Validation of a Forest Values Typology for Use in National Forest Planning

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ABSTRACT. Public values for national forestlands are assumed to underlie preferences for actual forest use and define the context for forest planning and decision making, but the relationship between preferences and attitudes toward forest management activities and public forest values (both use and nonuse values) is not well understood. Using data from a survey of Alaskan residents in the Chugach National Forest plan revision process, the relationship between attitudes toward forest management actions and forest values is examined using a variety of statistical procedures. Key findings indicate that: (1) survey respondents were able to identify with 13 distinct forest values based on a modified forest value typology developed by Rolston and Coufal (1991), (2) no obvious latent structure of variables or constructs emerged from factor analysis of the 13 forest values indicating that the forest value typology may not be easily simplified without compromising the exclusiveness of measured forest values, (3) small, but statistically significant correlations were found between attitudes toward specific forest management practices such as logging and mining and held forest values, and (4) forest values are modestly predictive of respondent preferences for specific forest planning decisions. For. Sci. 46(2):240–247.

Additional Key Words: Forest values, forest planning, value typology.

National forest management planning issues have usually been framed in terms of forest *uses*, especially commodity uses, rather than forest *values* (Rolston and Coufal 1991). However, what values a forest holds for people in the United States, both collectively and individually, lies at the heart of the debate over forest management. Conflict over forest management may actually reflect both individual and collective differences in held forest values. While values for forestlands and resources are assumed to underlie preferences for actual forest use, the relationship between preferences and attitudes[1] toward forest management activities and forest values (both use and nonuse values) is not well documented if understood.

In forest management, Rolston and Coufal suggest that attention to an expanded set of values is preferable to the traditional array of uses spelled out in the 1960 Multiple Use-Sustained Yield Act. For forest planners to actually utilize the concept of forest values as a tool in forest planning, two distinct problems must be addressed: (1) the scope and range of values must be identified (the *identification/classification* issue) and (2) the values must be rendered measurable and commensurable. Though not explicitly examined in this article, following the "theory of reasoned action" (Ajzen and Fishbein 1980), we presume that publicly held forest values are ultimately manifest in attitudes and preferences toward specific forest management outcomes and activities. However, the measurement of these forest value/attitude relationships may not be strong or direct as witnessed in other areas of social inquiry.

[1] The term "preferences" as used in this study refers to the set of choices made by study participants from among a number of potential forest allocation decisions (e.g., designating more, less, or an amount of "wilderness" equal to the current forest plan designation). These preferences are amalgams of participant attitudes and beliefs that are tied to *specific* forest plan allocations. In contrast, attitudes in this study are measured as *generalized* predispositions (favor vs. oppose) toward generalized forest management activities such as logging, mining, and fishing.

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Consistent with Rolston and Coufal's conclusion that forest values deserve attention, the Chugach National Forest (CNF) and Alaska Pacific University in early 1998 initiated a cooperative study of the values the CNF holds for residents of local communities. The results of the study are being incorporated into the CNF forest plan revision consistent with the 1969 National Environmental Policy Act and 1976 National Forest Management Act.

Conceptual Framework

Bengston and Xu (1995) defined forest values as relatively enduring conceptions of "the good" related to forests and forest ecosystems wherein "value" is an ideal or held value. A number of different classification systems for defining forest values have been developed in the past. For example, eight categories of social values provided by forests were identified in the Forest Ecosystem Management Assessment Team (FEMAT) report (FEMAT 1993). Rolston and Coufal identified ten categories of forest values, and Bengston and Xu opted for a four-category typology of forest values. Others developed comparable schema for general wildland and wilderness values. Henning (1987) identified 13 categories of wilderness values; Driver et al. (1987) distinguished 34 categories of wilderness benefits and values; and a number of other comprehensive lists have been described by McCloskey (1990), Hendee et al. (1990) and others [see, for example, Hendee and Martin (1994), Lime (1990), and Reed (1990.)] Of particular interest to this study are the Bengston and Xu and Rolston and Coufal value typologies because these provide the most recent conceptualizations of generalized forest values that describe the multiple values of forestlands.

The Bengston and Xu typology distinguished four ways in which people value forests and forest ecosystems: economic/utilitarian, life support, aesthetic, and moral/spiritual value. They identified these values as either *instrumental*—the good is equated with what is useful to some desirable human end—or *noninstrumental*—the worth of something is seen as an end in itself.

