

# The Relationship Between Perceptions of Wilderness Character and Attitudes Toward Management Intervention to Adapt Biophysical Resources to a Changing Climate and Nature Restoration at Sequoia and Kings Canyon National Parks

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**Abstract** In a recent national survey of federal wilderness managers, respondents identified the high priority need for scientific information about public attitudes toward biophysical intervention to adapt to climate change and attitudes of the public toward restoration of natural conditions. In a survey of visitors to one National Park wilderness in California, visitors revealed that they largely do not support biophysical intervention in wilderness to mitigate the effects of climate change, but broad support for activities that restore natural conditions exists. In an attempt to understand how these attitudes vary among visitors, it was found that those visitors who most value naturalness aspects of wilderness character also most positively support restoration and are most negative toward climate change intervention practices. More information about visitor-defined wilderness character attributes is needed and strategic planning to guide intervention decisions and restoration should be a priority. In this study, it was found that wilderness character is largely defined by visitors based on its wilderness attributes, which include

natural sounds, low density of people, pure water, clean air, and the presence of humans substantially unnoticeable.

**Keywords** National Wilderness Preservation System · Wilderness attributes · Climate change · Natural · Wild · Free nature

*Arthur Carhart (1961) asserted, “[L]ands called ‘wild’ have retained the attribute of freedom. They have their own integrity intact. They have not been skinned, scraped, dug up, regimented and pounded into shapes and services desired and demanded by ‘civilized’ man.” Cited in Aplet et al. 2000.*

## Introduction

At the time of Carhart (and even the more recent citation by Aplet et al.), the primary threat to wild places and their freedom was believed to be human development and economic pursuits. Arthur Carhart is most famous for his recommended resistance to those threats by protecting some places in their wilderness condition. There has always been a perception that if we do not do anything to the land, keep it untrammled, the land will retain its wild nature. In places we call wilderness, one is assumed to be free to recreate there and witness the freedom of nature, unconstrained and without human intervention. But in reality, we know that a great deal of land in North America has been influenced in many ways, going back to early interventions by indigenous people to increase chances of survival, later by settlers to increase the economic productivity of agricultural land and forests, and now, more and more discussion about human manipulation in response to vulnerability anticipated from anthropogenic influences that extend worldwide due to climate change (Wuerthner et al. 2014).

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Today, in many aspects of wilderness stewardship, the debate is often about the tradeoffs between wildness (untrammeled) and naturalness (Cole 1996). While wildness might be thought of as freedom and we are motivated to support this freedom of nature and people in wilderness, naturalness is either the perception of natural processes or scientific determination that, indeed, nature exists in some prescribed structure, with natural composition, and with a prescribed function. The question is whether we can appropriately and successfully implement management practices that protect naturalness without employing techniques that manipulate the physical environment, thus making it less wild. For example, over the past century human intervention to control fire through suppression, then more recently to restore the effects of fire through mechanical treatments and human-ignited fire, demonstrates changing attitudes toward wildlands, often with little respect for the freedom of nature, but instead more focused on some set of prescribed conditions or outcomes.

Currently, federal agencies in the US differentiate naturalness and wildness through operationalization of a framework to monitor wilderness character, first proposed in the 1990s (Landres et al. 1994) as a guide to research prioritization (e.g., Watson and Williams 1995; Cole and Landres 1996), but without organizational mechanisms for agency implementation until much more recently (Landres et al. 2008). In this applied monitoring framework, wildness is commonly operationalized through indicators of trammeling forces [such threatening actions that are taken that degrade this quality, even when these actions are taken to protect resources, such as spraying herbicides to eradicate or control nonindigenous species or reducing fuels accumulated from decades of fire exclusion (Landres et al. 2008)].

Indicators of natural conditions might include actions to preserve or “improve” nature, for example, by controlling or removing nonindigenous species or restoring ecological processes (Landres et al. 2008). There has been no research reported at this time to understand how some of the threats used as indicators of wildness and naturalness might be perceived by visitors to wilderness. In fact, Tricker et al. (2014) point out that in an effort to select indicators of wilderness character at one park, Sequoia and Kings Canyon National Parks (SEKI), they intentionally did not select indicators that address the symbolic, intangible, spiritual, and experiential values of wilderness character that are unique to individual persons, locations, and moments. The indicators of wilderness character are determined more by legislative interpretation and manager perceptions than research at the place or among visitors to the place. Specialist attempts to define these aspects of wilderness character through threats to biophysical parameters have been widely accepted at this time, though the

argument has been made for more acknowledgment of the variability of wilderness character perceptions among wilderness visitors and across places (Watson 2004).

