PERGAMON

Journal of Transport Geography 11 (2003) 271–283

JOURNAL OF TRANSPORT GEOGRAPHY

www.elsevier.com/locate/jtrangeo

A method for assessing highway qualities to integrate values in highway planning

Gregory Brown *

Department of Environmental Science, Alaska Pacific University, 4101 University Drive, Anchorage, Alaska 99508, USA

Abstract

Highway infrastructure planning is most often oriented toward assessing and maintaining physical inventories but it is often the lack of social knowledge about how people perceive, value and use a transportation system that generates the greatest user conflict and mistrust of public agency behavior. Using results from a 2001 statewide survey of Alaska residents, this paper presents a methodology for examining highway systems as a collection of intrinsic highway qualities and special places that provide a spectrum of highway experience opportunities. The concept of a highway experience opportunity spectrum is described and a number of potential dimensions for creating experience opportunity classes are suggested. With knowledge of spatial locations of intrinsic highway qualities, transportation planners can make informed choices to maintain or alter the set of highway experience opportunities associated with a highway system.

Keywords: Intrinsic highway qualities; Scenic byways; Opportunity spectrum

1. Introduction

Highways play a vital role in the functioning of human society. From ancient times to the present, highways have functioned as the arteries of human civilization providing pathways for human settlement, commerce, culture, and adventure. Highways have also proven to be a powerful force with their potential to create and alter human patterns of development on the landscape. In modern society, highways not only provide the means for commerce, they provide access to more natural landscapes for multiple values and leisure activities.

Much highway planning and monitoring activity is oriented toward assessing and maintaining physical inventories (e.g., surface condition, structural integrity, and hazard areas) because knowledge of these attributes is essential to system functionality and safety. But it is often the lack of social knowledge about how people value and use a particular landscape, including the highway system, that can generate user conflict and mistrust of public transportation agency behavior. For example, when the Alaska Department of Transportation proposed to nominate the Richardson Highway for a National Scenic Byway, a seemingly prestigious designation, there was community resistance (Anchorage Daily News, 2001). The suspension of the scenic byway nomination process by the Alaska Department of Transportation underscores the need to obtain broad-based public support for the scenic byway planning process.

The effectiveness of resource and transportation planning processes depends on current and accurate system inventories and assessments, both physical and social. A comprehensive inventory and mapping of a highway system for the human values and uses inherent in the system may help anticipate future conflict and ensure that limited resources are effectively distributed to achieve the greatest public benefit.

This paper describes a study conducted in Alaska to measure highway qualities for use in Alaska statewide scenic byways planning. Background information on the national scenic byways program is presented followed by an explanation of the survey methodology and selected research results. The larger purpose of this paper is to present a new paradigm for assessing highway systems through integration of social science research. A new paradigm for highways would view them as corridors of human values, not just transportation pathways. Highways represent human experiential opportunities, both latent and realized. In places like Alaska, the

* Tel.: +1-907-564-8267.
E-mail address: gregb@alaskapacific.edu (G. Brown).

0966-6923/$ - see front matter © 2003 Elsevier Ltd. All rights reserved.
doi:10.1016/S0966-6923(03)00004-8

non-transportation values of highways may actually exceed their transportation values. The idea that highways may be a destination unto themselves is the philosophical foundation for the national scenic byways program in the US and provides the basis for social science research to identify and measure the social attributes of highway systems.

1.1. Legislative history

The national scenic byway program was one of the first programs to explicitly embrace amenity or non-transportation values in highway transportation systems. The US Forest Service began its National Forest Service Scenic Byway designation program in 1988. In 1991, Congress enacted legislation providing for the establishment of a National Scenic Byways Program to promote and protect America's scenic roads under the Intermodal Surface Transportation Efficiency Act (ISTEA) (Pub. Law 102–240). The program was more clearly defined with passage of the Transportation Equity Act for the 21st century known as TEA-21 (Pub. Law. 105–178). The law identified six criteria for establishing National Scenic Byways as roads having outstanding scenic, historic, cultural, natural, recreational, or archeological qualities (23 U.S.C. Section 162(a)(1)). To become a National Scenic Byway or All-American Road, the road must be nominated by a State or a Federal management agency after having been first designated as a State scenic byway. To be designated as a National Scenic Byway, a road must possess at least one of the six intrinsic qualities and the significance of the features contributing to the intrinsic qualities must be regionally recognized. An All-American Road requires multiple intrinsic qualities that are nationally significant with one-of-a-kind features that do not exist elsewhere. There are currently 75 National Scenic Byways and 20 All-American Roads in 39 states (National Scenic Byways Program, 2002).

The scenic byway program authorized by Congress seeks to balance economic development with resource conservation by providing access to federal grants administered through the Federal Highway Administration. The law provides for up to 80% federal funding for eligible scenic byway project grants in eight categories: (1) development of a state scenic byways program, (2) development and implementation of corridor management plans, (3) necessary safety improvements resulting from designation, (4) certain specified facilities such as rest areas, turnouts, and interpretive facilities, (5) improved access to outdoor recreation opportunities, (6) protection of scenic, historical, recreational, cultural, natural, and archaeological resources in areas adjacent to a scenic byway, (7) provision of tourist and interpretive information, and (8) development and implementation of a scenic byways marketing program (23 U.S.C. Section 162(c)(1–8)). The Secretary of Transportation is prohibited from authorizing grants that "would not protect the scenic, historical, recreational, cultural, natural, and archaeological integrity of a highway and adjacent areas" (23 U.S.C. Section 162(d)).

1.2. Scenic byways intrinsic qualities

Intrinsic qualities are the essential, underlying characteristics of the byway program and are described in a national scenic byways planning guide titled, "Byway Beginnings: Understanding, Inventorying, and Evaluating a Byway's Intrinsic Qualities" (Swimmer and Whiteman, 1999). Intrinsic qualities are "features that are considered representative, unique, irreplaceable, or distinctly characteristic of an area" that result from the combination of natural or human made resources in the highway corridor (Swimmer and Whiteman, 1999, p. 8). The byway resources should be related to constitute a "unified whole" thus creating a distinctive byway. The intrinsic qualities of the byway are promoted through the byway story described as an "intentional, coordinated message that the byway conveys to visitors about the resources and qualities that it promotes" (Swimmer and Whiteman, 1999, p. 8).