In justifying their four-part value typology for statistical content analysis, Bengston and Xu note that other value typologies suffer from not being mutually exclusive—a condition wherein forest values cannot be viewed as conceptually distinct. Their four-category typology does not include a number of important and obvious forest values such as recreation, biodiversity, and scientific values because they believe it is important to separate *values* from *objects of value*:

> Objects of value are the things that we care about or think are important; values are the ways in which we care about those things. Values are a conception of what is good about objects of value. Confusion between values and objects of value is common because the dividing line between these two concepts is subjective and dependent on how terms are defined (p. 6).

The act of distinguishing between what they term a "root" forest value, such as *life support*, and an object of value, such as *biological diversity*, therefore requires subjective judgment. Adding further to the challenge of developing an exhaustive, yet mutually exclusive, forest value typology is the inherent difficulty in separating the means and ends components of human value systems. In his classic work on values, Rokeach (1968) defines a value as an enduring belief that a specific mode of conduct or end state of existence is personally and socially preferable to alternative modes of conduct or end states of existence. Thus, he makes a distinction between *instrumental* values (means) and *terminal* values (ends). For example, a world at peace may be a basic terminal value, while honesty may be seen as an instrumental value. Values are organized hierarchically within an individual to achieve cognitive consistency. Continuing with the previous example, the achievement of world peace through dishonest action would be an example of potential value conflict that would depend on how the particular values in question are cognitively organized. Likewise, forest values may conflict depending on how individuals hierarchically structure their value system. For example, the belief that active management of forest vegetation (e.g., logging) is desirable (an instrumental value) may or may not conflict with the desired forest state of sustaining biological diversity (a terminal value). Our use of a finite, quantitative forest value rating system encourages study participants to make explicit their hierarchy of forest values.

Rolston and Coufal proposed expanding the five statutory multiple uses (recreation, timber, range, watershed, and fish and wildlife as per 1960 Multiple Use-Sustained Yield Act) governing national forest management into categories that would integrate human and biotic values. The resultant forest value typology consisted of ten values: life support, economic, scientific, recreation, aesthetic, wildlife, biotic diversity, natural history, spiritual, and intrinsic. While this is a useful conceptualization of forest values, the typology raises a number of important questions. For example, is this generalized list inclusive and exhaustive? Are the values mutually exclusive? How are these values related to actual forest use and nonuse? Would an understanding of publicly held forest values assist land managers in making forest allocation decisions?

The Bengston and Xu typology appears to be a subset of the Rolston and Coufal typology. The latter typology contains some values (e.g., recreation, wildlife, biotic diversity) that Bengston and Xu would likely consider objects of value and therefore not mutually exclusive to their four categories. While the Bengston and Xu forest values typology may be exhaustive and mutually exclusive, it may suffer from too few categories given the human predisposition to blur the distinction between values and the objects of values in forestlands. Thus, an expanded and more explicit typology offered by Rolston and Coufal, even if not mutually exclusive, may prove more useful in the actual measurement of forest values.

In their content analysis of national forest values, Bengston and Xu argue that values "play a critical role in identifying ecosystem management goals, setting the context for decision making, and guiding our choices" (p. 1). And yet, there have been few studies that directly address the measurement of

forest values as a guide to forest planning and decision making.

Using data from a survey of forest values collected from the general public during CNF plan revision process, this article attempts to help fill the research void in the measurement of forest values by: (1) examining how closely survey results support a modified Rolston and Coufal forest values typology and classification system; (2) describing the relationships between measured forest values and attitudes toward potential forest uses and forest policy preferences; and (3) determining whether knowledge of the public's held forest values is useful in predicting forest management preferences.

Methods

In March 1998, we conducted a mail survey of Alaskan residents using Dillman's (1978) total design method. Our sampling methodology consisted of randomly selecting individuals from households in 12 communities (Anchorage, Cooper Landing, Cordova, Girdwood, Hope/Sunrise, Kenai, Moose Pass, Seward, Soldotna, Sterling, Valdez, and Whittier) in close proximity to CNF under the assumption that households in these communities would have the greatest interest in forest planning issues. In addition, a statewide random sample of households was selected for inclusion in the study to compare with households in close proximity to the forest. The names of the communities, sampling rates, and response rates appear in Table 1.

