7
	Personal vehicle	166	66.7
	Transit	16	6.4
	Other	4	1.6
	Total	249	100.0
Stowe Recreation Path	By foot	29	10.8
	Bicycle	50	18.6
	Personal vehicle	189	70.2
	Transit	0	0.0
	Other	1	0.4
	Total	269	100.0
Burlington Bike Path	By foot	82	26.2
	Bicycle	139	44.4
	Personal vehicle	84	26.8
	Transit	3	1.0
	Other	5	1.6
	Total	313	100.0

Question 5. The purpose of using the greenway can range from purely "transportation" (for example, to get from one place to another) to purely "recreation" (e.g., to enjoy the journey), or it can be some combination of these purposes.

Using the scale below, please indicate the purpose of your use of the greenway today.

Context	*Rating*	*n*	*Percent*
Acadia Carriage Road	1	1	0.4
	2	0	0.0
	3	0	0.0
	4	1	0.4
	5	6	2.4
	6	1	0.4
	7	11	4.4
	8	22	8.8

	9	207	83.1
	Total	249	100.0
Stowe Recreation Path	1	2	0.7
	2	0	0.0
	3	0	0.0
	4	1	0.4
	5	12	4.4
	6	5	1.8
	7	10	3.7
	8	6	2.2
	9	235	86.7
	Total	271	100.0
Burlington Bike Path	1	10	3.2
	2	6	1.9
	3	9	2.9
	4	6	1.9
	5	50	16.0
	6	13	4.2
	7	33	10.6
	8	23	7.4
	9	162	51.9
	Total	312	100.0

Context	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Acadia Carriage Road	249	1	9	8.66	.967
Stowe Recreation Path	271	1	9	8.59	1.748

Burlington Bike Path	312	1	9	7.29	2.244

Question 6. What did you most enjoy about your travel along the greenway today?*

Context	*Item*	*n*	*Percent*
Acadia Carriage Road	Scenery/views	233	34.3
	Route quality/condition/design	119	17.5
	Weather	55	8.1
	Time with family and friends	42	6.2
	Health/fitness	34	5.0
	Other	197	29.0
	Total	680	100.0
Stowe Recreation Path	Scenery/views	249	35.1
	Route quality/condition/design	120	16.9
	Weather	53	7.5
	Time with family and friends	45	6.3
	Quiet/natural sounds/solitude	44	6.2
	Other	198	27.9
	Total	709	100.0
Burlington Bike Path	Scenery/views	242	31.9
	Weather	102	13.4
	Time with family and friends	71	9.4
	Route quality/condition/design	60	7.9
	Absence of motorized vehicles	35	4.6
	Other	249	32.8
	Total	759	100.0

*Respondents could list up to three items that they most enjoyed.

Question 7. What did you least enjoy about your travel along the greenway today?*

Context	*Item*	*n*	*Percent*
Acadia Carriage Road	Nothing	41	13.9
	Low LOS/crowding	38	12.9
	Insects	35	11.9
	Poor path quality/condition/design	33	11.2
	Lack of signage/facilities/interpretation	17	5.8
	Other	130	44.2
	Total	294	100.0
Stowe Recreation Path	Poor path quality/condition/design	95	28.0
	Low LOS/crowding	40	11.8
	Other users	40	11.8
	Nothing	34	10.0
	Lack of signage/facilities/interpretation	31	9.1
	Other	99	29.2
	Total	339	100.0
Burlington Bike Path	Poor path quality/condition/design	125	27.6
	Other users	49	10.8
	Lack of signage/facilities/interpretation	39	8.6
	Other types of users	34	7.5
	Low LOS/crowding	31	6.8
		175	38.6
	Total	453	100.0

*Respondents could list up to three items that they least enjoyed.

Question 8. Please rate the desirability of the following items for the greenway.

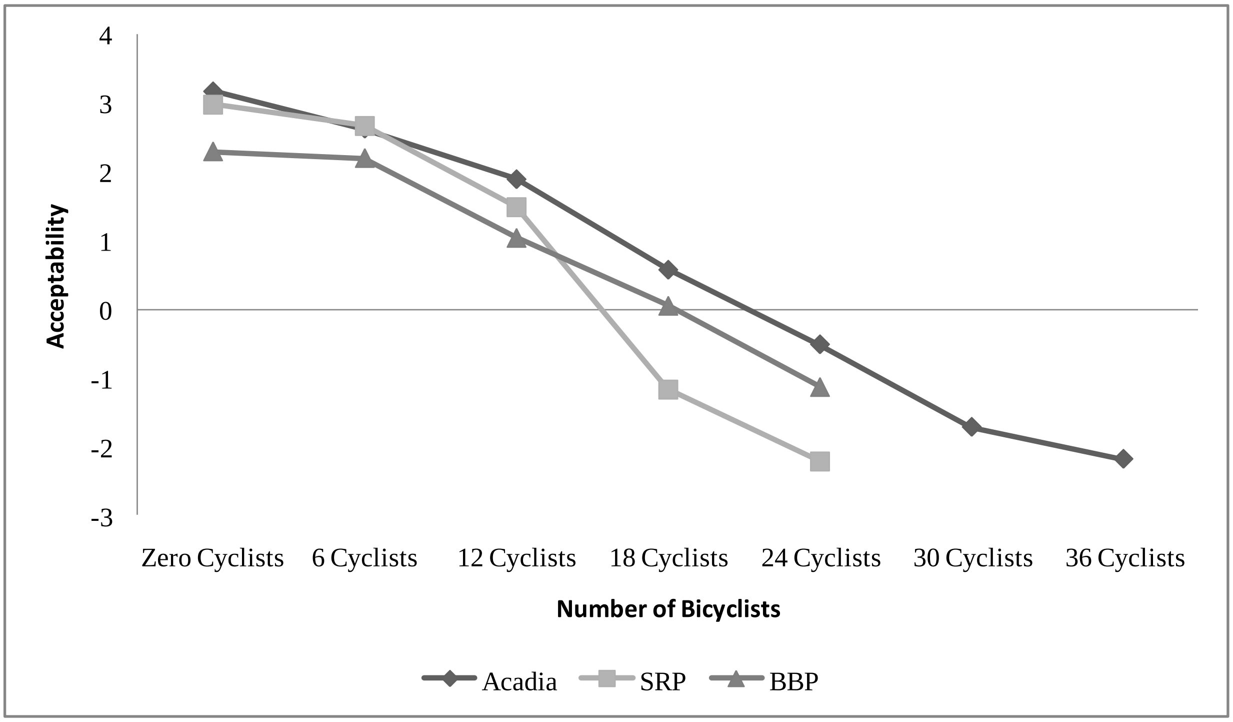
	Acadia Carriage Road		Stowe Recreation Path		Burlington Bike Path	
Scale -2 → +2	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Scenic views	1.88	.392	1.81	.449	1.81	.481
Opportunities to take photographs	1.37	.76	1.23	.784	1.1	.920
Seeing wildlife	1.02	.895	0.71	.944	0.79	.950
Access to parking	0.71	1.083	1.24	.865	0.36	1.119
Access to local businesses	-0.17	1.191	0.93	.955	0.79	.985
Access to recreation/tourism attractions	0.5	1.315	1.03	.889	1.18	.878
A smooth greenway surface	1.36	.787	1.52	.634	1.35	.779
Hills throughout the greenway	1.08	.908	1.14	.740	0.64	.986
Curves throughout the greenway	1.35	.652	1.21	.799	0.94	.865
Being away from motorized transportation	1.9	.28	1.7	.59	1.7	.65
A wide greenway	1.46	.784	1.34	.840	1.3	.849
Presence of defined travel lanes (i.e., center stripe)	-0.28	1.297	1.39	.727	0.72	1.123
Presence of lane designated for bike use only	0.1	1.346	1.01	1.051	0.82	1.14
Presence of lane designated for pedestrian use only	-0.05	1.208	0.76	1.081	0.76	1.124
Scenic overlooks/pull offs	1.44	.771	1.44	.697	1.41	.708
Participating in a healthy form of transportation/recreation	1.86	.382	1.82	.447	1.76	.531
Participating in a quiet form of transportation/recreation	1.81	.471	1.77	.482	1.66	.603