To prepare for scenic byway nomination, an inventory of a highway's qualities must be completed. The inventories may be conducted by communities, tribal governments, state and federal agencies, or other interested groups. The process for inventorying intrinsic qualities can include community meetings, volunteer teams, and interviews with key individuals. Ultimately, the byway inventory must identify and map resources along the proposed scenic byway.

The planning guide suggests mapping at a level of detail that is easily attainable, for exampling using symbols to denote precise locations and shading for resources that are more general in nature. The guide provides a sample resource inventory worksheet, a byway significance worksheet, and an intrinsic quality summary sheet. The resource inventory worksheet identifies and describes a specific corridor resource and indicates the intrinsic quality (or qualities) that the resource contributes. A photo of the resource is to accompany the resource description. The resource inventory worksheet seeks answers to the following questions:

> Why is this scene important? How do the resources shown in this photo help to tell the byway's story? How is this resource linked to other resources along the byway corridor? How is this resource linked to the roadway? Has this resource been recognized by any regional or national program or organization? Who owns this resource? Is the owner involved in the corridor strategy process? (Swimmer and Whiteman, 1999, pp. 61–62)

The byway significance worksheet summarizes the significance of the combination of resources present along the byway and explains the regional and national significance of the byway's story. The intrinsic quality summary is completed for each intrinsic quality represented on the byway and describes the resources that contribute to the intrinsic quality, the location of the resources on a map, and the relationship of the resources to the entire byway.

In the planning guide, the concepts of intrinsic qualities and resources are used interchangeably. Byways resources may contain one or more intrinsic qualities while intrinsic qualities may make reference one or more byway resources. The imprecise terminology flows from the definitions for the six intrinsic qualities or resources and their relationship to the concept of human value. Intrinsic highway qualities exist because humans place value on them.

Human values have been the subject of considerable research across a variety of academic disciplines (see e.g., Rokeach, 1973; Andrews and Waits, 1980; Brown, 1984; Bengston, 1994; Bengston and Xu, 1995; Kempton et al., 1995) and are derived from three different theoretical traditions: (1) a social utility perspective where value represents an object's usefulness for human purposes, (2) a cohesiveness perspective where values are meta-sociological constructs that facilitate coordinated action, and (3) a social discourse perspective where values represent evaluative judgments resulting from interpretation of social phenomena and emergent properties of communicative action (Kuentzel, 2000).

Environmental values, the subset of human values that relate human interaction to the physical environment, are also plagued by problems of definition. Environmental values are constructed through the interaction of individuals and structures in a socioinstitutional context in places and may be said to have a 'geography' (Davies, 2001). Environmental values can be examined through different methodologies (i.e., qualitative or quantitative), epistemological frameworks (i.e. realist or social-constructivist) and disciplines (e.g., economics, ecology, or psychology) that appear incommensurable (Davies, 2001). Environmental values can also be studied at very different scales—from individual understanding, to a societal or even global level of analysis.

In this study, the six intrinsic qualities reflect a mixture of environmental values representing physical corridor features (i.e., realist objects of value) and human perceptions of highway qualities (i.e., social-constructivist value opportunities). For example, natural, archeological, and historic qualities reference obvious physical landscape features. Recreation quality is associated with, and dependent upon, natural elements but the physical landscape does not represent the intrinsic quality itself. Cultural intrinsic quality is largely a social-construction of perceived cultural opportunities (e.g., a festival or dance) although there are often physical manifestations of culture within the byway corridor (e.g., architectural design of buildings). Scenic quality is arguably the most subjective of the six intrinsic qualities and represents a heightened visual experience while traveling the corridor. Scenic quality may be described by scenic evaluation concepts such as variety, color, contrast, scale, or harmony.

Whether the six intrinsic highway qualities as provided in the scenic byway legislation and program guidelines are *mutually exclusive* and *exhaustive* of highway corridor qualities is an open question. For example, there may not be a bright line between the intrinsic qualities of "historic" and "archeological" or between "natural" and "aesthetic". But as will be discussed in the study results below, the general public appears to have little problem locating intrinsic qualities on the Alaska highway system.

1.3. Expanding the highway inventory process

The number of participants involved in inventorying scenic byway resources can be relatively limited or expansive depending on the type of process chosen. The process should include individuals with considerable local knowledge about the highway corridor and its resources. There are some advantages to expanding the inventory process to the general public in the planning process. For example, local people are often considered experts on the local environment and the processes that affect it and they may have direct experience with the interconnectedness of the local ecology (DeWalt, 1994). Thus, the lay public represents a vast reservoir of knowledge derived from experience in using highway systems that serves to complement "expert" knowledge of the transportation planning professionals.

Rational, comprehensive planning requires that once planning decision criteria are identified, objective measures of evidence in support of the decision criteria (i.e., the six intrinsic highway qualities) be applied to the decision outcome (i.e., nomination of a national scenic byway). But the nomination of national scenic byways does not appear to resemble a comprehensive, rational process as much as a local planning advocacy process. The scenic byways nomination approach has been to encourage local constituencies to build and submit the application for nomination without consideration for statewide, regional, or national priorities, although the support and involvement of a statewide scenic byway coordinator is usually evident in the process. An obvious question is whether local scenic byway planning conducted for the purpose of economic development is comprehensive and objective enough to support statewide or regional goals for scenic byway protection and enhancement?

By including comprehensive, public-based inventories of highway attributes in the scenic byway nomination

process, it is possible to reduce subjectivity in the nomination process, and more important, develop a rationally defensible statewide list of highway priorities. But beyond the nomination of highways, public-based intrinsic highway inventories have the potential to identify specific highway areas that warrant special management attention. A spatial inventory of highway qualities can provide a baseline for establishing a monitoring program to determine how the mix of intrinsic byway qualities changes over time. It is conceivable, though unlikely and not explicitly provided for in law, that a national scenic byway, if not protected, could change to the point where its prestigious scenic byway status is no longer justified.

