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Human dimensions of biodiversity conservation in the Interior forests of British Columbia

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Abstract

Generally, studies on biodiversity conservation have focused on topics within the natural sciences, such as species and ecosystem concerns. However, an understanding of the human dimensions of biodiversity conservation is lacking. To address this gap, a study was undertaken in the Robson Valley in east-central British Columbia in 2001 to document stakeholders' understanding and perceptions of biodiversity issues, examine potential trade-offs associated with conservation, and provide decision makers with insight concerning the acceptability of potential forest management scenarios. A mail survey was used to collect data from residents of British Columbia and two groups of recreationists. Results show that stakeholders are diverse in their perceptions and knowledge related to biodiversity conservation. A choice experiment was used to examine trade-offs inherent in conserving biodiversity at the landscape level. The choice model showed that respondents preferred options that emphasized biodiversity conservation, and that Robson Valley residents had different preferences than the respondents in the other subsamples. Several potential forest management scenarios were simulated using the choice model results. The potential for future research, and ideas for improving the model, are discussed.

KEYWORDS: *forest management, biological diversity, biodiversity, conservation, human dimensions, social science, stakeholder perception, choice experiment, British Columbia.*

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Introduction

Canada's commitment to the conservation of biological diversity (biodiversity) has been made clear through the United Nations Convention on Biological Diversity, the Canadian Biodiversity Strategy, and the *Species at Risk Act*. The Canadian Council of Forest Ministers has included the conservation of biological diversity as one of several criteria for achieving sustainable forest management in Canada (Canadian Council Forest Ministers 2000). In British Columbia, the Forest Practices Code was established to help promote the conservation of biodiversity (B.C. Ministry of Forests 1995). The Forest Practices Code specifies operational requirements for harvest planning, silviculture, road construction, and associated forestry activities for Crown lands outside protected areas, settlement lands, and lands zoned for agricultural production (Fenger 1996). Conservation of biodiversity within these lands is based on ecological principles, and biodiversity objectives are set at a landscape level. Consistent with the Forest Practices Code, the Robson Valley Enhanced Forest Management Pilot Project (EFMPP)[1] based its forest management objectives on the concept of "whole forest design and management" (Robson Valley Enhanced Forest Management Pilot Project 2001a). In the Robson Valley one particular concern is conserving old-growth forests and their associated biodiversity.

Most biodiversity research has focused on the natural sciences through the development of species recovery plans, ecosystem restoration programs, monitoring programs, and species inventories. However, understanding the human dimensions of biodiversity conservation is necessary for successful implementation of conservation plans and activities. Managing for biodiversity may require society to make choices between forest preservation, industrial uses (e.g., forestry, and oil and gas development), and non-timber uses (e.g., recreational access and wilderness), and these choices may involve trade-offs between these uses of the forest. Information is lacking from the biodiversity-related research about the public's acceptance of these trade-offs and the benefits of the trade-offs. Information is also lacking about the effects of trade-offs on resource-dependent communities and on Canadian society as a whole.

Studies were initiated under the EFMPP to examine the biological and ecological aspects of biodiversity (e.g., caribou conservation). To complement these physical science efforts, this study was conducted in 2001 to investigate some of the social science aspects of conserving biodiversity in the Robson Valley. Specifically, the objectives were to:

- Document stakeholders' knowledge of biodiversity issues, perceived threats to biodiversity conservation, and perceived effectiveness of potential conservation methods, as well as document who stakeholders believe should be responsible for biodiversity conservation.
- Examine potential trade-offs associated with biodiversity conservation.
- Provide policy and decision makers with insight into the social acceptability of preliminary forest management scenarios developed for the Robson Valley Community Advisory Group, in conjunction with the EFMPP.

After providing some background information, we describe the selection of the survey sample and the design of the questionnaire. This is followed by a description of the choice experiment design and analysis, and an explanation of how the trade-offs determined by the choice experiment can be applied as part of an existing forest management process (scenario planning) within the EFMPP. The results section describes respondents' knowledge of biodiversity conservation and the issues surrounding it, perceived threats to biodiversity, perceived effectiveness of methods to conserve biodiversity, and perceptions about who is responsible for conservation. The results section also describes the choice experiment modelling effort and the implications of the rankings of attributes for forest management scenario planning. A discussion of the study, including suggestions for future work, concludes the paper.

Background

Human Dimensions of Biodiversity Conservation

Managing for biodiversity conservation requires an understanding of the ecological and social systems that affect the forest and an understanding of how they are

[1] The EFMPP is a co-operative effort between government, the forest industry, and the academic community. Its goal is to establish new, or to enhance existing, forest management processes or tools by utilizing the expertise and experience of other EFMPP sites, model forests, academia, and researchers. For further background, refer to *http://www.for.gov.bc.ca/hcp/enhanced/robson/efmpp/index.htm*

integrated. The understanding of the ecological system derives from scientific facts about ecosystems, species, and their interactions. It is the social system, however, that largely determines which of these facts have relevance and how biodiversity goals will be achieved. Thus, to achieve biodiversity objectives it is imperative to identify relevant stakeholder groups and their forest management preferences, and to assess how these groups might be affected by conservation objectives.

Traditionally, professional foresters, and other experts in provincial governments and the forest industry, have been the dominant stakeholders in forest management. More recently, however, a shift has occurred to incorporate input from other stakeholders including both users and non-users of the forest (Beckley *et al.* 1999). Public involvement often entails different groups (e.g., chambers of commerce, environmental organizations, labor unions, and scientists) arguing about which objectives have priority. Biodiversity objectives, for example, may compete with other landscape-level objectives such as timber production and recreational access. Disagreements about these competing interests are usually resolved through public input processes. Ensuring that the public's involvement is effective largely depends on including a cross-section of interested groups. In the case of Crown land, every citizen is entitled to a voice in forest management. Thus, including the concerns of a broad range of citizens will help legitimize the public involvement process of the EFMPP. Existing mechanisms for involving the public, such as open houses and community advisory groups, can be complemented by the use of survey research. Survey research can reach a broad public relatively inexpensively and the results provide a means of comparing relevant populations.