Participating in a form of transportation/recreation that is integrated into a natural setting	1.91	.301	1.81	.425	1.72	.550
Participating in a form of transportation/recreation that is ‘better’ for the environment	1.76	.545	1.67	.675	1.67	.600
Signs for tourist attractions/commercial services	-0.38	1.413	0.38	1.191	0.2	1.266
Mile marker signs or blazes	0.77	1.129	1.17	.865	0.89	.878
Frequent police/safety patrols	0.07	.992	0.29	1.000	0.47	1.048
Presence of trash cans	0.22	1.152	0.97	.892	0.88	1.037
Being close to roads/motorized vehicles	-0.63	1.301	-0.31	1.242	-0.45	1.334
Few people on the greenway	0.82	.916	0.69	1.000	0.47	1.013

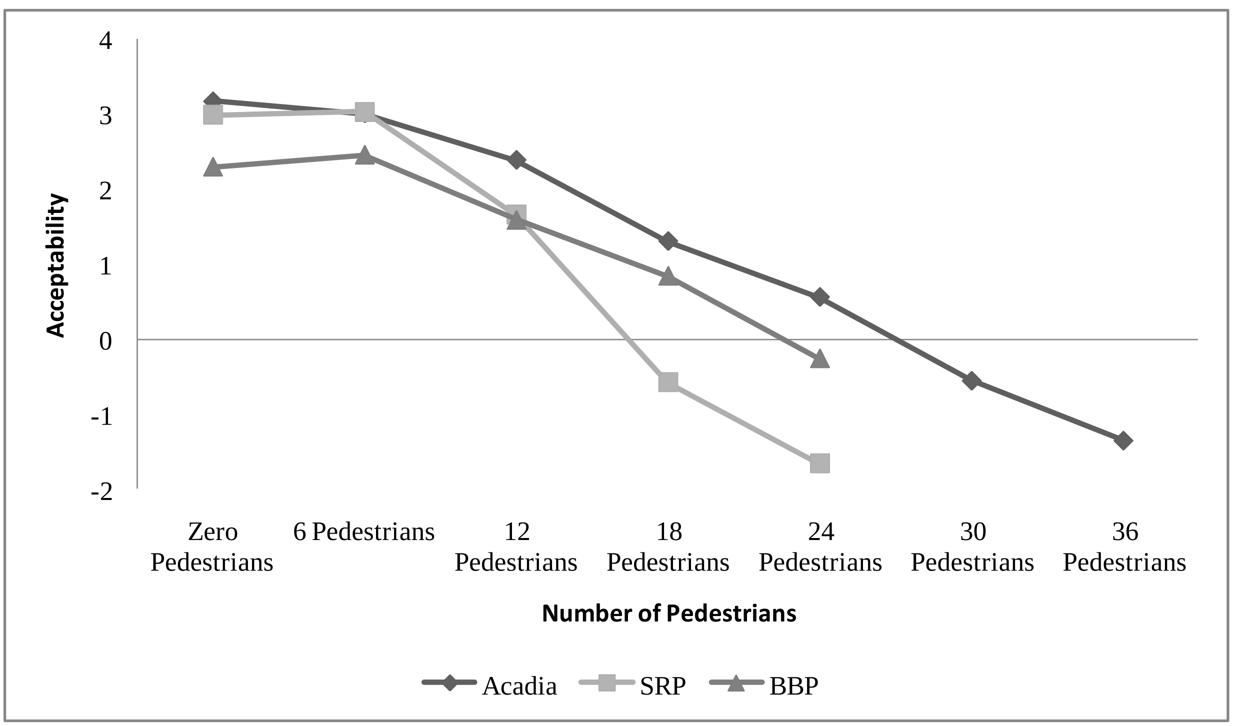
Question 9. Use Levels.

Scale -4 → +4	Photo	N	mean	SD
Acadia Carriage Road	0 Users	232	3.18	1.945
	6 Pedestrians	232	3.01	1.53
	12 Pedestrians	226	2.39	1.603
	18 Pedestrians	225	1.30	2.008
	24 Pedestrians	225	.56	2.238
	30 Pedestrians	226	-.55	2.424
	36 Pedestrians	226	-1.35	2.481
	6 Cyclists	227	2.63	1.823
	12 Cyclists	224	1.90	2.058
	18 Cyclists	224	.58	2.353
	24 Cyclists	230	-.52	2.518
	30 Cyclists	228	-1.72	2.324
	36 Cyclists	230	-2.19	2.361
	6 Mixed use	224	2.98	1.568
	12 Mixed use	222	2.13	1.841
	18 Mixed use	220	.86	2.263
	24 Mixed Use	220	-.61	2.393
	30 Mixed Use	223	-1.86	2.279
	36 Mixed Use	224	-2.37	2.303
Stowe Recreation Path	0 Users	257	2.99	2.153
	6 Pedestrians	253	3.04	1.478
	12 Pedestrians	243	1.66	2.023