The sampling frame used was a database produced by the State of Alaska of all individuals in Alaska who had applied to the state to receive a permanent fund dividend (PFD) from state oil revenues in 1997. The strength of this sampling frame is that it is reasonably comprehensive, and it includes most Alaskans who consider themselves permanent residents. For example, the 1996 U.S. Census Bureau population estimate for Alaska was 604,966 individuals, while the 1997 PFD application database contained names and addresses of 571,241 individuals. The PFD sampling frame has two major weaknesses: it includes Alaskan residents regardless of age (all Alaskan residents, including infants, are eligible to receive a PFD) and it underrepresents Alaskan residents who had lived in Alaska for less than a year (these individuals could not have applied for a PFD). From Census Bureau population estimates, approximately 30% of the questionnaire recipients were likely to be 17 years or younger, and thus nonresponse would be expected from a high percentage of these households even though the cover letter requested that someone else in the household complete the questionnaire if the named recipient was a child.

Table 1. List of communities sampled and the survey response rate.

Community	No. of 1997 PFD applicants[1]	Households sampled	Survey response rate (%)
Anchorage	194,140	281	29.7
Cooper Landing	329	148	43.9
Cordova	2,376	250	31.7
Girdwood	1,422	229	34.9
Hope	162	75	36.9
Kenai	10,118	265	27.4
Moose Pass	92	92	43.9
Seward	3,775	243	30.9
Soldotna	12,107	259	32.4
Sterling	2,488	239	36.4
Valdez	3,911	253	26.0
Whittier	237	113	22.5
Other Alaska	330,724	319	21.0

[1] PFD applicants are those individuals receiving Permanent Fund Dividends from state oil revenues in 1997.

Sampling was limited to one individual per household. An introductory letter announcing the intent of the survey was sent to each selected household prior to the actual mailing of the questionnaire with a cover letter. A followup reminder postcard was sent approximately 10 days after the questionnaire. The questionnaire and cover letter were accompanied by a USDA Forest Service-printed CNF map that recipients were to use to complete part of the questionnaire.

The questionnaire contained five sections: (1) questions about the familiarity and use of the CNF (number of times visited, level of subsistence use, employment relying on the Forest, and level of interest in the Forest's future); (2) questions that measure attitudes toward 19 potential forest uses such as "commercial logging," "sightseeing," and "subsistence hunting/fishing" on a 5 point Likert scale ranging from "Strongly Favor" to "Strongly Oppose"; (3) a series of eight policy questions specific to CNF forest plan revision such as how much logging, wilderness, "wild and scenic" river designation, and new roads should be included in the revised plan; [2] (4) a set of 13 forest values in which respondents were to express personal preferences by allocating a hypothetical amount of money ($100) among the value choices (discussed further below); and (5) selected demographic information including age, gender, level of education, occupation, and race.

The primary focus of this article is the section that requested survey participants to allocate a hypothetical $100 among 13 possible forest values. The specific instructions included in the questionnaire were as follows:

> The Chugach National Forest holds different values to different people. Some of these values are connected to direct use of the forest (such as for recreation). Some people value the Forest without setting foot on it (such as knowing that future generations will have the opportunity to enjoy it as it is now). Listed below are some of the best known values of national forests. We would like to know how important each of the following values of the Chugach National Forest is to you.
>
> *Imagine that you could "spend" $100 to insure that the Chugach National Forest keeps its existing values. You may allocate or spend the $100 in any way you like, but*

[2] An example of the wild and scenic rivers policy question is as follows: "Congress may designate rivers as 'wild and scenic' to preserve their outstandingly remarkable recreation, scenic, and geologic features, or to protect fisheries. Designation does not restrict current uses of rivers but it may restrict future development if development is incompatible with protection goals. In general, do you support the recommendation of wild and scenic rivers in the Chugach National Forest?" Respondent choices included "Do not support wild and scenic river designation under any conditions," "Support designation of a few rivers (5 or less) that are suitable." or "Support designation of all rivers that are suitable."

your total spending may not exceed $100. You might spend all $100 on one value (and $0 on all others) or you might spend $50 on one value, $25 on another value, and $25 on yet another value. Remember, the total dollars you spend should equal $100.

The initial list of forest values to be included in the questionnaire was based on the typology suggested by Rolston and Coufal. However, some changes were made to expand and clarify the typology. Two additional values—cultural and therapeutic value—as suggested by Rolston (1989) were added. Future value was also added to explicitly acknowledge bequest and option values for the forest that people may hold. The separate "wildlife" value proposed by Rolston and Coufal was dropped because it represents a clear object of value that we wished to avoid in the typology. Several other changes were made to the Rolston and Coufal value terminology, but the intent was to maintain the cognitive meaning—scientific value became learning value, natural history value became simply historic value, and life support value became life sustaining value. Finally, in deference to the importance of subsistence as a legal, social, and political concern to Alaskans, we added a thirteenth and final value: subsistence.