1.4. Research objectives

The purpose of the research project was to identify and measure general public awareness about the scenic byway system in Alaska and to comprehensively assess and measure actual and potential scenic byway qualities in Alaska for use in scenic byway planning (designation, enhancement, and maintenance), scenic byway marketing, and scenic byway interpretation. More specifically, the research was intended to provide a comprehensive, statewide inventory of highway system values to provide for the following types of analyses:

(1) Development of a statewide scenic byway priority list based on public perceptions of intrinsic highway qualities. Other concerns and issues may supercede the public support nomination priority list but this information would provide strong justification for the nomination and designation of a given highway or highway segment.
(2) Spatially identify areas near the highway system that offer unique opportunities for corridor protection or development. Highway system qualities (e.g., aesthetic, recreational) are not homogeneous nor uniformly distributed. This methodology would identify those highway segments that possess special qualities or characteristics so that corridor plans could capitalize on these values.
(3) Identify potential interpretive ''themes'' for highway segments based on public perceptions of these areas. These themes could be incorporated into roadside interpretive displays as well as incorporated into marketing programs for the highways.
(4) Identify and measure general public awareness and knowledge about the scenic byway system that could be used to develop and tailor public information programs.

Following the research methodology, selected study results will be presented to illustrate the application of the spatial survey methodology for highway planning purposes. In the discussion, I present the concept of a highway experience opportunity spectrum as a starting point for a discussion on how to manage highway corridors from a human values perspective.

2. Methods

Survey instrument. A survey instrument for measuring scenic byway attributes was developed and pre-tested in the spring of 2001 utilizing a modified Total Design Method (Dillman, 1978), a procedure used in Alaska on three previous mail surveys (Brown et al., 2002; Smith, 2002). The survey instrument was reviewed by individuals at the Alaska Department of Transportation, planning personnel from the National Scenic Byways Resource Center in Duluth, Minnesota, and professional colleagues of the primary investigator. The survey instrument was modified and pre-tested on a convenience sample of approximately 30 Anchorage residents.

The mail survey contained questions in six sections: (1) Alaska residents' familiarity with and rating of Alaska's highways for scenic beauty, (2) place identification of any or all of six intrinsic qualities of Alaska's highways and roads (scenic, recreational, natural, historic, archeological, and cultural), (3) place identification of the best and worst highways locations in Alaska and the reason for their identification as such, (4) place identification of locations where respondents engage in any or all of 16 pre-selected activities (pleasure driving, viewing wildlife, fishing/hunting, hiking/walking/backpacking, rock/ice climbing, skiing/snowshoeing, bicycling, kayaking/canoeing/rafting, camping/picnicking, shopping, dining/eating, snowmachining and/or ATV/ORV, food gathering, commuting, driving for job/work, commercial truck/bus driving), (5) general policy questions about future highway construction projects, performance of the Alaska Department of Transportation, and knowledge of national and state scenic byway programs, and (6) respondent characteristics (e.g., length of residence, level of formal education, gender, and occupation).

The Alaska resident sample was randomly drawn from the state of Alaska's year 2000 Permanent Fund Dividend (PFD) database. This database contains the names and addresses of an estimated 90% of Alaska residents. [1] A total of 2233 individual households were initially selected for receiving the questionnaire.

[1] The Permanent Fund is an endowment funded by state oil revenues. Alaska residents are eligible to receive an annual dividend based on the fund's earnings. The PFD database under represents new residents to Alaska because individuals must live in Alaska at least one full year to be eligible to receive the dividend.

There were three rounds of mailing: (1) the initial survey packet with cover letter and map, (2) a follow-up reminder postcard (approximately two weeks later), (3) a second survey with cover letter and map (approximately four weeks after the postcard). To encourage participation in the study, each survey packet contained an attractive Official Alaska State Highways map that the individual was allowed to keep and use in their Alaska travels.

Operationalization of intrinsic highway qualities and special places. A reduced grayscale map of Alaska (USGS Map E) was provided with each survey. Survey instructions requested that participants find the map and accompanying map legend sheet containing six sticker dots for each of the six intrinsic highway qualities. A definition of each of the six intrinsic qualities appeared on the map legend and on the survey instrument. The map legend with attached dots appears in Fig. 1. The instructions read, ''For *each* of the landscape qualities described below, place the sticker dots directly on the Alaska highway corridors or areas that best reflect those qualities.''

Participants were also instructed to place dots representing the ''best'' and ''worst'' highway locations and to indicate their reason for placing the dots where they did. Six dots representing the ''best'' and ''worst'' highway areas were included on the map legend. The instructions read, ''Using the colored dots marked 'B' for 'BEST' and 'W' for 'WORST', place up to six sticker dots on the highway segments that you particularly like or dislike and describe why you like or dislike them.''

Although not discussed here, participants were also asked to map the highway *activities* they participate in along the highway system. Participants were provided with a map legend containing three dots for each of 16 highway activities.

Spatial analysis. The point location data from the 293 usable maps were ''heads up'' digitized with ArcView® software using the scanned and rectified USGS map as a background. Approximately 10,200 points were digitized. The survey data from SPSS® was then ''joined'' to the point GIS coverage using a unique survey identification number common to both the map and survey as the join field. Highways not contained in the Alaska Department of Transportation centerline coverage of Alaska highways (i.e., the Alaska Marine Highway) were digitized to create a more complete Alaska highway coverage.

A buffer distance of 5000 m (approximately 3 miles) from Alaska roads and highways was used to clip (reduce) point locations to those locations within reasonable proximity to the highways. The 5000 m distance was a heuristic that captured a high proportion of dots (approximately 87%) while keeping the point-to-highway attribution error to a reasonable level. Points beyond the 5000 m buffer are likely meaningful for ''activity'' locations but not meaningful for highway intrinsic ''quality'' locations since these were intended to be located in highway corridors. The number of point

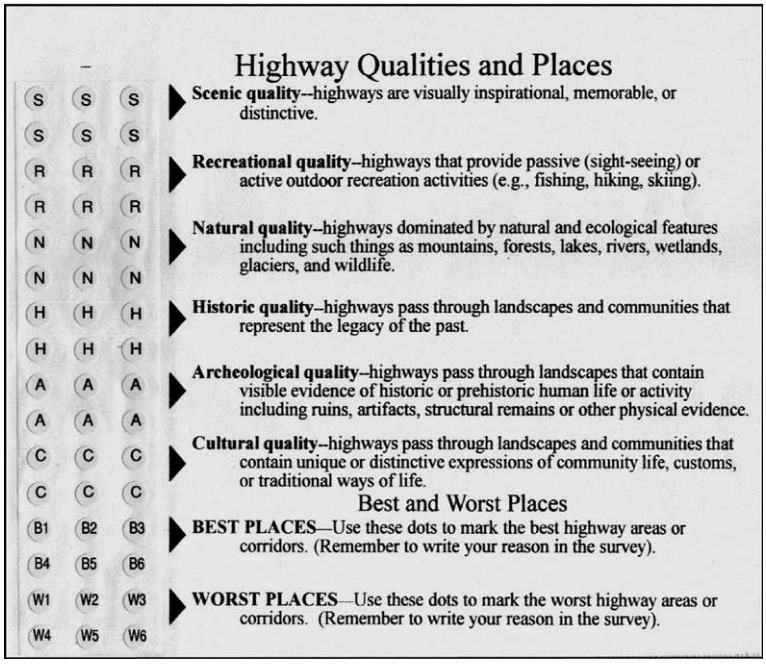

Fig. 1. Map legend and location stickers used in survey.

locations, after clipping, was reduced to approximately 8900.