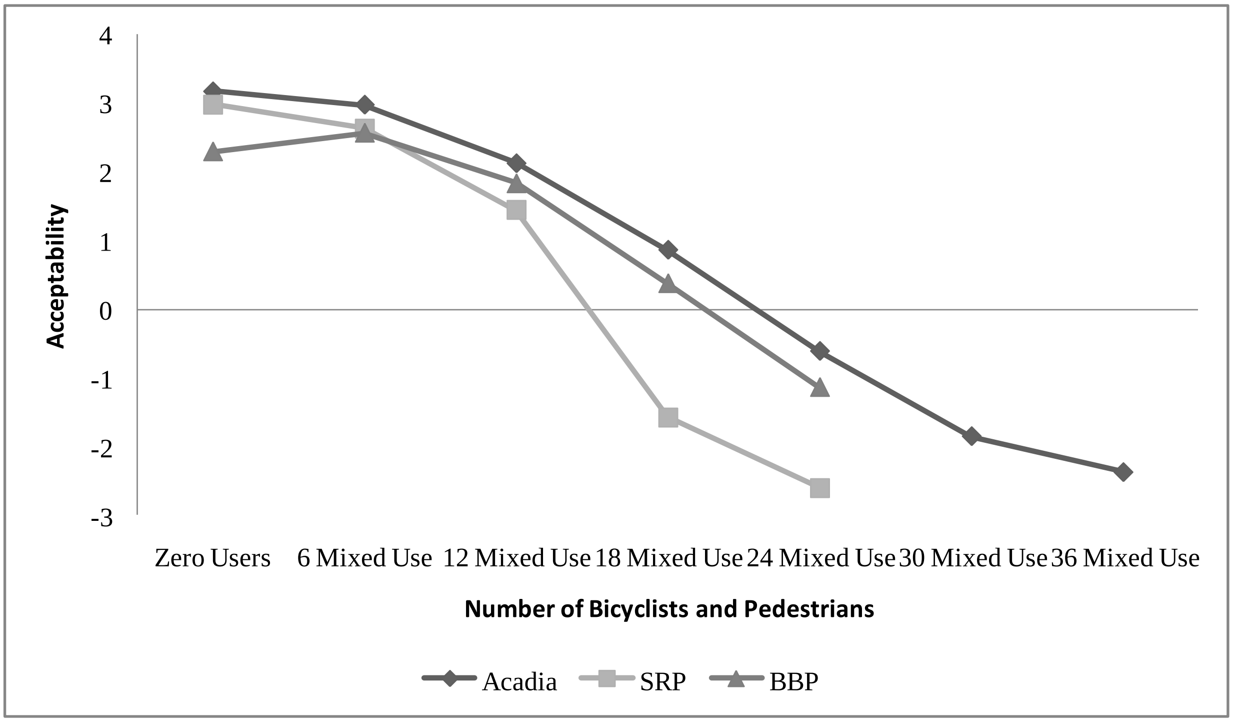
	18 Pedestrians	241	-.58	2.537
	24 Pedestrians	242	-1.66	2.518
	6 Cyclists	247	2.68	1.645
	12 Cyclists	243	1.49	2.005
	18 Cyclists	246	-1.17	2.361
	24 Cyclists	248	-2.21	2.385
	6 Mixed use	242	2.64	1.699
	12 Mixed use	244	1.44	2.110
	18 Mixed use	249	-1.57	2.390
	24 Mixed Use	247	-2.60	2.169
Burlington Bike Path	0 Users	299	2.3	2.502
	6 Pedestrians	292	2.46	1.823
	12 Pedestrians	293	1.60	2.174
	18 Pedestrians	286	.84	2.392
	24 Pedestrians	294	-.26	2.692
	6 Cyclists	293	2.20	1.931
	12 Cyclists	291	1.05	2.259
	18 Cyclists	290	.06	2.530
	24 Cyclists	293	-1.13	2.658
	6 Mixed use	292	2.57	1.848
	12 Mixed use	292	1.84	2.017
	18 Mixed use	287	.38	2.453
	24 Mixed Use	295	-1.14	2.725



Social norm curve for encountering bicyclists along greenways.



Social norm curve for encountering pedestrians along greenways.



Social norm curve for encountering a 50/50 mix of bicyclists and pedestrians along greenways.

Use Levels Summary Table

		Acadia Carriage Road		Stowe Recreation Path		Burlington Bike Path	
	Photo	*N*	*%*	*N*	*%*	*N*	*%*
Preference	0 Users	64	27.4	40	16.4	30	10.5
	6 Pedestrians	21	9.0	39	16.0	27	9.5
	12 Pedestrians	5	2.1	12	4.9	5	1.8
	18 Pedestrians	1	.4	2	.8	6	2.1
	24 Pedestrians	1	.4	1	.4	3	1.1
	30 Pedestrians	1	.4	-	-	-	-
	36 Pedestrians	0	0	-	-	-	-

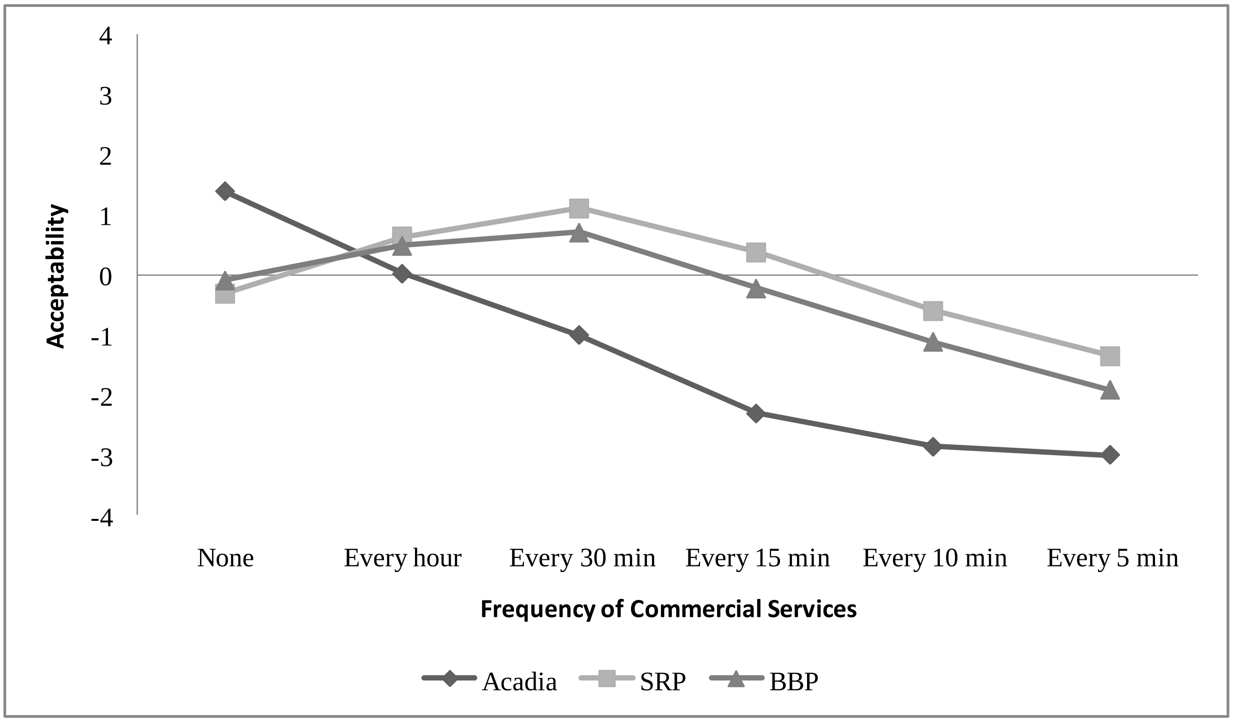
	6 Cyclists	15	6.4	55	22.5	27	9.5
	12 Cyclists	6	2.6	17	7.0	9	3.2
	18 Cyclists	0	0	4	1.6	6	2.1
	24 Cyclists	0	0	2	.8	2	.7
	30 Cyclists	0	0	-	-	-	-
	36 Cyclists	0	0	-	-	-	-
	6 Mixed use	94	40.2	57	23.4	107	37.5
	12 Mixed use	22	9.4	13	5.3	45	15.8
	18 Mixed use	3	1.3	2	.8	11	3.9
	24 Mixed Use	1	.4	0	0	7	2.5
	30 Mixed Use	0	0	-	-	-	-
	36 Mixed Use	0	0	-	-	-	-
Displacement*	0 Users	2	1.0	0	0	3	1.3
	6 Pedestrians	0	0	0	0	1	.4
	12 Pedestrians	1	.5	7	3.3	2	.9
	18 Pedestrians	2	1.0	14	6.6	8	3.4
	24 Pedestrians	3	1.6	11	5.2	27	11.6
	30 Pedestrians	1	.5	-	-	-	-
	36 Pedestrians	9	4.7	-	-	-	-
	6 Cyclists	0	0	0	0	3	1.3
	12 Cyclists	5	2.6	2	.9	3	1.3
	18 Cyclists	2	1.0	5	2.3	13	5.6
	24 Cyclists	5	2.6	43	20.2	66	28.4
	30 Cyclists	9	4.7	-	-	-	-
	36 Cyclists	53	27.5	-	-	-	-
	6 Mixed use	2	1.0	4	1.9	3	1.3
	12 Mixed use	1	.5	0	0	0	0
	18 Mixed use	1	.5	11	5.2	5	2.2