Each of the 13 forest values was accompanied by a short phrase to communicate the intended meaning of the value. Pretesting of the questionnaire resulted in some changes to the list of value names and explanatory phrases. The actual list of values and phrases used in the final questionnaire appears in Table 2. Pretest results indicated that all the forest values were selected by at least some of the respondents (and thus we were reluctant to drop any of the values), that few new values were suggested for inclusion (the one exception was "wilderness," which was mentioned by more than one individual), and that few individuals had difficulty grasping the value meanings.

Table 2. Forest value definitions used in the questionnaire.

Aesthetic value—I value the forest because I enjoy the forest scenery, sights, sounds, smells, etc.
Economic value—I value the forest because it provides timber, fisheries, minerals, or tourism opportunities such as outfitting and guiding.
Recreation value—I value the forest because it provides a place for my favorite outdoor recreation activities.
Life sustaining value—I value the forest because it helps produce, preserve, clean, and renew air, soil, and water.
Learning value—I value the forest because we can learn about the environment through scientific observation or experimentation.
Biological diversity value—I value the forest because it provides a variety of fish, wildlife, plant life, etc.
Spiritual value—I value the forest because it is a sacred, religious, or spiritually special place to me or because I feel reverence and respect for nature there.
Intrinsic value—I value the forest in and of itself for its existence, no matter what I or others think about the forest.
Historic value—I value the forest because it has places and things of natural and human history that matter to me, others, or the nation.
Future value—I value the forest because it allows future generations to know and experience the forest as it is now.
Subsistence value—I value the forest because it provides necessary food and supplies to sustain my life.
Therapeutic value—I value the forest because it makes me feel better, physically and/or mentally.
Cultural value—I value the forest because it is a place for me to continue and pass down the wisdom and knowledge, traditions, and way of life of my ancestors.

To explore the forest value data, we performed a series of statistical analyses. We first obtained basic descriptive statistics on the value data—the frequencies and mean values for the 13 forest values. Value frequencies and mean scores represent two different dimensions. The frequency with which a particular forest value was allocated some hypothetical dollar amount represents the ubiquity of that forest value in the minds of the respondents. The mean value score represents the relative importance of the held forest value to the individual.

Next, potential relationships between the forest values and various sociodemographic characteristics (gender, age, level of formal education, and ethnicity) were explored using either analysis of variance or chi-square tests to determine the significance of the relationships, if any.

In the third phase of data analysis, principal component factor analysis was performed on the value responses to determine whether latent constructs exist within the set of 13 forest values such that the forest value typology could be meaningfully reduced into a smaller set of variables. The goal of factor analysis is to represent relationships among sets of variables parsimoniously with a high degree of interpretability.

In the fourth analysis phase, relationships between the 13 forest values and attitudes toward forest uses such as logging and grazing and forest policy decisions such as wilderness designation were examined to determine whether forest values are predictive of respondent predisposition toward particular CNF forest planning decisions. Specifically, Pearson product moment correlations were computed between the 13 forest values and the 19 attitudinal questions about forest use.

Discriminant analysis was used to determine whether knowledge of forest values actually enhances the ability to predict a respondent's predisposition toward a specific forest policy issue. For example, does knowledge of an individual's held forest values help predict whether that individual would support the designation of all suitable wild and scenic rivers, a specific CNF forest policy question? Discriminant analysis is useful here because it allows one to determine which variables together most strongly distinguish or discriminate membership in a particular group where a "group" consists of those individuals that support a particular forest planning decision such as opposition to all wild and scenic river designation. In discriminant analysis, individuals are classified into a group based on discriminant scores derived from the discriminant function in which the posterior probability—the estimate of likely classification—is the largest. Discriminant analysis determines the linear combination of predictor variables (equations known as *discriminant functions*) that best classify cases into one of several known groups. The function coefficients produced by the equations are standardized in relation to one another with the size of the coefficients indicating their relative importance in distinguishing group membership.