The point location database was then spatially joined with the Alaska highways coverage to associate a highway name with each point location. Some error was inevitable using this method, particularly where highways intersect. The map scale and dot size do not provide for unambiguous point attribution to a highway when points lie near an intersection. However, it is likely that some errors of attribution will cancel or be offset by errors of attribution in the opposite direction.

Descriptive maps of intrinsic quality densities were generated from the point data using ArcView Spatial Analyst®. These density maps indicate the spatial distribution and intensity of intrinsic qualities in the highway corridors and are similar in concept to the mapping of biological diversity "hotspots" from the field of conservation biology. These intrinsic value "hotspots" and are described further below.

3. Results

Response rate. The surveys reached 2093 households out of the 2233 originally sampled. Four hundred and seven (407) usable survey responses were received for an overall response rate of about 20%. Two hundred ninety-three (293) usable maps were returned and digitized resulting in the identification of approximately 10,200 point locations in Alaska. This response was lower than three other public mail surveys conducted in Alaska in 1998, 1999, and 2001 by this researcher that had between 25% and 35% response rates. In general, the lower response rate likely reflects the unavoidable summer administration of the survey and the statewide target survey population, a population that historically has had lower response rates than more specifically targeted rural communities.

Respondent characteristics deviated from 2000 census characteristics as follows: respondents contained more males, were somewhat older, had more formal education, were more likely to live in rural areas, and under represented minority subpopulations, especially Alaska natives. In this study, having respondents that are somewhat more familiar and knowledgeable about Alaska's highways may be viewed a positive feature of the apparent non-response bias.

Perception of most scenic highways. Three methods were used to measure the most scenic or aesthetic highways statewide: (1) an open-ended question asking the most scenic highway, (2) average scenic ratings based on a four point Likert scale ranging from "not scenic" to "very scenic" on 27 road and highway segments, and (3) frequency of aesthetic point locations in the highway corridors. Table 1 shows a comparison of the results for the three methods. Just over half of the individuals responded to the open-ended question. The low response may reflect lack of understanding in the survey instructions or more likely, reluctance among the survey respondents to select a single most scenic highway from many options in Alaska.

The average rating method often results in "end-piling" or lack of differentiation based on mean scores, but one could argue this method provides a more valid measure of scenic quality because of the higher response rate on the individual highway ratings. In this study, analysis of the scenic ratings was limited to those respondents who indicated that they were at least somewhat familiar with the highway.

Table 1 also shows the most scenic highways based on the number of "scenic" point locations spatially mapped by respondents within the highway corridors. This method results in yet a third set of scenic rankings that differ from the other two methods. The differences in ranking based on method indicate that familiarity with the highway system (discussed below) likely influences aggregate perceptions of scenic highway quality.

Familiarity with highways. Respondents were asked to rate their familiarity with Alaska highways on a four point Likert scale ranging from "not at all (0 lifetime

Table 1
Most scenic highways in Alaska based on three different measures

Highway name	Open-ended ranking[a]	Average rating method[b]	Frequency of mapped "scenic" qualities[c]
Seward	1	3	1
Denali	2		6
Richardson (Valdez to Glenallen)	3	4	2
Marine highway (Southeast)	4	1	7
Glenn (Palmer to Glenallen)	5		3
Marine highway (Southcentral)		2	
Alaska RR		5	
Parks (Wasilla to Denali NP)			4
Sterling			5

[a] Based on frequency of highway being cited as *most* scenic.
[b] Rankings based on *highest average score* using four point scale where 1 = not scenic to 4 = very scenic.
[c] Rankings based on count of "scenic" qualities located within 5000 m highway corridor.

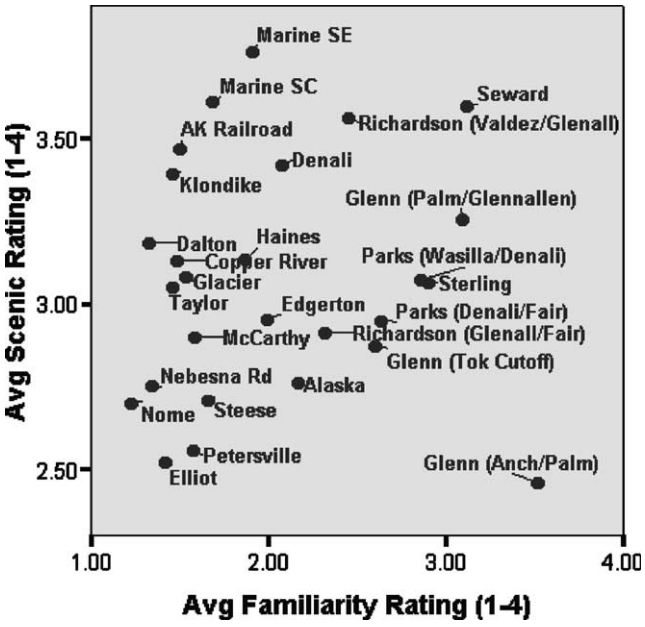

Fig. 2. Highways/roads plotted by average scenic rating and average familiarity rating.

trips)'' to ''very familiar (10+ lifetime trips)''. The results of highway familiarity are depicted graphically in Fig. 2. The average scenic ratings are plotted on the other axis. The 27 familiarity ratings were summed to create on overall highway familiarity score to relate to respondent characteristics. There was no significant relationship (ANOVA, $P > 0.05$) between highway familiarity statewide and the respondent variables of gender and place of residence. There were weak but statistically significant *positive* correlations between highway familiarity and age ($r = 0.16$, $P < 0.05$) and length of residence in Alaska ($r = 0.28$, $P < 0.05$). As expected, those more familiar with Alaska's highways are also more knowledgeable about the existence of state and national scenic byway programs (t-tests, $P < 0.05$).