	24 Mixed Use	11	5.7	88	41.3	64	27.6
	30 Mixed Use	15	7.8	-	-	-	-
	36 Mixed Use	63	32.6	-	-	-	-
Typically Seen	0 Users	24	10.3	8	3.3	10	3.5
	6 Pedestrians	26	11.1	20	8.2	24	8.4
	12 Pedestrians	14	6.0	10	4.1	8	2.8
	18 Pedestrians	1	.4	3	1.2	12	4.2
	24 Pedestrians	0	0	2	.8	1	.3
	30 Pedestrians	0	0	-	-	-	-
	36 Pedestrians	1	.4	-	-	-	-
	6 Cyclists	23	9.8	73	30.0	39	13.4
	12 Cyclists	13	5.6	35	14.4	10	3.5
	18 Cyclists	3	1.3	8	3.3	7	2.4
	24 Cyclists	0	0	0	0	3	1.0
	30 Cyclists	0	0	-	-	-	-
	36 Cyclists	0	0	-	-	-	-
	6 Mixed use	80	34.2	53	21.2	95	33.2
	12 Mixed use	35	15.0	18	7.4	46	16.1
	18 Mixed use	11	4.7	12	4.9	21	7.3
	24 Mixed Use	2	.9	1	.4	9	3.1
	30 Mixed Use	1	.4	-	-	-	-
	36 Mixed Use	0	0	-	-	-	-
Crowding**	*Mean*	*Mean*	*SD*	*Mean*	*SD*		*SD*
	3.13	2.80	1.748	3.52	2.000		1.972

*Percent of individuals indicating that none of the photographs are so unacceptable that they would no longer use greenway: Burlington Bike Path (14.6%, n=34), Stowe Recreation Path (13.1%, n=28), Acadia Carriage Road (4.1%, n=8). **Measured in 9-point scale from “not at all crowded” to “extremely crowded.

Question 10. Frequency of Commercial Services

Scale -4 → +4	Frequency	N	mean	SD
Acadia Carriage Road	None	216	1.39	2.934
	5 min	209	-3.00	2.093
	10 min	204	-2.86	2.045
	15 min	202	-2.30	2.333
	30 min	205	-1.01	2.798
	1 hour	207	.03	2.899
Stowe Recreation Path	None	226	-.31	2.789
	5 min	226	-1.35	2.805
	10 min	217	-.60	2.677
	15 min	225	.38	2.508
	30 min	228	1.11	2.296
	1 hour	226	.64	2.599
Burlington Bike Path	None	722	-.09	2.792
	5 min	273	-1.92	2.495
	10 min	266	-1.12	2.621
	15 min	269	-.22	2.585
	30 min	269	.71	2.526
	1 hour	271	.49	2.562

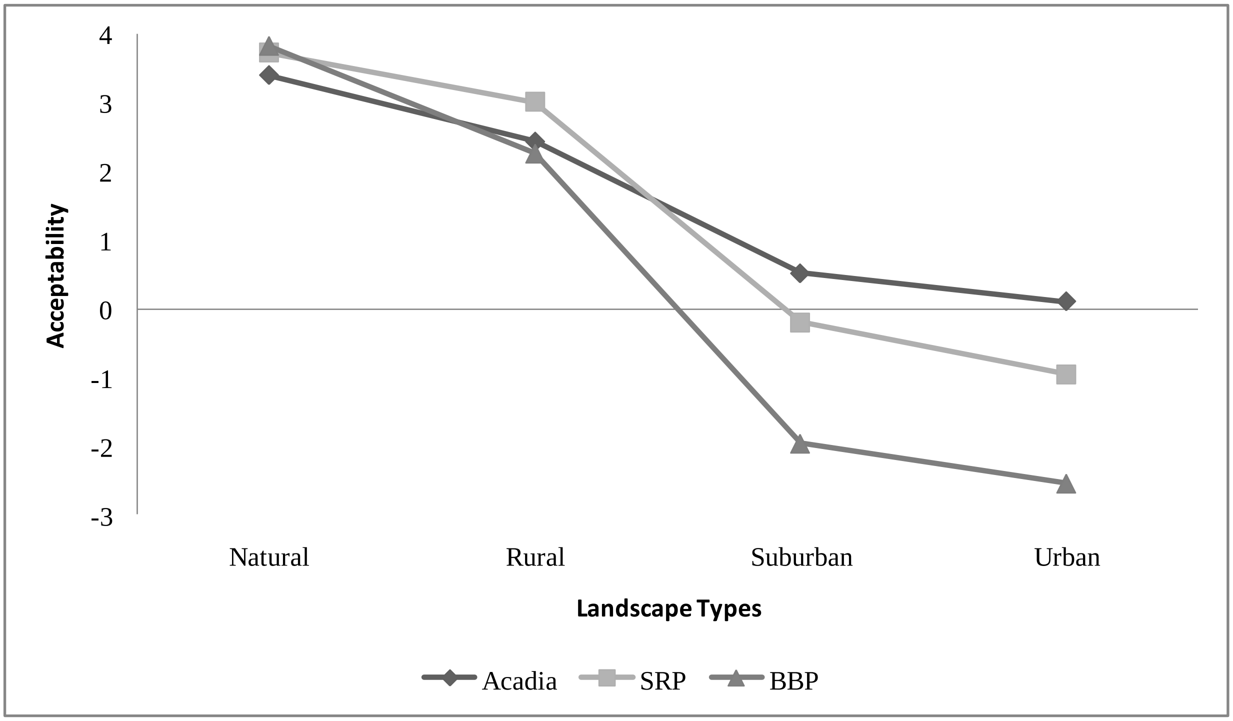


Social norm curve for the acceptability of commercial service frequencies along greenways.