In a recent survey of managers of federal wilderness areas by Ghimire et al. (2015), when asked to identify those stewardship topics with the least information available to guide them in making decisions, respondents identified “public attitudes toward intervention to adapt to climate change influences” as the area most in need of research information. While 58 % of these federal managers agreed that information on this topic is not adequate or only somewhat adequate to help them make decisions, more common historic wilderness research topics received much lower interest as needs for scientific information: for example, visitor management (35 %), wilderness monitoring protocols (34 %), fire and fuels management (22 %), and fish and wildlife management (21 %). Managers are facing new issues, struggling with knowing when to intervene, how to make such decisions, and how the public will respond to intervention decisions managers will make in the future. Over half of the managers (52 %) also indicated a belief that science-based information about public attitudes toward ecological restoration is not adequate or only somewhat adequate. A better understanding of how visitors define wilderness character and how this definition might correspond with proposals for intervention (with potential impacts to wildness) or restoration (to maintain natural conditions) are important pieces of information not available to managers today. This is the primary purpose of this paper.

## Materials and Methods

### Survey

A survey questionnaire was used to collect visitor attitude data at SEKI Wilderness in California (Martin et al. 2014). The questionnaire was administered in both hard-copy mailback and electronic web-based formats designed to produce comparable results. The survey had four general sections. “**Introduction**” section measured trip characteristics (locations visited, method of travel, activities, fuel use, food storage techniques, and technology use); “**Materials and Methods**” section measured the impact of potential influences on visitor experiences (perceptions of technology, social conditions encountered, administrative and user support facilities encountered, restoration and climate change interventions, wilderness character and place attributes); “**Results**” section assessed perceived conflicts and problems that need to be addressed by managers (visitor behaviors, resource impact problems, overuse problems, management activities, etc.); and “**Discussion**”

section obtained experience use history and demographic characteristics (previous visits, education level, income category, age, gender, race/ethnicity). This paper presents findings from “[Materials and Methods](#)” section of the survey.

### Study Period and Target Population

Most visits to the wilderness of SEKI occur during the summer season (July and August). Backcountry visitor numbers are estimated at approximately 33,000 visitors each summer, with 8500 overnight group camping permits issued in 2009. The target population for the study included overnight recreation visitors (age 18 or older) from the first of May to the end of September, 2011.

SEKI personnel drew a sample of names/addresses from summer 2011 wilderness permits. Neighboring national forest ranger stations (Inyo and Sierra National Forests) that also issued SEKI wilderness permits did the same. From May 1 through July 31, every 9th permit was selected. Due to a very late snowpack, visitor use was so low in the first 3 months that there was concern about not meeting a sample target. In August and September, the sampling interval was changed to every 4th permit. We received a total of 1043 useable names and addresses to serve as the visitor sample.

Investigators prepared and mailed initial survey packets, reminder postcards, and, if necessary, follow-up survey packets to all 1043 contacts. Reminder postcards were mailed 1 week after the initial mailings. Follow-up surveys were mailed 2 weeks after the reminder postcards. First class postage stamps were used on all outgoing packets and postcards, while business reply postage was used for the return envelopes. Investigators also prepared and administered an online version of the survey using a commercially available service known as SurveyMonkey.

The final sample size of returned and useable surveys was 635, for a response rate of 62 %. We received 355 completed surveys from visitors who obtained their SEKI Wilderness permits from the Inyo National Forest, 231 surveys from visitors who obtained their wilderness permits directly from SEKI, and 35 surveys from visitors who obtained their wilderness permits from the Sierra National Forest.

Only 18 % of responses were returned online via SurveyMonkey. While many surveys today are tending more toward dependence on electronic response formats, the alternative of a mailback response seems to still be an important one to wilderness visitors. Respondents who used SurveyMonkey were slightly younger than those who responded by way of the mailed survey (average 44 vs. 48 years; sig. <0.01), but no differences were found in gender, level of education, group size, or length of stay.