Effective public involvement requires that citizens make informed decisions. Focus groups in Alberta (Parkins *et al.* 1999) and Ontario (Parkins *et al.* 2000) as well as studies elsewhere (Turner-Erfort 1997; Spash and Hanley 1995) suggest that the public is not well informed about biodiversity and its complexity, nor about issues related to its conservation. This can have implications for managers in achieving certain biodiversity objectives because the amount and type of information that individuals have regarding natural resource issues may influence their attitudes towards biodiversity issues, forest management preferences, and acceptable trade-offs. Although the effects of knowledge on attitudes are not conclusively known, some studies suggest a link exists between knowledge and attitudes toward natural resource management. For example, Bright and Manfredo (1997) found that exposure to information affected the strength of attitudes toward old-growth forests; Cable *et al.* (1987) found that interpretive messages about forest management had a positive effect on visitor attitudes about forest management in Canada; and McFarlane and Boxall (2003) found that as knowledge related to forest management increased, the Alberta public had less-favourable views about the sustainability of forest management.

In addition to understanding the amount and type of information individuals have about biodiversity and related issues, it is necessary to understand the importance (i.e., the relevance to day-to-day lives) of biodiversity to the public, the public's perceptions of potential threats to biodiversity, the public's preferred methods for biodiversity conservation, and who the public believes should be responsible for biodiversity conservation. All of these factors can potentially influence individuals' preferences for forest management and the trade-offs they may be willing to accept in order to achieve biodiversity conservation. These factors can also help forest managers and provincial government agencies determine the information needs of stakeholders.

> *The design of a choice experiment allows the researcher to show how trade-offs between each of the attributes are made.*

Trade-Offs in Biodiversity Conservation

Management of a forested region for biodiversity conservation involves making a number of choices concerning the activities that will be allowed within the region, and these choices will often involve trade-offs between different activities. For example, creation of protected areas will normally lead to the exclusion of resource extraction activities, such as forestry, from these areas and may influence the type of recreational opportunities available. Determining which trade-offs are involved in a given conservation strategy, and how the various stakeholders will respond to them, is important for gaining the public's acceptance of any particular conservation plan. Biodiversity conservation does not fall into the category of market goods; that is, it is not something that is normally bought and sold. However, it may have market implications; for example, a reduction in forestry may result in lower tax revenue for the government.

A number of research methods can be used to obtain information about non-market goods. The two main categories are: revealed preference, where actual behavior is measured, and stated preference, where people are asked about the situation of interest. Revealed preference methods cannot measure passive values (i.e., non-use), whereas stated preference methods can determine valuation for both use and non-use values. As well, in a policy or management situation, it may be of interest to determine how people would respond to proposed changes. A revealed preference method can place a value on how people use the forest at present, but can say nothing about how they might use the forest for a situation that does not currently exist. Stated preference methods can capture the valuation of hypothetical future changes.

Of the stated preference methods, contingent valuation (where people are asked for their willingness to pay to achieve a single desired future), contingent ranking and rating (rank ordering or rating a list of future outcomes), and choice experiments are the most commonly used. The choice experiment format is the most amenable to studies of this type (Bennett and Blamey 2001) and, thus, was used in our study.

Choice Experiments

The advantages of the choice experiment framework over other stated preference methods include allowing pertinent attributes of an overall situation to be valued separately, and allowing the researcher to propose multiple situations outside the existing reality.

The design of a choice experiment—which includes specific variations in the levels of the attributes between choice tasks—allows the researcher to show how trade-offs between each of the attributes are made. The selection of pertinent attributes, which requires careful consideration and consultation, is perhaps the most critical element in designing the choice experiment. This is necessary to ensure that the chosen attributes are actually important to the public and to ensure that the levels chosen are realistic.

Within a choice experiment respondents are presented with a set of tasks that involve choice (choice tasks). For each choice task, they are requested to choose a preference from a group of options. It is important to give respondents an "opt-out" choice. In the case of environmental management changes, the usual opt-out is the current situation or the status quo (Figure 1). It is also common to include some sort of payment method, such as an increase in taxes or a contribution to a voluntary fund. The use of a monetary attribute contributes to making the exercise more relevant to respondents and constrains the amount of conservation they desire by their disposable budget. This valuation can subsequently be used in a benefit/cost analysis, though in many cases it is used only as a common denominator for the evaluation of acceptable trade-offs.

Methods

Sample Selection

Two samples of recreationists were obtained from on-site surveys: snowmobilers in the Robson Valley and backcountry hikers in Mount Robson Provincial Park. Those completing an on-site survey were asked if they would be willing to participate in a follow-up mail survey. Also, a sample of the general public in British Columbia was obtained by telephone solicitation; of these, residents of the Robson Valley and Prince George areas were oversampled to ensure an adequate subsample size. The mail survey sample consisted of 510 snowmobilers, 138 hikers, and 1052 British Columbia residents.

The mail survey was sent to participants in December 2001. A reminder postcard was sent two weeks later, and about six weeks after the first mailing a second copy of the survey was sent to those who had not yet responded. After making an adjustment for undeliverable surveys, a response rate of 61% was achieved.

The respondents were divided into subsamples to allow a comparison of stakeholders. The recreationists were comprised mostly of Alberta residents, which allowed for the creation of two subsamples: Alberta snowmobilers and Alberta hikers. Residents of British Columbia were divided into three subsamples: Robson Valley, Prince George, and other British Columbia residents.