Knowledge of state and national scenic byway programs. Two questions were asked to determine Alaska resident awareness of the state and national scenic byway programs. About 36% of Alaska residents are aware of the *state* scenic byway program and about 40% are aware of the *national* scenic byway program (see Tables 2 and 3). There is greater awareness of both state and national byway programs by Anchorage residents and there is a significant relationship between age and awareness of the national scenic byway program with younger age groups less aware than older age groups. The higher awareness of Anchorage residents is likely due to the proximity of the Seward National Scenic byway to Anchorage and the signage associated with it.

Role of state of Alaska in scenic byways programs. Even though the majority of Alaska residents are not aware of the scenic byway programs, all but 13% of participants chose to express an opinion about the role

Table 2
Knowledge of Alaska *state* scenic byway program by community

			Sampling group				Statewide total
			Anchorage	Fairbanks	Juneau	All other communities	
Know about ''state'' scenic byways	Yes	Count	49	6	5	77	137
		%	43.4	19.4	29.4	34.8	35.9
	No	Count	64	25	12	144	245
		%	56.6	80.6	70.6	65.2	64.1
Total		Count	113	31	17	221	382
		%	100.0	100.0	100.0	100.0	100.0

Table 3
Knowledge of *national* scenic byway program by community[a]

			Sampling group				Statewide total
			Anchorage	Fairbanks	Juneau	All other communities	
Know about ''national'' scenic byways	Yes	Count	63	3	2	85	153
		%	55.8	9.7	11.8	38.8	40.3
	No	Count	50	28	15	134	227
		%	44.2	90.3	88.2	61.2	59.7
Total		Count	113	31	17	219	380
		%	100.0	100.0	100.0	100.0	100.0

[a] Proportions between sampling groups are significantly different (Chi-square, $P < 0.05$).

Table 4
What should be role of state of Alaska in a scenic byways program (by community)[a]

	Statewide ($n = 373$) (%)	Anchorage ($n = 111$) (%)	Fairbanks ($n = 30$) (%)	Juneau ($n = 16$) (%)	Other communities ($n = 216$) (%)
Construct and build wayside areas	63	73	63	56	58
Develop education and interpretive displays	47	55	43	56	43
Plan for scenic byway corridor and development	42	45	37	70	40
Market Alaska scenic byways to outside visitors	38	42	33	19	38
Do not know enough about scenic byways	17	13	23	13	18
Provide money to individuals/businesses enhance properties	13	13	13	6	13
Alaska should not participate in program	8	7	3	0	9
No opinion	5	6	0	13	5

[a] Respondents allowed to check multiple responses. Percentages reflect frequency of response for each item.

of state of Alaska in a scenic byways program (see Table 4). Alaska residents were most enthusiastic about the state of Alaska building more waysides along scenic byways (63% of respondents) and least enthusiastic about providing money to individuals and businesses along scenic byways to enhance their properties (13% of respondents). Only about 8% of Alaska residents indicated that the state of Alaska should not participate in the scenic byways program.

Quantity of scenic byway qualities. The mapped locations of the six scenic byway nomination criteria are generally consistent with the scenic ratings from the questionnaire. Table 5 contains the percent of scenic byway qualities found along the major highways in Alaska. The Seward Highway corridor has the highest percentage of all mapped scenic byway qualities (12.6%) followed by the Richardson (12.2%), Parks (9.7%), Glenn (9.3%), Sterling (8.9%), Denali (6.1%) and Marine SE (5.2%). Grouping all six scenic byway criteria together can mask important distinctions between the highways. For example, the Seward Highway has the highest percentage of "scenic" and "recreation" qualities in its corridor, but the Richardson Highway has the highest percentage of "natural", "historic", and "archeological" qualities. The Alaska Marine Highway SE is perceived to have the highest "cultural" qualities. The McCarthy Road is notable for its historic and archeological qualities.

Spatial location of outdoor activities in highway corridors. Participants were asked to identify places where they engage in various outdoor activities. Table 6 contains the percentage of combined outdoor activities by highway corridor. Consistent with the previous "Recreation" scenic byway quality finding, the Seward Highway and Sterling Highways also have the highest number of outdoor activities located in their respective highway corridors.

"Best" and "worst" highway locations. Participants were asked to identify the best and worst highway places in Alaska and to state their reason. The "best" and "worst" highway locations were mapped and the reasons were coded and classified. Those that identified the "best" highway locations based their perceptions on aesthetics. Aesthetic locations account for approximately 80% of the "best" highway point locations. The highway corridors with the highest number of "best" places closely followed the results of respondent mapped scenic byway qualities (see Table 6). Individuals that

Table 5
Scenic byway qualities identified by highway (percent of points identified within 5000 m highway corridor)

All six qualities	Scenic	Recreation	Natural	Cultural	Historic	Archeological
Seward (12.6%)	Seward (15.6%)	Seward (15.8%)	Richardson (14.7%)	Marine SE (11.5%)	Richardson (13.9%)	Richardson (9.1%)
Richardson (12.2%)	Richardson (13.5%)	Sterling (14.9%)	Seward (14.2%)	Sterling (9.2%)	McCarthy Rd (9.2%)	Marine SE (7.8%)
Parks (9.7%)	Glenn (11.5%)	Parks (11.5%)	Glenn (10.2%)	Glenn (9.2%)	Seward (7.6%)	McCarthy Rd (7.8%)
Glenn (9.3%)	Parks (11.3%)	Richardson (9.8%)	Parks (10.2%)	Richardson (8.5%)	Taylor (7.4%)	Denali Hwy (7.5%)
Sterling (8.9%)	Sterling (8.7%)	Glenn (8.8%)	Denali Hwy (7.6%)	Parks (7.5%)	Marine SE (6.2%)	Sterling (6.8%)
Denali Hwy (6.1%)	Denali Hwy (7.2%)	Denali (7.8%)	Sterling (6.6%)	Seward (6.0%)	Parks (6.2%)	Seward (6.5%)
Marine SE (5.2%)	Marine SE (4.6%)	Steese (2.6%)	Marine SE (4.8%)	Taylor (4.7%)	Glenn (5.7%)	Parks (6.5%)