### Questions About Wilderness Character

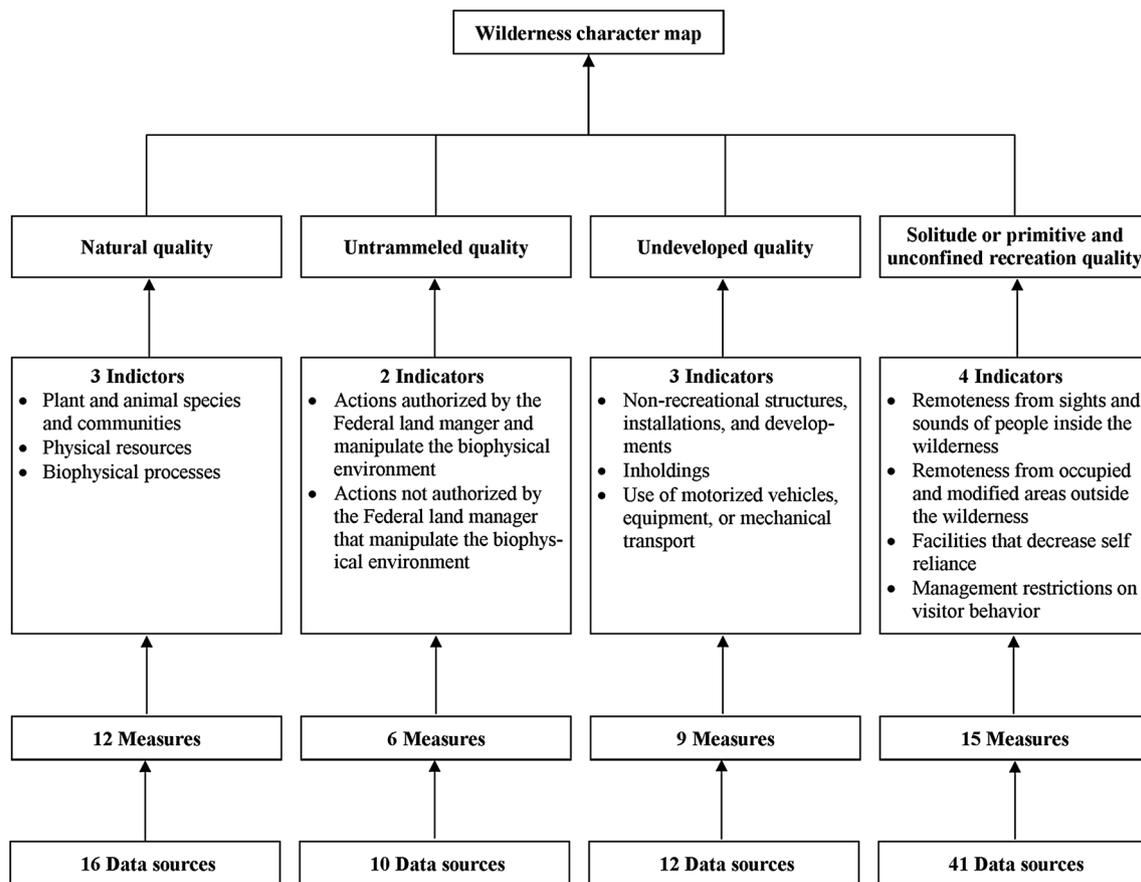
A total of 19 items about wilderness character were included in the survey. These were selected from a larger pool developed through pilot testing but reduced in an effort to limit the burden to the visitor by shortening the questionnaire. The full pool of items was developed to reflect the items identified through a wilderness character assessment at SEKI (Frenzel and Fauth 2014) initiated at about the same time as the visitor survey in 2011. Definitions of wilderness character for this assessment came from a variety of input, but not a visitor survey. Most prominent in selecting wilderness character indicators was a wilderness ranger survey and some interviews and a workshop with current and former park employees who had extensive experience in and with SEKI wilderness. The wilderness character assessment also incorporated public comments from scoping for two relatively recent wilderness planning efforts. The wilderness character assessment and eventually wilderness character mapping at SEKI wilderness “...do not portray in any way the symbolic, intangible, spiritual, or experiential values of wilderness character. In short, ... they do not describe the complexity, richness, or depth of wilderness character” (Tricker et al. 2014, p. 5). Therefore, it is acknowledged that those items selected by managers to reflect the wilderness character of this place may differ from how visitors perceive wilderness character.

While wilderness may have different meanings to different people, this assessment of wilderness character was based on the tangible elements found within the Wilderness Act. It follows the framework and terminology of the “Keeping it Wild” interagency wilderness character monitoring strategy (Landres et al. 2008). As such, it considers the distinctive attributes of SEKI that contribute to the following qualities:

1. Untrammeled
2. Natural
3. Undeveloped
4. Solitude or primitive and unconfined recreation
5. Other features

The indicators of wilderness character for mapping applications selected by managers at this wilderness are shown in Fig. 1. Measures were selected to reflect the indicators that managers thought best represented untrammeled character, natural character, undeveloped character, and solitude and primitive and unconfined recreation character. These represent a baseline indication of the wilderness character of this place at the current time.

Questionnaire items for the survey were selected in an effort to represent each of the four clearly identified dimensions of wilderness character, as well as to include some items from an original pool that were believed to possibly be unique to visitors to this park and wilderness.



**Fig. 1** Indicators selected by park management staff at Sequoia and Kings Canyon National Parks Wilderness for monitoring and mapping (Tricker et al. 2014)

The 19 items selected for the survey appear in Table 1 below. These items were selected to primarily reflect the general guidance provided to all managers proceeding through wilderness character assessments as described by Landres et al. 2008.

### Questions About Intervention and Restoration

There are many possible management interventions that could be of interest to park personnel and science investigation staff, but due to the length of the survey and interest in many other topics to managers there, only three intervention questions were asked (Table 2). A short list of potential restoration actions was also included for visitor evaluation (Table 3) for the same reason.

### Analysis Methods

Factor analysis of the wilderness character survey items was used to identify underlying constructs of visitor perceptions of wilderness character. The items to be factored in this analysis were designed to measure specific elements

of the framework, including the qualities of untrammed, natural, undeveloped, solitude or primitive and unconfined recreation, as well as other features.