Survey Design

The survey consisted of three sections. The first section used several measures to determine the level of knowledge

Please remember to consider all attributes when choosing between options.

Scenario 1 Version 1

Attributes of the Forest Region	Option 1 Current Situation	Option 2	Option 3
Protected Areas	**14% of total region**	**5% of total region**	**25% of total region**
Age of Stands	**Mainly mature**	**Even-aged**	**Mainly young**
Recreation Access	**4WD**	**2WD**	**FOOT**
Biodiversity Levels (% area in each level)	45% Low, 45% Medium, 10% High	30% Low, 50% Medium, 20% High	50% Low, 30% Medium, 20% High
Change in Taxes	**No change (stay at current)**	**No change (stay at current)**	**$20 increase/year /household**
Preferred option: (Check one box)	❑	❑	❑

FIGURE 1. Choice experiment task.

among stakeholders: familiarity with the term biodiversity, importance of biodiversity issues, self-rated level of knowledge of biodiversity issues, and true or false questions related to biodiversity issues in British Columbia—including items related to endangered species, forest management, biodiversity of different regions, and laws about protected areas. It also included questions related to perceptions of threats to biodiversity in British Columbia, who should be responsible for biodiversity conservation, and the effectiveness of methods to conserve biodiversity.

The second section consisted of a choice experiment for the analysis of trade-offs associated with biodiversity conservation and the valuation of some aspects of biodiversity. This section included a two-page, pull-out description of the attributes and attribute levels.

The final section collected demographic information about such things as the respondent's age, household income, and membership in recreation and conservation organizations. Also, space was provided for comments about forest management or biodiversity in Interior British Columbia.

Choice Experiment Design

In designing the choice experiment, we selected the attributes and their levels (Table 1) in consultation with B.C. Ministry of Forests staff and by consulting the Forest Practices Code of British Columbia's *Biodiversity Guidebook* (B.C. Ministry of Forests and B.C. Ministry of Environment 1995). These sources revealed the attributes that are currently considered by foresters in forest management planning. The relevance of these attributes was confirmed in a recent study (Shapansky 2001), which found that some of the same attributes were important to the public in Saskatchewan. The selected attributes and levels were tested for relevance with two undergraduate classes at the University of Alberta. A more comprehensive description of the attribute selection process can be found in Watson *et al.* (2002).

The final step in the choice experiment design was to develop the set of choice tasks that would be presented to respondents. To ensure that a model could be estimated from the responses, the attribute level combinations had to be determined using statistical criteria. We employed an orthogonal main effects design using

TABLE 1. Choice experiment attributes and levels

Attribute	Levels	Description
Protected area	1	5% of the total region
	2	15% of the total region
	3	25% of the total region
Age of stands	1	Young (40% young, 60% middle-aged, 0% old and mature)
	2	Middle-aged (20% young, 50% middle-aged, 30% old and mature)
	3	Old and mature (10% young, 10% middle-aged, 80% old and mature)
Recreation access	1	Foot
	2	Four-wheel drive (4WD/ATV)
	3	Two-wheel drive (2WD)
High biodiversity emphasis	1	5% of the managed area
	2	10% of the managed area
	3	15% of the managed area
Low biodiversity emphasis	1	30% of the managed area
	2	45% of the managed area
	3	60% of the managed area
Change in taxes	1	$10 decrease/household/year
	2	No change
	3	$15 increase/household/year

SAS/QC software (SAS Institute Inc. 2002). The final design resulted in four versions of the survey with seven tasks in each. An example of the choice tasks presented to respondents is shown in Figure 1.

Choice Experiment Analysis

Haener *et al.* (2001) provide a very good, basic description of choice experiments, which is summarized below. The use of choice experiments to elicit preferences is supported by random utility theory. Random utility theory suggests that an individual will select the option that provides them with the greatest utility. Therefore, the probability of selecting an alternative increases as the utility associated with it increases. The utility that an individual derives from an alternative is considered to be associated with the attributes of the alternative.

The resulting utility function has a deterministic component (V) and an unobservable or stochastic component (ε):

$$U = V + \varepsilon \quad (1)$$

where

V is the indirect utility function in which the attributes are arguments.

Therefore, V can be characterized as

$$V_i = \beta_k X_i \quad (2)$$

where

X is a vector of *k* attributes associated with alternative *i*, and

β is a coefficient vector.

If the distribution of the stochastic component or error terms is characterized as IID Gumbel, McFadden (1974) shows that the conditional probability of selecting alternative *i* is

$$\text{Prob}(i) = \frac{\exp(\mu\beta_k X_i)}{\sum_{j\in C}\exp(\mu\beta_k X_j)} \quad (3)$$

where

μ is a scale parameter, and

C is the choice set.

This is known as the conditional logit model. When a single set of data is used to estimate a model, μ is confounded with the parameter vector and cannot be identified. The normal practice is to set the scale parameter to a value of one. If, however, the goal is to compare a subset of the data with the whole sample, the scale parameter is used and tested with a likelihood ratio test. This test used the log likelihood (LL) calculated for each model estimation:

$$L = -2[\text{Joint LL} - (\text{subset A LL} + \text{subset B LL})] \quad (4)$$

The test parameter is then used in a chi-square test. If it is found greater than the critical value (degrees of freedom is attributes minus one), then the hypothesis that the parameters are the same in the two cases is rejected.

Responses to the choice experiment provide the discrete dependent variable which, when combined with the designed attribute matrix, can be used to estimate a conditional logit model. In the model, attributes with qualitative levels, such as recreation access, are coded using effects codes.[2]

Trade-offs among attributes can be shown by calculating marginal values.[3] Marginal values consist of the amount of income that would be given up or provided to obtain an increase or decrease in some other attribute.