Question 11a. Landscapes

Scale -4 → +4	Landscape	n	mean	SD
Burlington Bike Path	Urban	291	.10	2.542
	Suburban	291	.52	2.196
	Rural	296	2.44	1.646
	Natural	294	3.40	1.172
Stowe Recreation Path	Urban	243	-.95	2.589
	Suburban	243	-.20	2.329
	Rural	248	3.02	1.274
	Natural	251	3.73	.687
Acadia Carriage Road	Urban	229	-2.54	2.243

	Suburban	226	-1.96	2.280
	Rural	229	2.27	1.893
	Natural	232	3.83	.742



Social norm curve for the acceptability of landscape types along greenways.

Question 11b. Landscape Percentage

Context	*Landscape*	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Acadia Carriage Road	Urban	123	0	50	4.21	8.592
	Suburban	131	0	25	5.33	6.824
	Rural	195	0	70	18.79	13.528
	Natural	230	10	100	78.53	20.999
Stowe Recreation Path	Urban	187	0	40	6.48	7.311
	Suburban	196	0	30	9.33	7.729
	Rural	233	0	100	30.80	15.371
	Natural	243	0	100	58.64	19.913
Burlington Bike Path	Urban	230	0	95	14.26	11.863
	Suburban	235	0	90	15.53	11.891
	Rural	254	0	100	27.21	14.594
	Natural	278	0	100	51.91	23.600

Question 12. How many people are in your group today, including yourself?

Context	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Acadia Carriage Road	233	1	12	2.17	2.022
Stowe Recreation Path	257	1	50	2.91	1.698
Burlington Bike Path	288	1	15	2.99	3.234

Question 13. Do you live in the United States or Canada?

Acadia Carriage Roads		
	N	Percent
Maine	61	27.1
Massachusetts	27	12.0
New York	17	7.6
Pennsylvania	14	6.2
Connecticut	12	5.3
Maryland	11	4.9
New Hampshire	8	3.6
Vermont	8	3.6
Virginia	8	3.6
Florida	8	3.6
New Jersey	6	2.7
California	5	2.2
Canada	5	2.2
South Carolina	4	1.8
Ohio	4	1.8
Washington DC	3	1.3
North Carolina	3	1.3
Delaware	2	0.9
Indiana	2	0.9
Michigan	2	0.9
Texas	2	0.9
Colorado	2	0.9
Netherlands	2	0.9
Georgia	1	0.4

Alabama	1	0.4
Virgin Islands	1	0.4
Illinois	1	0.4
Germany	1	0.4
Italy	1	0.4
South Africa	1	0.4
United Arab Emirates	1	0.4
Syria	1	0.4
Total	225	100.0

Stowe Recreation Path		
	N	Percent
Vermont	84	33.5
Massachusetts	41	16.3
Canada	21	8.4
Connecticut	20	8.0
New York	19	7.6
New Jersey	14	5.6
New Hampshire	9	3.6
Pennsylvania	8	3.2
United Kingdom	5	2.0
Maine	4	1.6
Ohio	4	1.6
Maryland	3	1.2
Florida	3	1.2
Rhode Island	2	0.8
Virginia	2	0.8
North Carolina	2	0.8
Texas	2	0.8
Washington DC	1	0.4
Georgia	1	0.4
Wisconsin	1	0.4
California	1	0.4
Oregon	1	0.4
Bermuda	1	0.4
France	1	0.4
Israel	1	0.4
Total	251	100.0

Burlington Bike Path		
	N	Percent
Vermont	200	77.5
Massachusetts	10	3.9
Canada	10	3.9
New York	8	3.1
New Jersey	4	1.6
New Hampshire	3	1.2
Maine	3	1.2
Maryland	2	0.8
Virginia	2	0.8
North Carolina	2	0.8
Oregon	2	0.8
United Kingdom	2	0.8
Connecticut	1	0.4
Pennsylvania	1	0.4
South Carolina	1	0.4
Ohio	1	0.4
Wisconsin	1	0.4
Illinois	1	0.4
Nebraska	1	0.4
Texas	1	0.4
Colorado	1	0.4
California	1	0.4
Total	258	100.0

Question 14. What is your gender?

		n	%
Acadia Carriage Road	Female	123	52.6
	Male	111	47.4
Stowe Recreation Path	Female	156	60.9
	Male	100	39.1
Burlington Bike Path	Female	157	54.3
	Male	132	45.7

Question 15. Are there any children traveling with you today?

	Children	Frequency	Percent
Acadia Carriage Road	Yes	88	37.6
	No	146	62.4
Stowe Recreation Path	Yes	119	46.5
	No	137	53.5
Burlington Bike Path	Yes	61	21.0
	No	230	79.0

Question 16. What is your age?

	N	Minimum	Maximum	Mean	Std. Deviation
Acadia Carriage Road	234	18	75	46.94	11.806
Stowe Recreation Path	252	18	82	49.40	12.807
Burlington Bike Path	283	18	80	41.53	15.747

Question 18. What is the highest level of education you have completed?

	Education	Frequency	Percent
Acadia Carriage Road	Some high school	2	.9
	High school graduate or GED	3	1.3
	Some college, business or trade school	16	6.8
	College, business or trade school graduate	70	29.8
	Some graduate school	23	9.8
	Master's degree or professional degree	121	51.5
Stowe Recreation Path	Some high school	2	.8
	High school graduate or GED	12	4.7
	Some college, business or trade school	20	7.8
	College, business or trade school graduate	90	34.9
	Some graduate school	26	10.1
	Master's degree or professional degree	108	41.9
Burlington Bike Path	Some high school	8	2.8
	High school graduate or GED	19	6.6
	Some college, business or trade school	48	16.7
	College, business or trade school graduate	88	30.6
	Some graduate school	28	9.7
	Master's degree or professional degree	97	33.7

Appendix A3

Transit

Survey Details

Context	*Location*	*n*	*Percent*
Acadia Island Explorer	Bar Harbor	194	77.3
	Jordan Pond	45	17.9
	Sand Beach	12	4.8
	Total	251	100.0
Muir Woods Route 66 Shuttle	Arrival	96	40.2
	Departure	143	59.8
	Total	239	100.0
Alcatraz Ferry	Total	199	100.0

Question 1. Have you ridden (the transit system) before today's visit?