The analysis of the SEKI wilderness character questionnaire items first required examining the response data for potential problems with using factor analysis. For example, not all respondents provided answers to each of the wilderness character questions. Missing responses for wilderness character items were estimated with the SAS missing values imputation procedure based on responses to the other items listed in Table 1. After applying the missing values estimation procedure, 16 cases remained unusable because of missing responses across all of the assigned value items. This approach has little influence on the estimate of the mean and standard deviation of the value items, although it does tend to lower the estimated standard deviations slightly because of increased sample size. The final sample size of 619 complete cases cross all 19 wilderness character items far exceeds the minimum recommended criterion of having at least 10 observations for every item included in a factor analysis (Hair et al. 2006).

**Table 1** Question 30. After visiting the Wilderness of Sequoia and Kings Canyon National Parks, how important do you believe each of the following characteristics is to defining this wilderness (things that should be protected in order to maintain its value to you)? Please circle one response for each description that best represents the importance you place on it

Item description (in order of presentation)
a. A place with no (or few) non-native plants
b. A place where human influences are relatively unnoticeable
c. A place with opportunity for unrestrained or unconfined recreation
d. A place with opportunity for off-trail travel and camping
e. A place without private inholdings
f. A place with little development for visitor use (e.g., trails, bridges, signs)
g. A place with little evidence of modern human occupation or modification (e.g., buildings, dams, mines, etc.)
h. A place without management actions that manipulate the environment
i. A place where I do not see or hear motorized or mechanized equipment
j. A place I can go with low density of people
k. A place where natural fires are not suppressed
l. A place where natural conditions, or forces, dominate
m. A place without fish stocking (native or non-native)
n. A place without non-native animals
o. A place with relatively clean air
p. A place where rivers and streams flow unimpeded
q. A place with pure water
r. A place with only natural sounds
s. A place with no (or few) restrictions on my behavior

Response scale was a 4-point scale where 1 not at all important; 2 slightly important; 3 moderately important; 4 very important

**Table 2** Please indicate how you would rate each of the following management interventions to mitigate climate change impact

Intervention technique
a. Introducing new genetic material more resistant to drought or disease
b. Moving plants or animals in anticipation of habitat change
c. Irrigating to compensate for changes in precipitation

Response scale was a 7-point scale where 1 strongly oppose; 4 neutral; 7 strongly support

The assumption of normality is important in factor analysis, particularly when applying statistical tests of significance to the factor results, and (more practically) because poorly distributed variables tend to behave poorly in model development. In examining normality in the distribution of responses across the value-rating opinion scales, kurtosis was generally not a problem in itself, but was associated with skewness—i.e., responses tended to

**Table 3** Please indicate how you would rate each of the following management interventions to restore natural conditions

Restoration technique
a. Removing non-native species to promote recovery of native species
b. Reintroduction of missing native species
c. Management-ignited fires

Response scale was a 7-point scale where 1 strongly oppose; 4 neutral; 7 strongly support

cluster at the ‘very important’ end of the scale but were not over-represented at the moderate mid-point. Items with extreme skewness, kurtosis, and high levels of agreement across responses violate the normality assumption. The skewness statistic, computed by a SAS descriptive analysis procedure, is generally considered severe if its absolute value exceeds 2.0. Of the 19 items, five had measures of skewness and kurtosis that indicated substantial departures from a normal distribution. Two of the items, 30o and 30q, were severely negatively skewed, thus indicating very high agreement among respondents about their importance to defining wilderness character [their mean responses were 3.88 and 3.82 (Table 4), respectively, on a 4-point scale].

The only transformation that would influence the distribution of these severely skewed items would be to dichotomize the variables into response categories of ‘very important’ and ‘all other responses.’ However, 91 % of the respondents felt that item 30o, “a place with relatively clean air” was very important, so even the most severe transformation could not correct that departure from normality. Because there was a wide range in the severity of departure from normality across the items and no one type of transformation would correct all of the distributions, we proceeded cautiously with the factor analysis using the original unmodified set of variables. Statistical measures within factor analysis were examined during the iterative process to determine if the severely skewed items were having undue influence on a factor solution. Items that lack normal variation in agreement tend to group together in factor solutions.

## Results

Table 4 presents a listing of all potential wilderness character attributes evaluated in the survey, ranked by mean value.