Table 6
Attributes of highways (percent of points identified within 5000 m highway corridor)

All outdoor activities[a]	Best highway places[b]	Best highway places Aesthetics[c]	Worst highway places[d]	Worst highway places (Aesthetics)[e]
Seward (16.6%)	Seward (18.1%)	Seward (20.5%)	Glenn (18.9%)	Parks (35.9%)
Sterling (12.1%)	Richardson (12.7%)	Richardson (13.8%)	Parks (16.5%)	Sterling (14.8%)
Glenn (9.6%)	Glenn (11.1%)	Sterling (11.1%)	Richardson (12.4%)	Glenn (14.0%)
Richardson (8.8%)	Sterling (10.6%)	Glenn (10.2%)	Sterling (9.6%)	Richardson (10.1%)
Parks (8.0%)	Parks (9.7%)	Parks (8.7%)	Seward (6.5%)	Alaska (8.6%)
Denali (7.8%)	Denali (7.7%)	Denali (7.3%)	Alaska (6.5%)	Seward (2.3%)
Marine SE (3.5%)	Marine SE (4.7%)	Marine SE (5.8%)	Tok "Cut-off" (5.7%)	Tok "Cut-off" (1.5%)

[a] Percent of total outdoor activity points located in highway corridor. Activities include pleasure driving, viewing wildlife, fishing/hunting, hiking/walking/backpacking, skiing/snowshoeing, bicycling, kayaking/canoeing/rafting, camping/picnicking, snowmachining/ATV/ORV, and food gathering.
[b] Percent of total "Best" highway points located in highway corridor.
[c] Percent of total "Best" highway points that were chosen for reasons of scenery or aesthetics ($n = 551$).
[d] Percent of total "Worst" highway points located in highway corridor.
[e] Percent of total "Worst" highway points that were chosen for reasons of aesthetics ($n = 128$).

identified the worst highway locations gave three primary reasons—unattractiveness (30%), poor road conditions including surfacing and safety (47%), or traffic congestion (20%). The highways with the highest number of "worst" locations were the Glenn, Parks, Richardson, and Sterling highways. The "worst" highway segments were those located inside the Anchorage municipality (Glenn Highway) and the Wasilla area (Parks Highway). The Alaska and Tok "Cut-off" highways were noteworthy for their perceived poor road surfacing.

Spatial distribution scenic byway qualities. The identification and mapping of highway qualities and characteristics provides for analysis of highways at various map scales. A large number of maps can be generated from the survey data to show the spatial distribution of each of the six highway qualities in the system, location of corridor activities, and the perceived "best" and "worst" highway locations. While it is not possible to present all the spatial distributions, a map showing the densities of "scenic" highway qualities in Alaska is presented in Fig. 3 to illustrate the possibilities for highway planning purposes.

The density map of "scenic" qualities in Fig. 3 (right panel) was generated by creating polygons based on the number of points per square kilometer (left panel) using a 250 m grid cell with a 3000 m search radius. This type of density mapping allows visualization of "hotspots" or areas with unusually high concentrations of highway attributes. Color coding of quality densities using a color ramp heightens the contrast in distribution of highway qualities. One obvious conclusion is that perceived "scenic" highway attributes are not uniformly distributed along highway corridors in Alaska but rather tend to cluster or group in geographic locations. Specifically, the Seward Highway, has sustained concentrations of scenic qualities in its corridor with observable hotspots in the Turnagain Arm of the highway

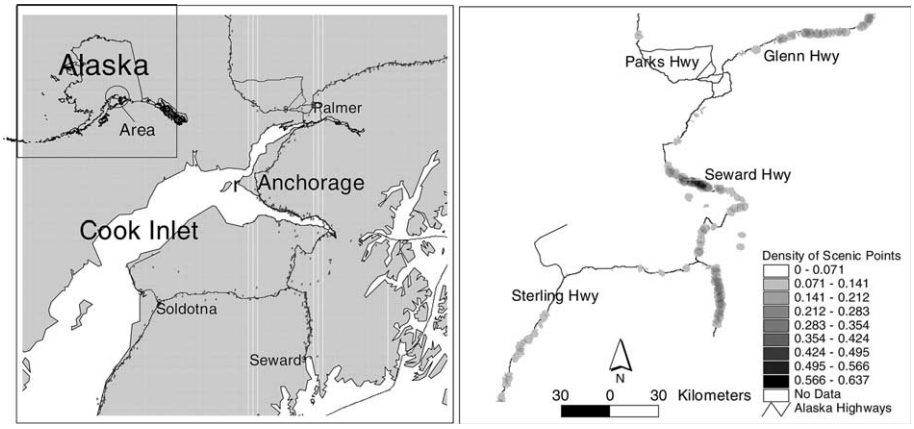

Fig. 3. "Scenic" highway quality "hotspots" based on spatial density of mapped locations. Point locations (left panel) are converted to density map (right panel) using 250 m grid cell with 3000 m search radius.

south of Anchorage and in the highway segment north of Seward on the Kenai Peninsula. In contrast, there are long stretches of the Parks highway without any observed "scenic" highway qualities.

Density maps for other intrinsic highway qualities also show distinct patterns of clustering in different Alaska highway corridors. Just as there are scenic hotspots, there are also observable hotspots for recreation, historic, cultural, archeological, and natural intrinsic qualities.

4. Discussion

4.1. Alaska specific implications

There are a number of practical recommendations that derive from the spatial survey methods described herein. Alaska currently has one "All-American Road" (Seward Highway) and two recently listed National Scenic Byways (Glenn Highway and Alaska Marine Highway) added June 13, 2002. The survey results indicate that virtually all highways in Alaska possess the qualities to satisfy the criteria for nomination as a National Scenic Byway. But with limited resources for corridor planning, designation, and plan implementation, it makes sense to prioritize and select the Alaska highways that possess the greatest abundance of qualities used as scenic byway criteria. The Richardson Highway (from Valdez to Glennallen) ranks number two in intrinsic qualities and would logically be the next Alaska highway considered for national recognition. Interestingly, the Alaska State Department of Transportation decision to nominate the Glenn Highway as the second nationally recognized highway in Alaska is not directly supported by the survey results.