Forest Management Scenarios

As part of a planning exercise for the Enhanced Forest Management Pilot Project, the Robson Valley Community Advisory Group had several forest management scenarios developed for them (Robson Valley Enhanced Forest Management Pilot Project 2001b) for the purpose of providing insight concerning the effects of altering management priorities. The scenarios helped us illustrate how the estimation of benefits using the choice experiment can supplement existing planning exercises. We used some of the preliminary scenario descriptions and made assumptions about the resultant changes to the levels of the attributes in the choice experiment. The assumptions about the attribute changes are for illustrative purposes and would probably require further refinement to reflect more accurately the implications of the scenarios.

- The *first scenario* proposed enhanced *silvicultural activities*. These activities included "reforesting with genetically superior trees, fertilizing specific stands of timber, . . . and employing partial harvesting systems in community watersheds, sensitive recreation sites, and areas with outstanding visual beauty." It was assumed that this scenario would affect at least two attributes in the choice model: protected areas and tax levels. We assumed that the amount of protected area would increase by 5% because less area would be needed for forestry. We also assumed that forestry revenues would increase in the long-run, which would allow for a decrease in provincial tax levels by $10 per household.
- The *second scenario* proposed additional efforts to *preserve and enhance biodiversity*. "The intent of this scenario is to ensure that ecological integrity and function is [*sic*] maintained across the landscape while providing for human needs." It was assumed that the amount of area managed for high biodiversity emphasis would increase by 5% and the amount managed for low biodiversity emphasis would decline by 5%.
- The *third scenario* emphasized *tourism and recreation values*. "Emphasis under this scenario will be placed on the development of appropriate and managed access . . . " It was also suggested that forest management practices would be adapted to make them more complimentary to recreation and tourism. It was assumed that recreational access would change from four-wheel drive/all-terrain vehicle to two-wheel drive in most areas and that an additional 5% of land intended for harvesting would be set aside as protected areas.

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2 In effects coding one of the levels is assigned as the base, and dummy variables are created for the other two levels. For example, with Access Level 1 as the base, the dummy for Access Level 2 would be a column where Level 1 is assigned a value of -1, Level 2 is assigned the value of 1, and Level 3 is assigned a value of 0. The Level 3 dummy is -1, 0, 1. Effects coding is the convention in stated preference models (Adamowicz *et al.* 1994) and has the benefit of allowing information on the base level to be calculated as the negative sum of the coefficients of the other two levels.

3 Following common practice, marginal values were calculated in monetary terms. The cost coefficient was assumed to be a reasonable estimate of the marginal utility of money. For the continuous variables, the coefficients of the attribute of interest were divided by the negative of cost coefficient. For effects coded attributes, the marginal value was calculated by using the difference in coefficients at two levels (i.e., coefficient for the ending level minus coefficient for the starting level), to show the effect of moving between the two levels.

- The *fourth scenario* proposed *greater emphasis on resource extraction*. Timber, and other renewable resources not currently marketed commercially, could be harvested on forested lands that would otherwise be set aside for protection. With the additional forestry revenue, it was assumed that this scenario would cause taxes to decrease by $10 per household, protected areas to decline by 5%, and the proportion of young stands to increase.
- The *combination of the second and third scenarios* (preserve and enhance biodiversity plus emphasize tourism and recreation) was also examined. In this case, it was assumed that the recreational access would change from four-wheel drive/all-terrain vehicle to two-wheel drive in most areas and the biodiversity emphasis would change as in the second scenario. Unlike the third (tourism) scenario, we assumed no increase in protected area because added protection would result from the increased biodiversity emphasis.

Results

Knowledge of Biodiversity

When asked to rate their level of familiarity with the term biodiversity on a four-point scale ranging from completely unfamiliar to completely familiar, the group of subsamples showed a wide range of familiarity with the term biodiversity, with the snowmobilers showing the least awareness. About two thirds of snowmobilers were completely unfamiliar with the term (Table 2). The hikers showed the highest familiarity, with 22% being completely familiar, and 52% being somewhat familiar. For British Columbia residents, the three subsamples were quite similar in their familiarity with the term biodiversity, with 41 to 47% being somewhat familiar and approximately 20% being somewhat unfamiliar.

Only those respondents indicating at least some familiarity with the term biodiversity were asked if they had heard the term biodiversity or talked about biodiversity in the previous six months. Biodiversity was most familiar to the hikers, with 82% having heard about it and 57% having talked about it (Table 3). Robson Valley residents were the next most likely to be aware of biodiversity, with 72% having heard about it and 58% having talked about it. The snowmobilers were the least aware of the term, with only 45% having heard the term and only 30% having talked about it.

When respondents were asked how well informed they considered themselves to be concerning biodiversity issues in British Columbia, snowmobilers and hikers said they were the least informed, with 29% and 25%, respectively, rating themselves as not at all informed (Table 4). However, of the respondents that considered themselves somewhat informed, the hikers displayed the highest percentage (63%) followed closely by all the British Columbia resident groups (55 to 58%). A significant number of Robson Valley residents considered themselves very well informed (12%), whereas < 10% of any other group considered themselves very well informed.