### Factor Analysis to Identify Underlying Dimensions

In examining the initial factor correlation matrix, multivariate normality was screened by assessing Cronbach

**Table 4** The importance respondents placed on each of the following characteristics in defining this wilderness<sup>a</sup>; items presented in descending order of mean importance

	<i>N</i>	Mean	95 % CI	Median	Mode	Skewness
Q30o A place with relatively clean air	616	3.88	3.85–3.92	4	4	−4.08
Q30q A place with pure water	614	3.82	3.78–3.86	4	4	−3.01
Q30i A place where I do not see or hear motorized or mechanized equipment	616	3.75	3.71–3.80	4	4	−2.63
Q30r A place with only natural sounds	616	3.75	3.71–3.80	4	4	−2.30
Q30j A place where I can go with a low density of people	617	3.70	3.66–3.75	4	4	−2.01
Q30p A place where rivers and streams flow unimpeded	617	3.69	3.64–3.74	4	4	−1.88
Q30b A place where human influences are relatively unnoticeable	618	3.65	3.60–3.70	4	4	−1.67
Q30l A place where natural conditions or forces dominate	616	3.63	3.58–3.68	4	4	−1.55
Q30d A place with opportunity for off-trail travel and camping	616	3.43	3.36–3.49	4	4	−1.26
Q30g A place with little evidence of modern human occupation or modification (e.g., buildings, dams, mines, etc.)	617	3.33	3.26–3.40	4	4	−1.17
Q30e A place without private inholdings	588	3.11	3.03–3.19	3	4	−0.82
Q30a A place with no or few non-native plants	611	2.77	2.69–2.85	3	3	−0.29
Q30h A place without management actions that manipulate the environment	604	2.76	2.68–2.84	3	3	−0.33
Q30k A place where natural fires are not suppressed	611	2.66	2.59–2.74	3	3	−0.24
Q30n A place without non-native animals	612	2.63	2.55–2.72	3	3	−0.15
Q30c A place with opportunity for unrestrained or unconfined recreation	595	2.53	2.44–2.63	3	3	−0.06
Q30s A place with no (or few) restrictions on my behavior	609	2.42	2.34–2.50	2	2	0.10
Q30f A place with little development for visitor use (e.g., trails, bridges, signs)	613	2.40	2.32–2.48	2	2	0.14
Q30m A place without fish stocking (native or non-native)	611	2.13	2.04–2.22	2	1	0.46

<sup>a</sup> Measured on a 4-point scale where 1 not at all important; 2 slightly important; 3 moderately important; 4 very important

alpha results with and without standardization. The set of wilderness character items was highly correlated overall, according to a Cronbach alpha measure of 0.80 (0.82 when standardized). These results showed little difference between original and standardized results (this is a positive indicator in support of multivariate normality).

Kaiser's measure of sampling adequacy (MSA), an index of multicollinearity, was also examined, and was found to be 'meritoriously' high for factor analysis (Hair et al. 2006), with an overall index of 0.83. The variable-specific measures of inter-item-correlation, as indicated by individual MSA scores were fairly high for most variables, exceeding 0.77. However, two items (30c and 30s) had low ('miserable,' according to Hair et al. 2006, p. 115), but still acceptable individual MSAs of 0.58. Based on the MSA criteria, the correlation matrix was acceptable for factoring and the analysis proceeded with all of the original wilderness character items.

A maximum likelihood method of extraction was used to identify factors based on their communalities (i.e., common factors were extracted rather than principal components). The common factor approach is more theoretically rigorous while the principal component approach is better at data reduction. Thus, the common factor approach was chosen because it better represented the goal of this study to assess underlying wilderness character

constructs. The initial maximum likelihood common factor extraction identified four factors based on their eigenvalues being greater than 1 and by examination of the scree plot of eigenvalues. However, several items in this initial solution demonstrated inappropriately low communalities with the extracted factors; Q30d, Q30f, and Q30h each had communalities of less than 0.2, indicating they were highly unique measures with less than 20 % of their variance shared with the underlying factors. Hair et al. 2006 suggest that while there are no statistical guidelines to identify high or low communalities, a very low communality indicates that a substantial amount of a variable's variance is not accounted for by the factor solution and that variable should be removed from the analysis. While higher cutoffs are commonly used to identify low communalities, we chose 0.2 as the lower cutoff in this analysis because many items had scores in the 0.2–0.4 range and just a few fell below that point.

The next modeling step was to use an iterative process to address the low communalities found among variables in the full factor model by removing items with low communalities one at a time until a satisfactory reduced factor model was identified. A total of three items were removed before all communalities exceeded 0.2. The number of factors to retain for this reduced set of variables was determined by examining scree plots and eigenvalues. Three

**Table 5** Standardized factor score coefficients and factor labels for wilderness character analysis, with orthogonal rotation