Context	*Traveled Before?*	*N*	*Percent*
Acadia Island Explorer	Yes	176	70.1
	No	75	29.9
	Total	251	100.0
Muir Woods Route 66 Shuttle	Yes	14	5.9
	No	225	94.1
	Total	239	100.0
Alcatraz Ferry	Yes	47	24.0
	No	150	76.0
	Total	197	100.0

Question 2. The purpose of using (the transit system) can range from purely "transportation" (for example, to get from one place to another) to purely "recreation" (e.g., to enjoy the journey), or it can be some combination of these purposes.

Using the scale below, please indicate the purpose of your use of (the transit system) today.

Context	*Rating*	*n*	*Percent*
Acadia Island Explorer	1	66	26.3
	2	13	5.2
	3	28	11.2
	4	8	3.2
	5	94	37.5
	6	10	4.0
	7	7	2.8
	8	6	2.4
	9	17	6.8
	Total	249	99.2
Muir Woods Route 66	1	119	49.8
	2	20	8.4
	3	17	7.1
	4	8	3.3
	5	44	18.4
	6	4	1.7
	7	3	1.3
	8	1	0.4
	9	13	6.7
	Total	232	97.1
Alcatraz Ferry	1	47	23.6
	2	10	5.0

	3	14	7.0
	4	8	4.0
	5	70	35.2
	6	3	1.5
	7	10	5.0
	8	1	0.5
	9	34	17.1
	Total	197	99.0

Context	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Acadia Island Explorer	249	1	9	3.97	2.369
Muir Woods Route 66	232	1	9	2.84	2.426
Alcatraz Ferry	197	1	9	4.53	2.728

Question 3. What did you most enjoy about your use of (the transit system) today?*

Context	*Item*	*n*	*Percent*
Acadia Island Explorer	Park/bus staff	104	17.2
	Runs on time/schedule	88	14.5
	Convenience	57	9.4
	Access to park resources	46	7.6
	It's free	39	6.4
	Other	272	44.9
	Total	606	100.0
Muir Woods Route 66	Scenery	78	15.9
	Don't have to drive	50	10.2
	Convenience	46	9.3
	Access to park resources	39	7.9
	It's free	39	7.9
	Runs on time/schedule	39	7.9
	Other	201	40.9
	Total	492	100.0
Alcatraz Ferry	Scenery	133	25.9
	Runs on time/schedule	60	11.7
	Comfortable seating/seating	43	8.4
	The ferry ride/the ferry itself	43	8.4
	Cleanliness	38	7.4
	Other	197	38.3
	Total	514	100.0

*Respondents could list up to three things that they most enjoyed.

Question 4. What did you <u>least</u> enjoy about your use of (the transit system) today?*

Context	*Item*	*n*	*Percent*
Acadia Island Explorer	Nothing	50	22.5
	Long wait/timing	34	15.3
	Bumpy/curvy road	24	10.8
	Unable to understand schedule	24	10.8
	Crowded bus	19	7.6
	Other	71	32.0
	Total	222	100.0
Muir Woods Route 66	Long wait/timing	47	16.7
	Nothing	31	11.0
	Crowded bus	26	10.2
	Bumpy/curvy road	23	8.2
	Nausea because of ride	17	6.0
	Other	137	48.8
	Total	281	100.0
Alcatraz Ferry	Crowded ferry	33	30.5
	Long wait/timing	56	25.1
	Nothing	23	10.3
	Other guests	17	7.6
	Wind/waves	11	4.9
	Other	83	37.2
	Total	223	100.0

*Respondents could list up to three items that they least enjoyed.

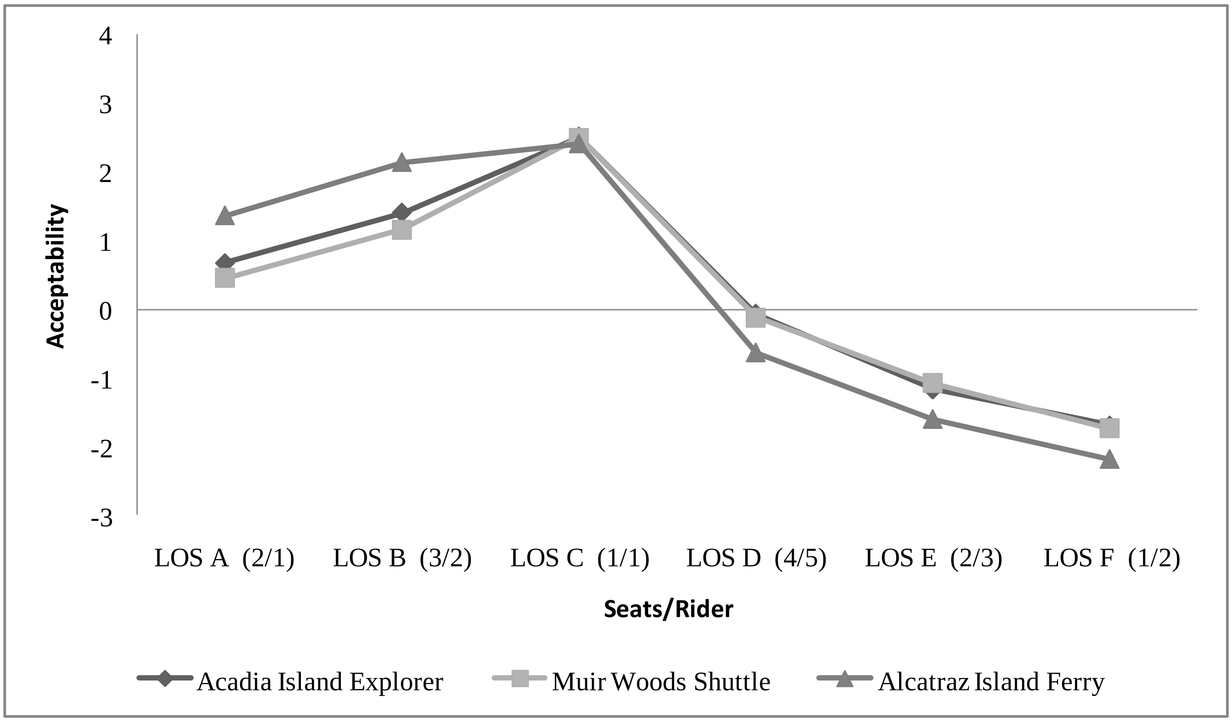
Question 5. Please rate the desirability of the following items for (the transit system).