When respondents were presented with a series of 11 true or false questions related to biodiversity issues in British Columbia, none of the subsamples achieved more than 50% correct; this suggests that knowledge of biodiversity issues is not high. Regarding knowledge of biodiversity issues, the results for the three subsamples of British Columbia residents were nearly identical, with a mean of about 5.4 (Table 4). The results for both groups of Alberta recreationists were lower and significantly different from those of the British Columbia subsamples, with the snowmobilers being the least knowledgeable. A large number of respondents answered "unsure" to several questions. The unsure responses ranged from 7% (all subsamples combined) for "there are no old-growth forests in B.C." to a high of 79% for "the Canadian Endangered Species Act was enacted in 1999." On all but one item, the Alberta subsamples were more likely to answer unsure than British Columbia residents. The one exception was the question concerning the Endangered Species Act—hikers had the most certainty about the correct response, but still 72% of them were unsure. The higher number of unsure responses among the Albertans may reflect the provincial focus of the questions. Albertans, however, were also less sure on questions that were not specific to British Columbia such as "most threatened or endangered forest species are mammals."

Perceived Threats to Biodiversity

Respondents were presented with a list of 15 possible long-term threats to forest biodiversity, and asked to rate them on a four-point scale ranging from not a threat at all to a great threat. They were also given the option of stating that they had no opinion. The 15 statements were later categorized into threats from forest management, other industries, natural disturbance, and other threats. All of the items listed were considered to be at least somewhat of a threat by all of the subsamples (Table 5). The item perceived as the greatest threat by all British Columbia residents was

TABLE 2. Familiarity with the term "biodiversity"

Level of familiarity	B.C. residents			Alberta recreationists	
	Robson Valley (%)[a]	Prince George (%)[a]	Other (%)[a]	Snowmobilers (%)[a]	Hikers (%)[a]
Completely unfamiliar	14.0	22.1	17.2	34.5	7.4
Somewhat unfamiliar	20.0	22.6	21.8	31.1	18.5
Somewhat familiar	47.0	41.3	44.1	31.9	51.9
Completely familiar	19.0	13.9	16.9	2.5	22.2

[a] % of survey respondents.

TABLE 3. Familiarity of the term "biodiversity" to respondents[a]

Statement	B.C. residents[a]			Alberta recreationists	
	Robson Valley (%)[b]	Prince George (%)[b]	Other (%)[b]	Snowmobilers (%)[b]	Hikers (%)[b]
Have heard the term "biodiversity" in the last 6 months	72.0	67.2	67.3	45.4	82.4
Have talked about "biodiversity" in the last 6 months	58.2	41.8	41.6	30.5	57.1

[a] Respondents answering completely unfamiliar in Table 4 are excluded from the analysis.

[b] % of survey respondents.

TABLE 4. Knowledge of biodiversity issues

Knowledge measure	B.C. residents			Alberta recreationists	
	Robson Valley (%)[a]	Prince George (%)[a]	Other (%)[a]	Snowmobilers (%)[a]	Hikers (%)[a]
Self-rated level					
Not at all informed	13.2	17.2	13.4	29.3	25.0
Somewhat not informed	13.2	18.2	19.8	29.8	7.1
Somewhat informed	58.4	55.2	56.9	38.0	62.5
Very well informed	11.7	7.4	7.5	2.1	3.6
Not sure	3.6	2.0	2.4	0.8	1.8
True or false questions					
Mean score	5.3	5.4	5.4	4.1	4.8

[a] % of survey respondents.

TABLE 5. Perceived threats to forest biodiversity

Perceived threat[a]	B.C. residents: Robson Valley[b] (mean, SD)	n	B.C. residents: Prince George[b] (mean, SD)	n	B.C. residents: Other[b] (mean, SD)	n	Alberta recreationists: Snowmobilers[b] (mean, SD)	n	Alberta recreationists: Hikers[b] (mean, SD)	n
Forest management										
The amount of trees being logged	2.7 a (0.9)	204	2.9 a (0.8)	205	3.2 bc (0.8)	263	3.2 b (0.7)	241	3.6 c (0.6)	55
The methods used to log trees (logging practices)	2.6 a (0.9)	203	2.7 ab (0.8)	205	3.0 c (0.8)	256	2.9 bc (0.8)	229	3.4 d (0.7)	53
The amount of forested land in the province allocated for timber harvesting	2.3 a (0.9)	196	2.6 ab (0.8)	196	2.8 b (0.9)	243	2.8 b (0.8)	211	3.3 c (0.7)	53
Genetic modification of tree species	2.6 ab (1.0)	156	2.6 ab (0.9)	162	2.7 b (0.9)	199	2.4 a (0.9)	174	3.0 b (0.8)	41
Loss of old-growth forests	2.7 c (1.0)	200	2.9 a (0.9)	203	3.1 b (0.9)	254	3.0 ab (0.8)	221	3.7 d (0.5)	55
Other industries										
Loss of forest land for agriculture	2.6 a (1.0)	198	2.7 a (0.9)	205	2.8 ab (0.9)	258	2.8 a (0.8)	236	3.2 b (0.8)	55
Grazing of forest lands	2.1 a (0.8)	197	2.2 a (0.8)	191	2.3 a (0.8)	244	2.3 a (0.8)	228	2.8 b (0.6)	51
Mining	2.4 a (0.9)	198	2.5 ab (0.8)	199	2.8 c (0.8)	248	2.7 bc (0.8)	226	3.2 d (0.7)	51
Oil and gas exploration and pipelines	2.6 a (0.9)	194	2.6 ab (0.8)	200	2.8 b (0.8)	246	2.7 ab (0.8)	237	3.2 c (0.6)	53
Natural disturbance										
Forest fires	2.4 ab (1.0)	201	2.5 ab (1.1)	209	2.6 bc (1.0)	264	2.8 c (1.0)	240	2.2 a (1.0)	56
Insects and diseases	3.3 a (0.8)	202	3.4 a (0.8)	208	3.3 a (0.8)	264	3.0 b (0.8)	232	3.0 b (0.8)	54
Other threats										
Climate change or global warming	2.9 ab (0.9)	193	3.1 b (0.8)	204	3.1 b (0.8)	260	2.8 a (0.9)	226	3.0 a (0.7)	54
Loss of forest land for urbanization (i.e. housing development)	2.9 a (1.0)	202	2.9 a (0.8)	206	3.2 bc (0.8)	265	3.0 ab (0.8)	240	3.4 c (0.8)	56
The amount of recreation use occurring in the forest	2.2 a (0.8)	200	2.1 a (0.8)	205	2.7 ab (0.7)	260	1.9 c (0.8)	243	2.6 b (0.6)	56
Big game hunting	2.0 a (0.9)	201	2.1 ab (0.9)	205	2.4 c (0.9)	258	1.9 a (0.8)	236	2.4 bc (0.8)	55