The survey results indicate that a majority of Alaska residents are not aware of the state or national scenic byway programs. A narrow majority of Anchorage residents are aware of the national scenic byway program by virtue of their proximity to the Seward highway. Is this lack of awareness and program visibility a problem? Not necessarily, but it does represent a missed opportunity for Alaska residents to develop pride and ownership in the Alaska transportation system. Developing a stronger awareness of the outstanding qualities inherent the Alaska highway transportation system would serve to reinforce the positive perceptions of the Department of Transportation as the caretakers of a very special transportation system and could also lead to greater voluntary protection of aesthetic and natural landscapes within the highway corridors by private landowners.

Especially scenic segments of the Alaska highway system should be recognized and promoted as being special. These highway segments are the best of the best. The form and content of the promotion might include, among other actions, a scenic byways brochure to be included in state tourism information packets, a feature article in a travel magazine (e.g., "The 10 Most Scenic Areas in Alaska", and a new highway scenic zone designation complete with road signage (e.g., you are now entering a "Alaska Special Scenic Area").

Perhaps the most valuable component of this study for Alaska is the spatial database that provides for detailed analysis for the qualities of Alaska highways on a segment by segment basis for planning purposes. Potential uses include facility planning (e.g., where should new facilities be located), safety analysis (e.g., do accidents occur along segments perceived to be unsafe?), and corridor management planning for scenic byway designation.

4.2. A highway opportunities experience classification system

Highways traverse landscapes that are dynamic places shaped by natural and human forces. Human perceptions of these landscapes is culturally processed and refined by human action. Undifferentiated spaces, the landscapes along the highways, become *place* when endowed with value (Tuan, 1977). The understanding that highways are not simply a path from Point A to Point B but also an expression of human values and perceptions on the landscape, has the potential to transform the mission of those who design and manage the highway system. If highways are viewed as collections of landscape qualities that provide value, then those that manage the transportation system have an obligation to provide a spectrum of travel experiences and to help protect and preserve those highway qualities that make them valuable. The building of transportation systems is often technically challenging but the engineering solution space is usually bounded and relatively stable. In contrast, building transportation systems to manage for complex human interactions with the landscape is unbounded and dynamic, an undertaking that requires repeated assessments of human values and landscape perceptions. This study represents a tentative step in spatially mapping perceived intrinsic highway qualities for state or regional analysis.

The systematic inventorying of state or regional highway systems for intrinsic highway qualities is similar in function to the assessment of landscapes used to identify outdoor recreation opportunities. The recreation opportunity spectrum (ROS) (Clark and Stankey, 1978) is a landscape classification system that describes and matches recreation preferences and experiences with recreation settings. The ROS makes assumptions about linkages between the physical environment and the human expectations about outdoor recreation experiences. The purpose of an ROS inventory is to identify,

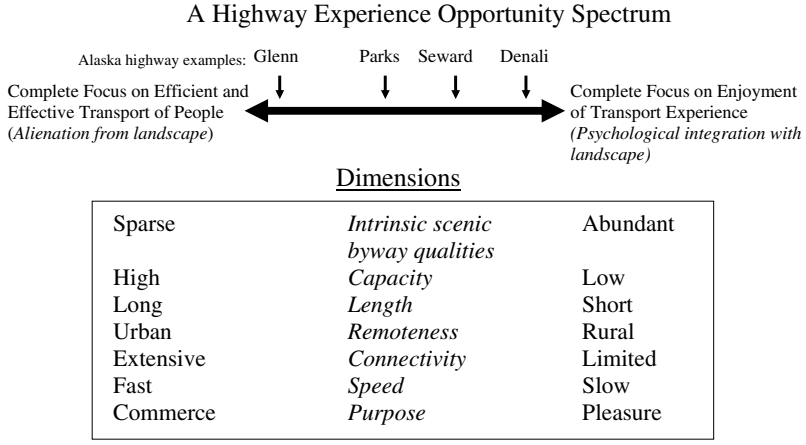

Fig. 4. A proposed highway opportunity spectrum based on highway attributes and proposed placement of selected Alaska highways.

delineate, and classify areas into recreation opportunity classes based on characteristics such as remoteness, naturalness and expected social experience. The ROS defines six opportunity classes ranging from "Primitive" at one end of the spectrum to "Urban" at the other end. The inventory provides information about existing recreation opportunities to assist land and resource managers in making decisions about appropriate land uses, resource development objectives and management prescriptions.

Similarly, an inventory of intrinsic highway qualities can be used to help derive what might be termed highway experience "opportunity" classes. Highway experience opportunity classes are bundles of intrinsic highway corridor qualities that combine with physical highway corridor features to provide a range of potential travel experiences. Fig. 4 presents some tentative ideas about what kind of highway attributes might be used to derive a highway experience opportunity spectrum.

The first observation about the highway opportunity spectrum as presented is that only the endpoints of the spectrum are defined. At the opposite ends of the spectrum lie two very different opportunities for travel experiences—a travel opportunity that is completely focused on the efficient and effective transportation of people and a travel opportunity that is completely focused on the enjoyment of the transportation experience. One can visualize different modes of transportation described with respect to this spectrum—for example, a commuter train designed to move large numbers of people to and from urban and suburban areas ("efficiency" based) to an off-road, backcountry jeep tour ("experience" based). Likewise, highways may be viewed on this spectrum—for example, a multi-lane urban freeway ("efficiency" based) to a national park road traversing scenic landscapes ("experience" based).

Unlike the endpoints of the spectrum, the highway experience opportunity classes that exist within the endpoints of the spectrum are more challenging to describe and define. These experience opportunities represent some mix of efficiency and intentional non-efficiency in transportation. They might also reflect different mixes of intrinsic qualities. For example, the Richardson Highway offers relatively high "natural" qualities. Thematically, the Richardson Highway might be termed the "natural" highway, or more promotionally, "Alaska's Most Natural Highway." The Sterling Highway has relatively more abundant outdoor recreation and cultural qualities but relatively fewer perceived aesthetic qualities. Thematically, the Sterling Highway might be termed the "recreation" highway, or more promotionally, "Alaska's Gateway to the Great Outdoors."