	Acadia Island Explorer		Muir Woods Route 66		Alcatraz Ferry	
Scale -2 → +2	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Scenic views	1.34	0.75	1.21	0.76	1.73	0.600
Photographic opportunities	0.35	1.04	0.10	1.05	1.50	0.643
Access to services	1.24	0.83	0.60	0.99	0.77	0.890
Access to recreation	1.59	0.67	1.06	0.95	1.31	0.819
Minimizing impacts of travel	1.72	0.62	1.36	0.84	1.27	0.839
Hearing interpretive announcements	0.74	1.02	0.05	1.11	0.81	0.975
Access to park highlights	1.51	0.74	0.86	1.06		
Taking the quickest route	1.24	0.93	1.03	1.01	1.25	1.043
Taking the most scenic route	1.00	0.87	0.64	0.99	1.27	0.919
Operating at a relaxed pace	0.95	0.98	0.50	1.01	0.98	0.974
Having plenty of room	1.06	0.78	0.91	0.89	1.33	0.759
Waiting with a crowd at stops	0.00	0.97	-0.39	0.93	-0.43	1.094
Waiting in queue to get on and off	-0.11	0.99	-0.32	1.02	-0.29	1.125
The ability to open the window	0.95	0.88	0.26	0.83	1.48	0.724
Limited development along the route	0.93	0.89	0.68	0.92		
Riders act in a courteous manner toward each other	1.38	0.72	1.12	0.83	1.39	0.769
Hearing outside natural sounds	0.59	0.93	0.33	0.91	1.11	0.846
The (bus) arrives at stops frequently	1.22	0.80	0.87	1.13	1.26	0.872

The (bus) arrives at stops on schedule	1.47	0.70	1.09	0.93	1.44	0.678
The ride is smooth	0.92	0.99	0.79	1.03	1.37	0.675
The ride is quiet	0.72	0.97	0.56	0.91	1.02	0.876
Able to move around freely within	0.24	1.00	-0.07	0.96	1.49	0.642

Question 6. Crowding Levels of Service

Scale -4 → +4	Level of Service (Seats/Rider)	n	mean	SD
Acadia Island Explorer	A (2/1)	232	0.68	2.247
	B (3/2)	228	1.40	2.036
	C (1/1)	225	2.51	1.683
	D (4/5)	230	-0.07	2.167
	E (2/3)	227	-1.17	2.214
	F (1/2)	228	-1.69	2.386
Muir Woods Route 66	A (2/1)	202	0.45	2.346
	B (3/2)	202	1.16	2.148
	C (1/1)	201	2.50	1.634
	D (4/5)	196	-0.12	2.275
	E (2/3)	199	-1.08	2.272
	F (1/2)	198	-1.74	2.109
Alcatraz Ferry	A (2/1)	189	1.37	2.161
	B (3/2)	192	2.14	1.726
	C (1/1)	192	2.41	1.749
	D (4/5)	189	-0.63	2.181
	E (2/3)	192	-1.60	2.147
	F (1/2)	191	-2.19	2.303



Social norm curve for the acceptability of use levels on transit systems.

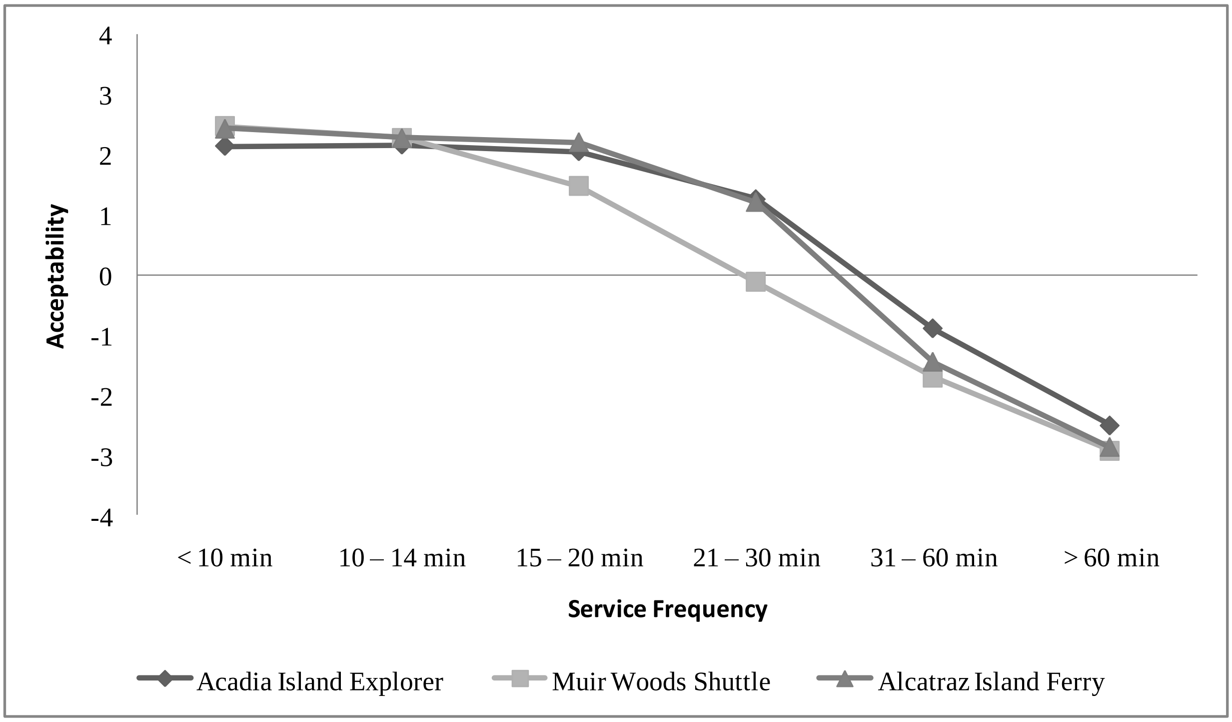
Use Levels Summary Table

	Acadia Island Explorer		Muir Woods Route 66		Alcatraz Ferry	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Preference	2.71	0.882	2.83	0.908	2.48	1.019
Displacement*	5.34	1.180	5.13	1.360	5.46	1.167
Typically Seen	2.15	1.094	2.43	0.975	2.63	1.016
Crowding**	2.14	1.956	2.46	2.329	3.62	2.090

*Percent of individuals indicating that none of the levels of crowding are so unacceptable that they would no longer use the (transit system): Acadia Island Explorer (35.5%, n=66), Muir Woods Route 66 (24.3%, n=36), Alcatraz Ferry (25.7%, n=47). **Measured in 9-point scale from “not at all crowded” to “extremely crowded.”

Question 7. Service Frequency Level of Service

Scale -4 → +4	Inter-arrival Time (minutes)	n	mean	SD
Acadia Island Explorer	A (< 10)	217	2.14	2.128
	B (10 – 14)	213	2.16	1.907
	C (15 – 20)	212	2.05	1.810
	D (21 – 30)	212	1.27	1.995
	E (31 – 60)	213	-0.90	2.064
	F (> 60)	213	-2.50	1.917
Muir Woods Route 66	A (< 10)	186	2.48	1.940
	B (10 – 14)	184	2.29	1.649
	C (15 – 20)	179	1.48	1.778
	D (21 – 30)	180	-0.12	2.118
	E (31 – 60)	183	-1.70	2.020
	F (> 60)	183	-2.92	1.853
Alcatraz Ferry	A (< 10)	188	2.44	2.089
	B (10 – 14)	188	2.29	1.807
	C (15 – 20)	190	2.21	1.655
	D (21 – 30)	190	1.21	2.109
	E (31 – 60)	187	-1.45	1.995
	F (> 60)	188	-2.87	1.769



Social norm curve for the acceptability of service freqeuncy for transit systems.