[a] Rated on a scale of 1 to 4. 1 = not a threat at all. 4 = a great threat. Respondents choosing a "no opinion" category were omitted from the analysis.

[b] Any two means in a given row that do not share a letter are significantly different ($p < 0.05$) according to Tukey's highly significant difference test.

"insects and diseases" with about 84% of all British Columbia residents rating this as somewhat of a threat or a great threat. In terms of forest-management-related threats, "the amount of trees being logged" and "the loss of old-growth forests" were rated as somewhat of a threat or as a great threat by a majority of all British Columbia resident groups. However, Robson Valley residents perceived all of the forest management activities as less of a threat than the other groups. "Climate change" and "conversion of land to urban use" were perceived by Robson Valley residents as more threatening than forest management or other industrial activities. Activities that were not perceived as threatening by a majority of British Columbia residents were "grazing on forested lands," recreational use, and hunting.

The Robson Valley and the Prince George residents were very similar in their responses, with no significant difference for 13 of the 15 threats (Table 5). However, significant differences occurred in how some of the subsamples perceived many of the threats. The hikers appeared to perceive threats differently than the other groups. Hikers tended to view all of the anthropogenic changes to the forest as more threatening than the other groups. Hikers rated three of the forest management items (logging practices, timber allocation, and loss of old growth) and three other industrial uses of the forest (grazing, mining, and "oil and gas exploration") as significantly more of a threat. In two other instances, a subsample was significantly different than all the other groups; the snowmobilers rated recreational use as much less of a threat, and the Robson Valley residents rated the loss of old-growth forests as much less of a threat.

Methods for Conserving Biodiversity

The perceived effectiveness of potential methods to maintain or enhance biodiversity was measured on a four-point scale ranging from not at all effective to completely effective. Respondents were given the option of answering not sure. Only two methods of conserving biodiversity were rated as very or completely effective by a majority of all groups: "educating the public and industry," and "encouraging industry to use eco-friendly practices" (Table 6). Methods related to restrictions and regulations on industry ("limiting commercial development and restricting visitor numbers in protected areas," and "more restrictive regulations and legislation for industry") and methods related to "increasing the amount of protected area" were rated as somewhat effective or very effective by a majority of the groups. Snowmobilers were the least supportive of increasing protected areas and closing roads to restrict access in some wilderness areas. A majority of hikers rated all methods as very or completely effective.

Who Should Be Responsible?

Respondents were presented with a list of groups who could be considered responsible for biodiversity conservation. In each subsample, most respondents (69 to 79%) believed that the provincial government should have a lead role in biodiversity conservation (Table 7). A majority of the respondents in each subsample ranked industry and the federal government as second or third for a lead role. The Robson Valley and snowmobiler subsamples had similar opinions about environmental non-government organizations, but the hikers had a very different opinion. Environmental non-government groups received the highest percentage of responses in the "no role at all" category from each subsample except the hikers. For example, 23% of Robson Valley residents felt that environmental non-government organizations should have no role at all, compared to only 2% of hikers. More Robson Valley residents and snowmobilers felt the federal government should have no role at all in conserving biodiversity than respondents in the other subsamples.

Discrete Choice Experiment

In the choice experiment, a relatively large proportion of respondents (18%) chose the status quo or current targets option for all seven tasks. As well, 9% of respondents did not complete any of the choice tasks, and a further 2% either did not respond to at least one of the tasks or, if they made a choice, chose the status quo. This high level of preference for the status quo is not unusual in choice experiments (Bennett and Blamey 2001).

Respondents that chose the status quo for all tasks were excluded from the choice model. Responses from the remaining 692 respondents (a total of 4844 choice tasks) were used in the model estimation. We estimated a standard conditional logit model using all attributes in the experimental design. Two of the attributes were effects coded; thus, the model estimation included only two of the three levels of these attributes.

The model results are shown in Table 8. The only parameter that was not significant is recreation access at the four-wheel drive/all-terrain vehicle level (Level 2). The "current targets" option was positive and significant. Thus, despite removing respondents who chose only the current targets option for all tasks,