Four key forest policy questions were selected for analysis—logging level, wilderness allocation, wild and scenic river designation, and amount of new road building—because these same issues are important to many national forest planning processes, not just those found in the CNF. The responses to each of the four policy questions were categorical, thus providing separate "groups" based on policy orientation. For example, the response categories to the question on wild and scenic river designation included, "Do not support wild and scenic river designation under any conditions," "Support designation of a few rivers (5 or less) that are suitable," and "Support designation of all rivers that are suitable."

The discriminant analysis was conducted under two different scenarios: (1) with only the 13 value variables included as independent or predictor variables; and (2) with the 13 value variables and 19 attitudinal variables on potential forest uses as predictor variables. All the independent variables were entered simultaneously to discriminate among the categories of the grouping variable.

Results

The overall survey response rate was 30.8% with variation in the response rate positively correlated with the study community's proximity to CNF.[3] For example, as expected, communities with the highest response rates were those located closest to CNF, while the lowest response rate came from the Alaska statewide sample. A nonresponse analysis indicated that no demographic variables were highly correlated with a predisposition to complete the questionnaire.

Frequency and Strength of Values

The four most frequently acknowledged forest values for CNF were *aesthetic*, *recreation*, *life sustaining*, and *biological diversity*, while the least mentioned forest values were *cultural*, *spiritual*, and *historic* (*see* Table 3). The most noteworthy differences in frequency ranking and mean score ranking occurred with responses on *economic* and *spiritual* values which ranked eighth and twelfth in frequency of response but third and eighth in mean scores respectively. These rank discrepancies suggest that these two forest values, while not as widely held as some other forest values, are somewhat intensely held forest values. Nonetheless, the top three most frequently selected forest values (*aesthetic*, *recreation*, and *life sustaining*) were also the forest values that were selected as most important. These findings were consistent across the 12 Alaskan communities and the statewide sample with several exceptions: Cordova, Hope/Sunrise, and Moose Pass residents rated subsistence as one of the most important forest values while Whittier residents believed economic value to be very important.

The following statistically significant relationships were found between forest value scores and demographic variables: (1) gender—*economic* and *recreation* values were valued higher by men while *aesthetic*, *life sustaining*, *learning*, *therapeutic*, and *future* values were valued higher by women (ANOVA, $P < 0.05$); (2) age—*economic* value was weakly, but significantly correlated ($r = 0.18$, $P < 0.01$) with increasing age; (3) education—there was a weak but statistically significant relationship ($r = -0.14$, $P < 0.01$) between level of education and *subsistence* value with higher subsistence value scores being associated with lower levels of formal education and there was a weak, but statistically significant, correlation between *learning* value and level of education ($r = 0.10$, $P < 0.01$); and (4) ethnicity—Alaska Natives recognized *subsistence* and *culture* values more than whites (ANOVA, $P < 0.05$), while whites identified *therapeutic* and *learning* values of the forest more (ANOVA, $P < 0.05$). The greatest difference between the two groups occurred on *subsistence* value scores. This statistically significant difference in subsistence value between whites and Native Americans cannot be explained by formal education as there was no significant difference in level of formal education between the two groups.

Latent Value Structure

Factor analysis was performed on the 13 forest values to determine whether the value set can be meaningfully reduced to a smaller value set through discovery of latent value constructs. Principal components analysis of the 13 values yielded results that appear in Table 4.

A number of criteria are available to determine the number of components to retain in the factor model. The simplest criterion retains only components whose eigen-

[3] The survey response rate appears lower than others have reported using the total design method in part because the second "wave" mailing containing the questionnaire and Chugach NF map was not implemented for budgetary reasons. Our previous experience indicates that another survey mailing could have increased response rate by up to 10%.

Table 3. Frequency and mean scores for the 13 forest values.

	Frequency count	Rank frequency	Rank mean score	Mean	SD
Aesthetic	641	1	4	16.14	11.54
Economic	386	8	3	16.60	14.41
Recreation	640	2	1	19.11	15.58
Life sustaining	627	3	2	17.62	13.70
Learning	386	9	11	8.65	5.21
Biological diversity	614	4	6	14.68	10.36
Spiritual	299	12	8	10.90	9.52
Intrinsic	365	10	9	10.55	10.15
Historic	311	11	13	8.35	8.91
Future	539	5	7	13.70	10.78
Subsistence	402	6	5	15.94	14.33
Therapeutic	398	7	10	10.24	7.42
Cultural	209	13	12	8.62	9.65

Table 4. Results of factor analysis using principal components to extract factors.