Service Frequency Summary Table

	Acadia Island Explorer		Muir Woods Route 66		Alcatraz Ferry	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Preference	2.62	1.093	2.07	1.030	2.72	1.179
Displacement*	5.43	1.101	5.24	1.018	5.70	0.823
Typically Experienced**	14.83	11.558	14.88	12.419	19.05	8.825

*Percent of individuals indicating that none of the levels of service freqiency are so unacceptable that they would no longer use the (transit system): Acadia Island Explorer (27.6%, n=54), Muir Woods Route 66 (18.9%, n=32), Alcatraz Ferry (24.3%, n=44). **Measured in minutes of waiting time.

Question 8. How many people are in your personal group today, including yourself?

Context	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Acadia Island Explorer	228	1	20	2.82	2.454
Muir Woods Route 66	199	1	18	3.44	2.345
Alcatraz Ferry	193	1	60	4.40	5.970

Question 9. Do you live in the United States or Canada?

Acadia Island Explorer		
	N	Percent
Maine	29	14.5
New York	23	11.5
Massachusetts	15	7.5
Florida	12	6.0
Canada	12	6.0
Connecticut	11	5.5
Ohio	10	5.0
Jew Jersey	8	4.0
Maryland	6	3.0
Missouri	6	3.0
New Hampshire	6	3.0
Pennsylvania	5	2.5
Georgia	4	2.0
Virginia	4	2.0
Vermont	4	2.0
Germany	3	1.5
Arizona	2	1.0
California	2	1.0
Illinois	2	1.0
Michigan	2	1.0
Minnesota	2	1.0
Mississippi	2	1.0
North Carolina	2	1.0
New Mexico	2	1.0
Tennessee	2	1.0

Wisconsin	2	1.0
England	2	1.0
Alabama	1	0.5
Delaware	1	0.5
Hawaii	1	0.5
Kansas	1	0.5
Kentucky	1	0.5
Louisiana	1	0.5
Oregon	1	0.5
Rhode Island	1	0.5
Texas	1	0.5
Washington	1	0.5
Australia	1	0.5
Belgium	1	0.5
Bulgaria	1	0.5
Denmark	1	0.5
Holland	1	0.5
Ireland	1	0.5
Kazakhstan	1	0.5
Malawi	1	0.5
South Africa	1	0.5
Uganda	1	0.5
Total	200	100.0

Muir Woods Route 66		
	N	Percent
California	48	28.9
Texas	14	8.4
United Kingdom	9	5.4
Massachusetts	8	4.8
Connecticut	7	4.2
Illinois	7	4.2
Maryland	7	4.2
Pennsylvania	6	3.6
Arizona	5	3.0
North Carolina	5	3.0
New York	5	3.0
Germany	4	2.4
Florida	4	2.4
Colorado	3	1.8
Iowa	3	1.8
Ohio	3	1.8
Kansas	3	1.8
New Jersey	3	1.8
Australia	2	1.2
Netherlands	2	1.2
France	2	1.2
Georgia	2	1.2
Minnesota	2	1.2
Canada	1	0.6
Sweden	1	0.6
Italy	1	0.6

Alabama	1	0.6
Hawaii	1	0.6
Oklahoma	1	0.6
Michigan	1	0.6
South Carolina	1	0.6
Tennessee	1	0.6
Utah	1	0.6
Virginia	1	0.6
Wisconsin	1	0.6
Total	166	100.0

Alcatraz Ferry		
	N	Percent
California	42	22.6
United Kingdom	17	9.1
Canada	11	5.9
Texas	10	5.4
Washington	8	4.3
New York	6	3.2
Virginia	5	2.7
Netherlands	5	2.7
Colorado	4	2.2
Illinois	4	2.2
Maryland	4	2.2
Michigan	4	2.2
North Carolina	4	2.2
Australia	4	2.2
Denmark	4	2.2
France	4	2.2
Kansas	3	1.6
Massachusetts	3	1.6
New Zealand	3	1.6
Arizona	2	1.1
Hawaii	2	1.1
Iowa	2	1.1
Kentucky	2	1.1
Missouri	2	1.1
New Jersey	2	1.1
Nevada	2	1.1

Ohio	2	1.1
Oregon	2	1.1
Tennessee	2	1.1
Germany	2	1.1
Sweden	2	1.1
Switzerland	2	1.1
Arkansas	1	0.5
Connecticut	1	0.5
Georgia	1	0.5
Idaho	1	0.5
Indiana	1	0.5
Louisiana	1	0.5
Minnesota	1	0.5
Nebraska	1	0.5
Pennsylvania	1	0.5
South Carolina	1	0.5
Wyoming	1	0.5
Austria	1	0.5
Belgium	1	0.5
India	1	0.5
Norway	1	0.5
Total	186	100.0

Question 10. What is your gender?

		n	%
Acadia Island Explorer	Female	128	55.7
	Male	102	44.3
Muir Woods Route 66	Female	87	46.3
	Male	101	53.7
Alcatraz Ferry	Female	110	56.7
	Male	84	43.3

Question 12. What is your age?

	N	Minimum	Maximum	Mean	Std. Deviation
Acadia Island Explorer	224	18	77	47.9	16.240
Muir Woods Route 66	183	18	75	39.6	13.543
Alcatraz Ferry	189	18	77	40.9	14.383

Question 11. Are there any children traveling with you today?

	Children	Frequency	Percent
Acadia Island Explorer	Yes	42	18.2
	No	189	81.8
Muir Woods Route 66	Yes	60	31.4
	No	131	68.6
Alcatraz Ferry	Yes	94	49.2
	No	97	50.8

Question 13. What is the highest level of education you have completed?

	Education	Frequency	Percent
Acadia Island Explorer	Some high school	8	3.6
	High school graduate or GED	14	6.4
	Some college, business or trade school	32	14.5
	College, business or trade school graduate	62	28.2
	Some graduate school	24	10.9
	Master's degree or professional degree	80	36.4
Muir Woods Route 66	Some high school	2	1.1
	High school graduate or GED	5	2.8
	Some college, business or trade school	20	11.1
	College, business or trade school graduate	52	28.9
	Some graduate school	22	12.2
	Master's degree or professional degree	79	43.9
Alcatraz Ferry	Some high school	4	2.1
	High school graduate or GED	16	8.4
	Some college, business or trade school	28	14.7
	College, business or trade school graduate	58	30.4
	Some graduate school	14	7.3
	Master's degree or professional degree	71	37.2