TABLE 6. Rating of methods to maintain or enhance biodiversity

Method	Rating	B.C. residents			Alberta recreationists	
		Robson Valley (%)[a]	Prince George (%)[a]	Other (%)[a]	Snowmobilers (%)[a]	Hikers (%)[a]
Increasing the amount of protected area such as provincial parks and ecological reserves	Not at all effective	23.4	12.7	8.3	16.6	0.0
	Somewhat effective	38.3	40.0	28.8	49.4	28.6
	Very effective	24.4	36.6	46.2	21.2	41.1
	Completely effective	11.9	7.8	15.2	10.8	28.6
	Not sure	2.0	2.9	1.5	2.1	1.8
Encourage industry to use more eco-friendly practices	Not at all effective	5.5	1.5	3.4	1.2	5.4
	Somewhat effective	34.5	31.6	34.3	19.8	32.1
	Very effective	47.0	54.4	42.6	53.5	46.4
	Completely effective	12.0	12.1	18.1	23.9	16.1
	Not sure	1.0	0.5	1.5	1.6	0.0
Close roads so that access is restricted in some wilderness areas	Not at all effective	29.0	19.0	16.3	29.2	0.0
	Somewhat effective	44.0	38.1	42.2	45.4	33.9
	Very effective	20.0	30.0	28.9	16.3	48.2
	Completely effective	6.0	10.5	11.0	5.4	16.1
	Not sure	1.0	2.4	1.5	3.8	1.8
Limit commercial development and restrict visitor numbers in protected areas	Not at all effective	16.4	9.1	4.5	16.6	1.8
	Somewhat effective	43.8	38.3	33.3	43.2	19.6
	Very effective	27.4	36.4	47.3	27.0	55.4
	Completely effective	9.0	12.9	13.6	9.1	23.2
	Not sure	3.5	3.3	1.1	4.1	0.0
Establish more restrictive regulations and legislation for industrial use of the forest	Not at all effective	22.1	14.0	8.3	7.8	7.1
	Somewhat effective	39.2	39.1	29.2	33.7	16.1
	Very effective	28.6	29.5	38.3	37.4	41.1
	Completely effective	9.0	15.9	20.8	16.5	35.7
	Not sure	1.0	1.4	3.4	4.5	0.0
Educating the public and industry about biodiversity issues	Not at all effective	5.1	2.4	1.9	4.1	3.6
	Somewhat effective	25.8	18.8	22.6	21.4	17.9
	Very effective	39.9	49.5	41.4	40.3	41.1
	Completely effective	25.8	27.9	33.5	32.9	37.5
	Not sure	3.5	1.4	0.8	1.2	0.0

[a] % of survey respondents.

TABLE 7. Responsibility for maintaining or enhancing biodiversity

Group	Responsibility level	B.C. residents			Alberta recreationists	
		Robson Valley (%)[a]	Prince George (%)[a]	Other (%)[a]	Snowmobilers (%)[a]	Hikers (%)[a]
Individuals	Leading role	21.4	20.5	24.1	24.8	29.1
	Some role	72.6	73.7	72.0	68.6	67.3
	No role	6.0	5.9	3.8	6.6	3.6
Industry	Leading role	59.1	67.9	63.7	60.9	64.2
	Some role	38.9	31.1	34.0	37.4	30.2
	No role	2.0	1.0	2.3	1.6	5.7
Municipal government	Leading role	39.7	40.6	43.3	55.2	47.3
	Some role	53.8	50.7	49.8	41.8	49.1
	No role	6.5	8.7	6.8	2.9	3.6
Provincial government	Leading role	68.5	79.4	78.1	75.9	78.6
	Some role	31.0	19.6	20.8	22.8	21.4
	No role	0.5	1.0	1.1	1.2	0.0
Federal government	Leading role	49.3	62.5	66.0	53.3	57.1
	Some role	35.3	29.8	30.2	30.6	41.1
	No role	15.4	7.7	3.8	16.1	1.8
Non-government environmental groups	Leading role	22.9	32.1	41.2	20.4	49.1
	Some role	53.7	53.1	51.4	60.8	49.1
	No role	23.4	14.8	7.4	18.8	1.8

[a] % of survey respondents.

change from the status quo was still negative for many respondents. Cost was negative, which is what the random utility theory would suggest. The negative coefficient on the cost attribute is intuitively correct because people do not wish to pay more for the same amount of a good. The positive parameter for protected areas and the shift from a negative to a positive parameter when changing from low biodiversity to high biodiversity emphasis suggests that biodiversity protection was viewed positively by respondents. An indicator for the value of wilderness is shown in the recreation access attribute, where only the most primitive form of access (i.e., by foot) was positive. An interesting form of preference is shown in the stand age attribute, where predominantly young forests were negative, but the middle-aged level was preferred over the oldest. The old and mature level was positive, but the parameter was less than the intermediate middle-aged level.

Given that the residents of the Robson Valley are affected more directly by forest management changes within the valley than the other subsamples, a subsample model was estimated for these respondents (Table 8). The Robson Valley subsample was significantly different from the rest of the sample in a likelihood ratio test (chi square of 62.2, where the critical value at the 5% level for 8 degrees of freedom is 15.51).

The models in Table 8 show a difference in the significance of the attributes.[4] The Robson Valley subsample considered increased protected area to be

TABLE 8. Parameter estimates for the conditional logit models

Attribute[a]	Whole sample		Robson Valley residents	
	Parameter	*t*-statistic [b]	Parameter	*t*-statistic [b]
Current targets dummy	0.4953	10.128*	0.6490	5.569*
Cost ($'00)	-0.5478	-2.531*	-1.7501	-3.171*
Protected area (X/100)	3.9593	13.133*	1.0294	1.552
Biodiversity				
Low (X/100)	-1.7871	-8.236*	-1.5677	-3.684*
High (X/100)	4.0595	6.541*	1.1718	0.940
Recreation access				
Level 1 (2WD)	-0.0730		0.1705	
Level 2 (4WD/ATV)	-0.0165	-1.028	-0.0451	-0.602
Level 3 (foot)	0.0895	2.596*	-0.1254	-1.642
Stand age				
Level 1 (young)	-0.5289		-0.5362	
Level 2 (middle-aged)	0.3396	9.822*	0.2762	3.785*
Level 3 (old and mature)	0.1893	5.231*	0.2600	3.650*
Log likelihood	-4705.0		-897.63	
Rho-squared	0.115		0.11	

[a] Prior to modelling, the monetary attribute, the protected area attribute, and the two biodiversity emphasis attributes were divided by 100 (percent) because maximum likelihood estimation is more efficient if the values of the attributes are between 0 and 1.