Factor	Eigenvalue	% of variance	Cum. % of variance
1	1.803	13.9	13.9
2	1.356	10.4	24.3
3	1.338	10.3	34.6
4	1.197	9.2	43.8
5	1.106	8.5	52.3
6	1.042	8.0	60.3
7	0.960	7.4	67.7
8	0.946	7.3	75.0
9	0.888	6.8	81.8
10	0.837	6.4	88.3
11	0.813	6.3	94.6
12	0.696	5.4	99.9
13	0.011	0.1	100

values are greater than 1. Application of this criterion resulted in the retention of six components explaining about 60% of the variance. Various rotations of the resulting six-factor model yielded inconsistent results and factor loadings that were not logical.

The scree test criterion developed by Cattell (1966) plots the eigenvalues to look for kinks or elbows in the plot that indicate redundant components. While not included here, the scree plot based on the eigenvalues in Table 4 does not indicate redundant components. The eigenvalues decrease gradually incorporating roughly equal proportions of variance. No clear breakpoint and thus no simplification and potential reduction in the number of forest values is apparent with this criterion.

These results are consistent with a third criterion that examines the underlying correlation matrix. The presence of latent factors should be indicated by *groupings* of relatively high correlation coefficients. The corresponding correlation matrix does not contain a single correlation > 0.3 and only about 6% of the matrix correlations exceed –0.2. The Kaiser-Meyer-Olkin (KMO) statistic is a measure that compares the magnitudes of the observed correlation coefficients to the magnitude of partial correlation coefficients. Small values for the KMO statistic indicate that factor analysis may not be appropriate since correlations between pairs of values cannot be explained by other variables. The KMO statistic for the 13 forest values is 0.02. Kaiser (1974) characterizes values below 0.5 as unacceptable for factor analysis. Thus, the 13 forest values appear to be relatively distinct variables with no obvious latent structure.

Value and Forest Use Relationship

Correlations between the 13 forest value scores and 19 attitudinal forest use items indicated a number of statistically significant relationships. Higher *economic* value ratings were associated with more positive attitudes toward commercial logging ($r = 0.45$, $P < 0.01$), commercial mining ($r = 0.47$, $P < 0.01$), oil and gas drilling ($r = 0.40$, $P < 0.01$), commercial outfitting/guiding ($r = 0.26$, $P < 0.01$), commercial tourism ($r = 0.22$, $P < 0.01$), motorized recreation ($r = 0.22$, $P < 0.01$), using the forest for communication sites and utility easements ($r = 0.24$, $P < 0.01$), and negative attitudes toward wilderness designation ($r = 0.38$, $P < 0.01$) and nonmotorized recreation ($r = 0.20$, $P < 0.01$). Higher *recreation* value ratings were associated with positive attitudes toward sport hunting ($r = 0.25$, $P < 0.01$), motorized recreation ($r = 0.22$, $P < 0.01$), and sport fishing ($r = 0.18$, $P < 0.01$). A favorable attitude toward wilderness designation was associated with higher *spiritual* values ($r = 0.22$, $P < 0.01$), higher *learning* values ($r = 0.19$, $P < 0.01$), and higher *intrinsic* values ($r = 0.16$ $P < 0.01$). Higher *intrinsic* values were associated with negative attitudes toward commercial mining ($r = 0.19$, $P < 0.01$) and logging ($r = 0.18$, $P < 0.01$) and positive attitudes toward sport hunting ($r = 0.18$, $P < 0.01$). Higher *therapeutic* values were associated with negative attitudes toward motorized recreation ($r = 0.18$, $P < 0.01$), sport hunting ($r = 0.18$, $P < 0.01$), oil/gas drilling ($r = 0.14$, $P < 0.01$), and sport fishing ($r = 0.13$, $P < 0.01$).

Forest Policy Orientation

The results of the two discriminant analyses with two sets of predictor variables are presented in Tables 5 and 6. The discriminant analyses that include only the 13 forest values as predictor values indicate that knowledge of one's forest values is modestly predictive of one's forest policy orientation. Summary classification results indicate that knowledge of forest values improves classification from what would be expected by random chance. For example, on wild and scenic rivers designation, the resulting discriminant function correctly classified 60.3% of the respondents into one of three respondent groups where the three groups represent a particular policy preference: in this case, no new wild and scenic rivers designated, a few rivers (five or less), or all suitable rivers designated. Without prior knowledge of policy preferences, one would expect to correctly classify an individual by chance only 33.3% of the time.