The concept of highway experience opportunity classes is a heuristic that serves to reinforce the idea that highway corridors ought to be managed for both transportation functionality and psychological outcome of the transportation experience. Unfortunately, it is not clear how the intrinsic qualities would correlate to different positions on the highway opportunity spectrum because no measures of psychological outcome from traveling the various highways in Alaska were collected as part of this study.

One can speculate that the efficient highways (e.g., multi-lane freeways) tend to alienate travelers from the immediate landscape while highways with significant intrinsic qualities tend to integrate travelers with the landscape. For example, the Glenn Highway that travels north out of Anchorage offers impressive views of the Chugach mountains and upper Cook Inlet but this highway corridor scores low on most intrinsic highway qualities. One possible explanation is that this stretch of highway (multi-lane, divided, and relatively straight) is designed for speed and efficient movement of large numbers of vehicles and thus alienates travelers from the otherwise outstanding intrinsic qualities of the

surrounding landscape. At the opposite end of the spectrum would be the Denali Highway, an unpaved highway whose strategic transportation value has been usurped by the Parks Highway, but a highway that traverses landscapes with exceptional intrinsic qualities.

The quantity, quality, and spatial distribution of intrinsic highway qualities constitute one potential, but not fully explicated dimension of a highway experience opportunity spectrum. One could also look to other characteristics or dimensions of a given highway to determine where it might fit on the spectrum. For example, other potential dimensions include capacity (volume of traffic), length of highway, remoteness (i.e., distance from urban areas), connectivity (i.e., what cities or geographic areas does the highway connect), travel speed, and purpose (e.g., commerce or pleasure). The Glenn and Denali Highways provide excellent contrast on the different dimensions. The Glenn Highway is an urban, high speed, high capacity highway that connects Anchorage with the Matanuska-Suisitna Borough, the fastest growing area in the state of Alaska. The Glenn is primarily a commuting highway and as previously discussed, is relatively sparse in intrinsic highway qualities. In contrast, the Denali Highway is a rural, low capacity, low speed highway that connects the very small rural communities of Paxson and Cantwell. Since driving the highway can result in wear and stress on vehicles and paved, alternative routes exist, many individuals choose to drive the highway for a sense of adventure or to access recreational opportunities along the route.

One advantage to describing highways on an opportunity spectrum is to ensure that state or regional departments of transportation provide a range of experience opportunities for individuals who use a state or regional highway system. There is continual pressure to expand and upgrade highway systems to accommodate greater vehicle capacity. In the US, there are many highways that offer the high volume, urban transportation experience and the distribution of highways on the opportunity spectrum is skewed in the efficiency direction. The opportunities for pleasure driving across landscapes with high intrinsic qualities and low volume are less abundant. State highway transportation departments must have the ability to resist highway improvement projects that risk the intrinsic qualities that provide enjoyable highway travel experiences. Highway improvement projects within highway corridors with abundant intrinsic qualities should receive a careful level of review consistent with the protection mandate in the byways program. The National Recreation and Parks Association has argued that the current protection afforded scenic roads from visual and resource deterioration is insufficient (NRPA, 1989).

Arguably, protection of intrinsic highway qualities ought to trump highway improvement projects (e.g., alignment and addition of lanes) but a "bright line" in such project decisions is often lacking because intrinsic qualities and their associated human values appear "fuzzy" while highway safety and efficiency criteria are more tangible to project engineers. The systematic inventory of intrinsic highway qualities described herein is one method to provide more equitable trade-off analyses.

There is ample opportunity for further human dimensions research on highways. The delineation of more specific highway opportunity classes would require the development and administration of empirical psychological measures of highway travel experiences to correlate with perceived intrinsic highway qualities. With a better understanding of this relationship, it would be possible to assess the social impact of potential highway changes on human use of the highway corridors, and ultimately, to manage highway corridors for a broader mix of human values.

References

Andrews, R., Waits, M., 1980. Theory and methods of environmental values research. Interdisciplinary Science Review 5, 71–78.

Bengston, D., 1994. Changing forest values and ecosystem management. Society and Natural Resources 7 (6), 515–533.

Bengston, D., Xu, Z., 1995. Changing national forest values: a content analysis. USDA For. Serv. Gen. Tech. Rep. NC-323. 29 p.

Brown, G., Reed, P., Harris, C.C., 2002. Testing a place-based theory for environmental evaluation: an Alaska case study. Applied Geography 22 (1), 49–77.

Brown, T., 1984. The concept of value in resource allocation. Land Economics 60 (3), 231–246.

Clark, R., Stankey, G., 1978. The Recreation Opportunity Spectrum: A Framework for Planning, Managing and Research. General Technical Report PNW-98, Pacific Northwest Forest and Range Experiment Station, USDA Forest Service, Seattle.

Davies, A., 2001. What silence knows—planning, public participation and environmental values. Environmental Values 10, 77–102.

DeWalt, B.A., 1994. Using indigenous knowledge to improve agriculture and natural resource management. Human Organization 53 (2), 123–131.

Dillman, D.A., 1978. Mail and Telephone Surveys. John Wiley and Sons, New York, 325 p.

Kempton, W., Boster, J., Hartley, J., 1995. Environmental Values in American Culture. MIT Press, Cambridge.

Kuentzel, W., 2000. Social values and the lack of scientific consequences: divergent theoretical traditions. Paper presented at 8th International Symposium on Society and Resource Management, 17–22 June 2000, Bellingham, WA. Book of Abstracts: Pacific Northwest Research Station, PNW-GTR-497, p. 174.

National Recreation and Parks Association, 1989. [on-line] Statement of Policy on Scenic Byways adopted by NRPA Board of Trustees, 24 October 1989. Available at http://www.nrpa.org.

National Scenic Byways Program, 2002. [on-line]. Available http://www.byways.org/travel/scenic_byways.html.

Rokeach, M., 1973. The Nature of Human Values. Free Press, New York.

Smith, C., 2002. The identification of biological resources in Prince William sound: environmental values and a comparison of lay and expert knowledge. Masters Thesis. Alaska Pacific University, Anchorage, AK.

Swimmer, E., Whiteman, J., 1999. Byway Beginnings: Understanding, Inventorying, and Evaluating a Byway's Intrinsic Qualities. National Park Service Rivers, Trails, and Conservation Assistance Program and Whiteman and Tainor, Planning Consultants, Washington, DC. 80 p.

Tuan, Y.F., 1977. Space and Place. Arnold, London.