Item	Description	Factor 1 'Wild'	Factor 2 'Natural'	Factor 3 'Unconfined'
Q30r	A place with only natural sounds	0.36944	-0.10399	-0.01636
Q30i	A place where I do not see or hear motorized or mechanized equipment.	0.23629	-0.07271	-0.02351
Q30j	A place I can go with a low density of people.	0.1619	-0.02366	-0.00835
Q30q	A place with pure water.	0.13861	-0.02791	0.01445
Q30o	A place with relatively clean air.	0.13115	-0.02537	-0.00869
Q30b	A place where human influences are relatively unnoticeable.	0.10801	0.01493	-0.00913
Q30p	A place where rivers and streams flow unimpeded.	0.09697	0.06167	0.01224
Q30g	A place with little evidence of modern human occupation or modification (e.g. buildings, dams, mines, etc.).	0.07602	0.04515	-0.01204
Q30n	A place without non-native animals.	-0.08234	0.43326	-0.00024
Q30a	A place with no (or few) non-native plants.	-0.04944	0.26079	-0.01912
Q30m	A place without fish stocking (native or non-native).	-0.03348	0.18585	0.0127
Q30k	A place where natural fires are not suppressed.	-0.03815	0.15444	0.01964
Q30l	A place where natural conditions, or forces, dominate.	0.02922	0.10186	0.01507
Q30e	A place without private inholdings.	0.04105	0.07094	0.00523
Q30s	A place with no (or few) restrictions on my behavior.	0.02127	-0.05741	0.86316
Q30c	A place with opportunity for un-restrained or unconfined recreation.	-0.02901	0.04568	0.10442

Items removed from the analysis because of low communalities:

Q30d	A place with opportunity for off-trail travel and camping.
Q30f	A place with little development for visitor use (e.g. trails, bridges, signs).
Q30h	A place without management actions that manipulate the environment.

factors were retained in the final reduced model (the first four eigenvalues were 6.75, 6.07, 1.99, and 0.75). The MSA for the reduced model was a very good 0.82.

After examining an oblique rotation, a varimax orthogonal rotation was determined to provide a better solution by maximizing the separation between factors based on the standardized factor score coefficients. Table 5 shows the final results of the reduced model common factor analysis with orthogonal rotation. The grouping of items within the three factors is highlighted in Table 5 by varying colors to emphasize membership. Three items in the final solution had weak loadings on their primary factor along with similar loadings on a second factor. Thus, items Q30p, Q30g, and Q30e were poorly distinguished in this solution. The remaining 13 items formed three fairly distinct factor

groupings based on their factor score coefficients (Table 5).

**Description of Factors and Their Use in Further Analysis**

The factors that were identified in the modeling process are labeled in Table 5 by their factor number and by the wilderness character constructs that they were interpreted to measure. Items in the first factor most closely represent the wilderness character construct of “wild.” The items that formed the ‘wild’ factor included those that were identified in the analysis as having highly skewed distributions. These items were evaluated by respondents as being the most important aspects of SEKI wilderness

character that were included in the survey. The second and third factors included items that most closely represent the wilderness character constructs of ‘natural’ and ‘unconfined,’ respectively.

There are three general approaches to deriving measures of factor results to be used as descriptors of the underlying constructs and for additional analysis. The first approach is to use factor scores derived from the factor score coefficients listed in Table 5. This approach uses all of the information developed in the factor analysis to compute weighted composite factor scores for each respondent. The disadvantage of this approach is that each variable contributes in some way to all of the resulting composite factor scores. Thus, interpretation of results is more difficult because the underlying constructs are difficult to understand. The second approach is to create summated scales that represent the factors but use only the items that load high on each factor in the calculation. This approach can use either simple summated and averaged scores or a weighted average score based on factor score coefficients that correspond with the high loading items. This approach has the advantage of developing composite variables that are distinct for each underlying construct, and thus, are more

easily interpretable than factor scores. The disadvantage of this second approach is that it does not use all of the information derived from the factor analysis and thus does not strictly represent the underlying constructs that were derived empirically. The third option for deriving measures of the factors is to choose single items as surrogate measures for the underlying constructs. The surrogates are generally chosen from the top items in each factor based on their factor score coefficients. This approach is the simplest empirically and also may be the simplest to interpret. However, the surrogate approach uses the least amount of information from the original set of items to represent the complex underlying constructs.

Table 6 shows the measures of the factor results using all three approaches described above. For interpretation, all of the measures are calculated on the original scale of ‘1 not important’ to ‘4 very important.’ The measures derived using the first approach were calculated from adjusted standardized factor score coefficients. The summated scales derived from the second approach used a simple unweighted average. The surrogate variables for the third approach were chosen because they had the highest factor score coefficient for their respective factors: Q30r ‘Wild,’ Q30n ‘Natural,’ and Q30s ‘Unconfined’ (from Table 1). The resulting measures were similar across all three approaches.

**Table 6** Summary measures of factor analysis results of Sequoia and Kings Canyon National Parks wilderness character survey items. All scores represent means across the entire sample ( $n = 619$ ). Scores are measured on a scale from ‘1 not important’ to ‘4 very important’

Measurement method	Factor 1 ‘Wild’	Factor 2 ‘Natural’	Factor 2 ‘Unconfined’
Factor score	3.91	2.55	2.38
Summated scale	3.76	2.77	2.48
Surrogate variable	3.75	2.63	2.42

## Intervention and Restoration

There was little if any support for any of the potential intervention actions to mitigate climate change impacts explored with these visitors. Mean and median scores were between “Oppose” and “Slightly Oppose” (Table 7). For two of the three, the most common response was “Strongly Oppose.” For the other it was “Neutral.”