With respect to wilderness designation (see Table 6), the resulting discriminant function using the value variables correctly classified 45.8% of the respondents into one of four response categories ranging from no additional wilderness designation to designating more than 1.7 million ac, the current forest plan allocation. This is an improvement over the 25% classification success rate that would be expected by random chance. Thus, in both the designation of wild and scenic rivers, and the designation of wilderness areas, knowledge of the respondent's held forest values modestly improves the classification and thus predictive power of those who are likely to support or oppose allocation of forest areas for legal protection.

On the other two policy issues examined, the amount of timber harvest and amount of new road building, the overall classification results based on the discriminant functions were similar to those for wild and scenic river designation and wilderness allocation.

The summary discriminant results in Tables 5 and 6 indicate that the overall predictive accuracy of the discriminant function increases with the inclusion of the 19 attitude variables from the questionnaire. As expected, specific attitudinal questions that are directly related to the policy issue in question greatly enhance the discriminatory power of the resulting functions (see "Most Important

Table 5. Results of discriminant analysis for wild and scenic river designation and new road building using two sets of predictor variables.

	Designation of wild and scenic rivers		New road building	
Policy issue	Values (n = 780)	Attitudes and values (n = 678)	Values (n = 782)	Attitudes and values (n = 679)
Number of variables	13	32	13	32
Eigenvalue (primary function)	0.32	0.75	0.26	0.63
Percent of variation (primary function)	94.8%	91.2%	86.7%	87.1%
Classification by probability	33.3%	33.3%	33.3%	33.3%
Percent of grouped cases correctly classified	60.3%	67.7%	62.5%	72.2%
Most important predictors[1]	Life sustaining Intrinsic Spiritual Future	Wilderness (attitude) Life sustaining Spiritual Future	Life sustaining Economic Biological diversity Future	Oil/gas drilling (attitude) Motorized recreation (attitude) Sightseeing (attitude) Future Biological diversity
Most important value predictor[2]	Life sustaining	Life sustaining and spiritual (equal)	Life sustaining	Future

[1] Variables with the highest standardized coefficients in the primary discriminant func tion associated with each analysis listed in rank order from the highest coefficient.
[2] Value variable with the highest standardized coefficient.

Predictors" category in Tables 5 and 6). Attitudes toward wilderness designation are among the strongest predictors of preference for wild and scenic river designation. Attitudes toward oil/gas drilling and motorized recreation are among the strongest predictors of road building preferences. Attitude toward commercial logging is the strongest predictor of timber harvest level preference and attitude toward wilderness is the strongest predictor of wilderness allocation preference.

Discussion

In 1976, Congress declared that, on public lands, consideration ought to be given to the relative "values" and not necessarily to the "uses" that provide the greatest economic return (Federal Land Policy and Management Act of 1976, P.L. 94-579). Until the present, most research on forest values has focused on identifying and conceptualizing forest values rather than attempting to operationalize and measure

Table 6. Results of discriminant analysis for wilderness designation and timber harvesting using two sets of predictor variables.

	Wilderness designation		Timber harvesting	
Policy issue	Values (n = 770)	Attitudes and values (n = 672)	Values (n = 734)	Attitudes and values (n = 636)
Number of variables	13	32	13	32
Eigenvalue (primary function)	0.34	0.92	0.39	1.08
Percent of variation (primary function)	88.8%	84.7%	80.2%	79.2%
Classification by probability	25%	25%	20%	20%
Percent of grouped cases correctly classified	45.8%	57.1%	41.8%	56.5%
Most important predictors[1]	Future Spiritual Life sustaining Learning Economic	Wilderness (attitude) Sport hunting (attitude) Subsistence (attitude) Commercial logging (attitude)	Economic Future Life sustaining Aesthetic	Commercial logging (attitude) Economic Nonmotorized recreation (attitude) Motorized recreation (attitude)
Most important value predictor[2]	Future and spiritual (equal)	Future	Economic	Economic

[1] Variables with the highest standardized coefficients in the primary discriminant function associated with each analysis listed in rank order from the highest coefficient.
[2] Value variable(s) with the highest standardized coefficient.

them. But if land management agencies are to actually consider "values" and not just "uses" of the land in the planning process, reliable methods of values measurement need to be developed and tested.

The results of this study suggest that a forest values typology can be operationalized to measure the relative importance of different forest values held by members of the general public. Our analysis of the values data lead us to the following conclusions about the forest values typology.