**Table 7** Opinions on management interventions to mitigate climate change impact

Intervention technique	<i>N</i>	Mean <sup>a</sup> (95 % CI)	Median	Mode
a. Introducing new genetic material more resistant to drought or disease	612	2.74 (2.61–2.87)	2	1
b. Moving plants or animals in anticipation of habitat change	612	2.99 (2.86–3.12)	3	4
c. Irrigate to compensate for changes in precipitation	613	2.60 (2.48–2.72)	2	1

<sup>a</sup> Scale of 1–7 where 1 strongly oppose, 4 neutral, and 7 strongly support

**Table 8** Opinions on management interventions to restore natural conditions

Restoration technique	<i>N</i>	Mean <sup>a</sup> (95 % CI)	Median	Mode
a. Removing non-native species to promote recovery of native species	615	5.57 (5.45–5.69)	6	7
b. Reintroduction of missing native species	618	5.73 (5.63–5.84)	6	7
c. Management-ignited fires	612	5.07 (4.95–5.19)	5	4

<sup>a</sup> Scale of 1–7 where 1 strongly oppose, 4 neutral, and 7 strongly support

Respondents showed mild to moderate support for management actions intended to restore natural conditions, though slightly less for management-ignited fires (Table 8). For the first two items, the most common response was “Strongly Support” followed by “Support.” For “management-ignited fires,” the most common response was neutral.

### Relating Wilderness Character Factors to Attitudes About Intervention and Restoration

The final step was to see if there was a connection between the wilderness character factors and attitudes toward intervention and restoration. Pearson correlation coefficients were calculated to determine if there were simple correlations between the factor-summed scales and intervention and restoration attitudes. Both imply management intervention but for different reasons. Results suggest a strong relationship between scores on the “natural” factor and these attitude measures. Respondents that scored high on the “natural” factor were significantly more likely to oppose the three intervention techniques to mitigate climate change listed in Table 7 (Pearson correlation coefficients between the “natural” factor and the three attitude measures ranged from  $-0.15$  to  $-0.23$ ,  $p < 0.001$ ). However, these same respondents that scored high on the “Natural” factor were significantly more likely to support the three interventions to restore natural conditions listed in Table 8 (Pearson correlation coefficients between  $0.19$  and  $0.39$ ,  $p < 0.001$ ). The other two wilderness character factors were not significantly correlated with the intervention and restoration attitudes.

### Discussion

These results, while complex in concept and analysis presentation, offer us several very straight forward conclusions worthy of discussion.

- (a) A development dimension did not emerge in the wilderness character analysis, although a single item was evident, and it was evaluated as very low importance to visitors

The “development” dimension failed to emerge based on visitor indications of importance of potential wilderness character elements at SEKI wilderness, though several items included were meant to represent this construct. The single item of “a place with little development for visitor use (e.g., trails, bridges, signs)” (Q30f) is thought to uniquely represent the development dimension. In the analysis of individual items, however, it was second from the least important to people, compared to the other

individual items. Other “development” measures failed to congeal into a single dimension or merge well with the dimensions that investigators were able to identify.

- (b) Wildness was the most important dimension in the wilderness character analysis

The Wildness dimension included several items related to a “clean environment,” or a place “free” of human impacts. Clean air and water and natural sounds dominated this dimension, but it also included low density of other people. “Natural sounds” was the item that loaded highest on this dimension, suggesting it could be a good surrogate for this concept, highly correlated with other items in this dimension.

- (c) A social dimension did not emerge in the wilderness character analysis

Visitors did not indicate a strong “solitude” or isolation dimension, but rather low density of people correlated most strongly with elements associated with the “wildness” dimension. Lack of people, clean air, clean water, and natural sounds are the strongest descriptors of wilderness character to these visitors. Visitors also seemed to put low emphasis on not having restrictions on behaviors and being engaged in unrestrained, unconfined recreation experiences. These items rated low, between slightly important and moderately important in visitor evaluations of the importance of these items to wilderness character at this place.

- (d) Clean air and water were the most important wilderness character attributes to these users

The majority of respondents to this survey (80 %) were from California, where the 2010 Census indicated over 95 % live in urban areas. The importance of being in a place with clean air and clean water, experiencing natural sounds and a low density of people combined to be very significant to them and they perceived these as very important determinants of wilderness character at this place. While threats to air and water are not commonly considered as indicators in wilderness character monitoring plans, for these visitors they were extremely important. Those who valued clean air and water also valued natural sounds without mechanized noises, low density of people, and lack of evidence of people. It sounds like their picture of wilderness is as far away as possible from their daily surroundings. Wilderness is defined by the extreme wildness conditions.

- (e) Attitudes toward intervention to mitigate climate change impacts were generally negative

There was little support for any of the potential intervention actions in wilderness to mitigate the effects of climate change. Average scores were between “Oppose”

and “Slightly Oppose.” For two of the three, the most common response was “Strongly Oppose.” What does this mean to managers? At least at SEKI, talk of intervention of these types would not be popular at this time. Time and increasing evidence of climate change impacts could influence these attitudes. Or information and education suggesting the importance of specific intervention actions could be influential in changing public opinion. But at this time, these options are unpopular with visitors. If these questions were posed to visitors in a way that not only suggested intervention, but with respect, and aimed at some specific outcome, support may change. But, then again, it may be that the important values placed on wilderness by these visitors are severely threatened by these interventions evaluated. They may never be acceptable actions within wilderness, and may even be seen as a threat to what is valued most.

- (f) Attitudes toward restoration or re-naturalizing were generally positive

Very high evaluations as both the mode and mean on attitudes toward restoration activities investigated suggest managers will find positive support among visitors for removing non-native species, assisting native species to recover, and igniting fires to restore the natural role of fire in these places. Since perceptions of wildness or unconfined recreation importance did not have a relationship to restoration actions, managers should be able to focus completely upon naturalness arguments in justifying decided upon restoration intervention activities and find positive public support.

- (g) Attitudes toward restoration and intervention to mitigate climate change influences were correlated to the level of importance visitors placed on the naturalness component of wilderness character

The finding that evaluations of the “naturalness” dimension of wilderness character correlated positively with restoration actions and negatively with intervention techniques to mitigate climate change influences is very important. The more a visitor values wilderness as a place without non-native flora and fauna and where natural forces are allowed to dominate, the more likely that visitor is to oppose human interventions to protect some set of specific attributes in this wilderness, in order to adapt to anticipated climate change. With a great deal of emphasis today on natural process and actions to support natural change, these attitudes may change over time, but for now, intervention to adapt to climate change appears to conflict with this perceived naturalness dimension of wilderness. Valuing naturalness, however, does predict support for restoration to correct the absence of key natural species, elimination of invasive plants, animals and fish, and

management-ignited fires to generally allow nature to regain its course.

## Conclusions

This research points out the value of understanding how wilderness visitors perceive wilderness character and how better understanding of the things visitors value most about a wilderness can help managers plan for interaction with the public on intervention or non-intervention strategies. A great deal of social science over the years would certainly predict that visitors would differentiate between the concepts of wildness and naturalness (Ridder 2007), and that low density of people as a surrogate for solitude is not the most important aspect of a wilderness experience (c.f., Watson 1995). This research points out well that this wilderness, in contrast to where most visitors live, is highly valued for clean air and water, natural sounds, low density of people, lack of motorized noise, and where evidence of human influence is relatively unnoticeable. People evaluate these items in similar patterns, suggesting a strong, single, underlying dimension.

Similarly, though not as important a determinant of wilderness character to visitors, naturalness can be described as a place without non-native plants and animals, no fish stocking, where natural fires are allowed to burn, and natural forces dominate. These items contrast well with the “wildness” elements as general wilderness character concepts and are all evaluated as less important than the “wildness” elements. This information highlights the complexity of the wilderness concept. While exclusive dependence on specific wording of the Wilderness Act to guide definition of wilderness and selection of indicators to map and monitor wilderness has been common, analysis of these visitors’ responses suggests wilderness is also a very different socially or individually constructed concept. Visitors are able to identify specific things that define or threaten the wilderness character of these places.

This research suggests the value of adding the social science element to future efforts to measure, monitor, or map wilderness character. To address this socially constructed aspect of wilderness, however, may imply new methods. First of all, visitors and other socially relevant groups would need to be included in deciding on the best indicators to use. Basic surveys of relevant populations should be integrated with wilderness character assessments. They have not been in the past. Second, recent advances in mapping of social values attached to the landscape may suggest alternatives to using points, lines, and polygons in representing wilderness character (Carver et al. 2009). Through fuzzy GIS methods, the meanings of specific landscapes to specific people can be described,

represented geovisually, and overlaid with biophysical parameters in a manner much more similar to the true relationships people have with these places. Third, methods designed specifically to understand perceptions of wilderness character as visitors move through different social landscapes could be really important. Integration of the variously defined and measured characteristics of wilderness character with spatially explicit methods is long overdue.

In the end, we should be mindful that such complex discussions about such intangible benefits as protecting lands for their natural or wild attributes, and debating legal versus societal (or biophysical versus human) definitions of wilderness will become more complex as climate and land use change advances and humans develop more tools and knowledge to help correct past mistakes. In many places in the world, as Watson et al. 2009 noted, the wilderness is still something to overcome and subdue. In the face of a changing environment, technology and land use policy, let us hope we never discount the importance of wilderness as a wild place, where we are free to witness the significance of the greater forces of nature.

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