Validity of Forest Values Typology

All forest values are interwoven to some degree. For example, a grove of trees can provide both spiritual and aesthetic values to an individual. But despite the interweaving, the 13 forest values measured in this study appear to represent identifiable, if not circumscribed, value domains—they resist grouping into higher order factors. We would be reluctant to drop any of the forest values from the typology without additional testing. Even the least frequently selected forest value—"cultural" value—was selected by approximately 25% of the respondents. Replication of the forest values survey typology in a variety of regional forest settings would be beneficial to better establish the degree of internal and external validity associated with the measure.

Recognition of Abstract Forest Values

Not only were *all the values* selected by respondents but *noncommodity* values such as aesthetic, life sustaining, and biological diversity on average were deemed more important to the respondents in terms of both frequency selected and mean sum (see Table 3). While this result may be specific to the CNF, it does indicate that individuals are capable of recognizing and stating preferences among abstract forest values, a finding that is not necessarily intuitive given the strong historical emphasis on forest uses rather than abstract forest values.

Values Logically Correlated with Uses and Issues

While some correlations between values and a use or issue were not statistically significant, a fair number were. This reveals or confirms in several instances that forest values, uses, and policy issue positions are logically—even predictably—connected. Thus, there is good reason to believe that better knowledge of forest values may lead to more defensible, if not acceptable, forest plan activities.

An important question for future research is to determine whether the forest values typology developed and tested for the CNF process can be applied to both broader and more restricted ranges of forest settings and contexts. We believe it can and look forward to further validation of the methodology.

Literature Cited

AJZEN, I., AND M. FISHBEIN. 1980. Understanding attitudes and predicting social behavior. Prentice-Hall, Englewood Cliffs, NJ. 278 p.

BENGSTON, D.N., AND Z. XU. 1995. Changing national forest values: A content analysis. USDA For. Serv. Gen. Tech. Rep. NC-323. 29 p.

CATTELL, R.B. 1966. Handbook of multivariate experimental psychology. Rand McNally, Chicago, IL. 959 p.

DILLMAN, D.A. 1978. Mail and telephone surveys. Wiley, New York. 325 p.

DRIVER, B.L., R. NASH, AND G. HAAS. 1987. Wilderness benefits: A state of knowledge review. P. 294–319 *in* Proc. of conf. on National wilderness research: Issues, state-of-knowledge, future directions, Lucas, R.C. (ed.). USDA For. Serv. Gen. Tech. Rep. INT-220.

FEMAT. 1993. Forest ecosystem management: An ecological, economic and social assessment: Report of the Forest Ecosystem Management Assessment Team, July 1993. U.S. Gov. Print. Off., Washington, DC.

HENDEE, J., AND V. MARTIN, EDS. 1994. International wilderness allocation, management, and research. *In* Proc. of the 5th World Wilderness Congress. Internat. Wilderness Leadership Found., Fort Collins, CO. 334 p.

HENDEE, J.C., G.H. STANKEY, AND R.C. LUCAS. 1990. Wilderness Management, 2nd Ed. Internat. Wilderness Leadership Found., Fort Collins, CO. 546 p.

HENNING, D.H. 1987. Wilderness politics: Public participation and values. Environ. Manage. 11:283–293.

KAISER, H.F. 1974. An index of factorial simplicity. Psychometrika 39:31–36.

LIME, D., ED. 1990. Managing America's wilderness resource. Proc. of the Conf., Univ. of Minn., St. Paul, MN. 706 p.

MCCLOSKEY, M. 1990. Evolving perspectives on wilderness values: Putting wilderness values in order. P. 13–18 *in* Proc. of conf. on Preparing to manage wilderness in the 21st Century, Reed, P. (ed.). USDA For. Serv. Gen. Tech. Rep. SE-66. 173 p.

REED, P., ED. 1990. Proc. of conf. on Preparing to manage wilderness in the 21st Century, Reed, P. (ed.). USDA For. Serv. Gen. Tech. Rep. SE-66. 173 p.

ROKEACH, M. 1968. Beliefs, attitudes, and values: A theory of organization and change. Jossey-Bass, San Francisco, CA. 214 p.

ROLSTON, H. 1989. Philosophy gone wild. Prometheus Books, Buffalo, NY. 269 p.

ROLSTON, H., AND J. COUFAL. 1991. A forest ethic and multivalue forest management. J. For. 89:35–40.