[b] No *t*-statistic exists for the base level of the two effects coded attributes (recreation access - Level 1, and stand age - Level 1) given that they were not part of the initial model calculation. Their coefficients are calculated later as the negative sum of the other two levels of the attributes.

* Significant at $p < 0.05$.

positive, an increase in the amount of area of low biodiversity emphasis to be negative, and an increase in the amount of high biodiversity emphasis to be positive. However, only the low biodiversity emphasis variable was significant. Thus, on average, the Robson Valley residents were less concerned about biodiversity conservation than the whole sample. None of the recreational access attributes were significant, but the two stand age attributes were both significant. As with the whole sample model, the current targets attribute was positive and significant.

Marginal Value of Attribute Changes

The marginal values of attribute changes for two similar logit values can be compared because the confounding effect of the scale parameter is eliminated. Marginal values are presented in Table 9 and represent the benefit or utility (in monetary units or dollars) associated with the level of each attribute, thereby holding levels of the other attributes constant.

A change from a predominantly young forest to a more even-aged class mix (middle-aged) shows a marginal

[4] It should be noted that when comparing two independently estimated logit models, the magnitude of the coefficient values from the models cannot be directly compared. This is due to the confounding of the scale parameter and the parameter estimates in the logit model. However, the direction of significance, the pattern in changes in coefficient values as the attribute levels change, and the differences between the Robson Valley residents and the whole sample can be compared.

TABLE 9. Marginal values[a] of attribute changes for conditional logit models

Attribute change	Robson Valley residents ($)	Whole sample ($)
Middle-aged to old and mature	-0.93	-27.44
Young to middle-aged	46.42	158.54
4WD/ATV to foot access	-4.59	19.35
2WD to 4WD/ATV access	-12.32	10.31
High biodiversity areas (% of forest)	0.67	7.41
Low biodiversity areas (% of forest)	-0.90	-3.26
Protected areas (% of forest)	0.59	7.23
Current targets	37.08	90.42

[a] In determining the marginal monetary values, the attributes of recreation access, current targets, and stand age were multiplied by 100 to re-adjust to equal values with the protected area and biodiversity emphasis attributes.

value of $158.54 per household for the whole sample (Table 9), but a subsequent move from the middle-aged to the old and mature level results in a loss of $27.44 per household. For the Robson Valley residents, the changes result in marginal values of much lower magnitude (young to middle-aged, $46.42; middle-aged to old and mature, $-0.93). Each change to a more primitive form of recreation access results in positive marginal values for the whole sample, but negative values for the Robson Valley respondents suggest the residents prefer motorized access. For both samples, increasing the amount of landscape managed for low biodiversity emphasis results in a loss in value for each percent of the region shifted to this forest management option, whereas each percent increase in forest managed for high biodiversity emphasis results in a gain in value. However, the two samples differ in the magnitude of the resulting values. Increasing the amount of landscape managed for low biodiversity emphasis results in a loss of $3.26 per household for the whole sample and $0.90 for the Robson Valley residents. An increase in forest managed for high biodiversity emphasis results in a gain of $7.41 per household for the whole sample, but only $0.67 for the Robson Valley residents. The marginal value of the current targets option is positive: $90.42 for the whole sample and $37.08 for the Robson Valley. Thus, any change to the attributes affects some households negatively.

Analysis of Forest Management Scenarios

To infer the effects the scenarios might have on the value or utility people derive from the forest, the choice experiment results from both the whole sample and Robson Valley subsample models were combined with the assumed changes in attributes resulting from the scenarios. This analysis can be used to determine if stakeholders will be better or worse off from changes in various combinations of the attributes. The scenarios are used to illustrate how the combination of scenario planning and the estimation of benefits using the choice experiment can help inform the planning process.

Once assumptions were made concerning the effect of the scenario on the attribute levels, the marginal value was used to calculate a change in total benefits (Table 10). For example, in the tourism scenario, for the whole sample, the value of the increase in protected area is positive, but the value of the change in recreational access is negative. The total benefit is the net value associated with changes in the attributes.

We report the value of a change from the status quo (current targets) separately from other attribute effects. This is because any change from the status quo results in a large negative value, which tends to mask any positive values associated with the attribute changes.

The most desirable scenario for the whole sample is enhanced biodiversity and the most desirable for the Robson Valley residents is the combined scenario. The least desirable scenario for both groups is the greater emphasis on resource extraction, despite the fact that this scenario assumes a reduction in taxes. The loss of benefits associated with changing to predominantly young forest stands is greater than the benefits associated with tax savings. No net positive benefits result from the tourism scenario for either group. However,

TABLE 10. Benefit measures for proposed forest management scenarios

Scenario	Benefit changes Robson Valley ($)	Benefit changes Whole sample ($)
Silviculture		
Taxes decreased $10 and protected area increased 5%	12.94	46.14
Cost to move from status quo	-37.08	-90.42
Total	-24.14	-44.28
Enhanced biodiversity		
High emphasis increased 5% and low emphasis decreased 5%	7.83	53.36
Cost to move from status quo	-37.08	-90.42
Total	-29.25	-36.86
Tourism		
Access changed from 4WD to 2WD and protected area increased by 5%	15.26	25.82
Cost to move from status quo	-37.08	-90.42
Total	-21.82	-64.60
Resource extraction		
Stand age decreased one level and taxes decreased $10	-39.36	-184.68
Cost to move from status quo	-37.08	-90.42
Total	-76.44	-275.10
Mixed (biodiversity and tourism)		
High biodiversity increased 5%, low biodiversity decreased 5%, and access changed from 4WD to 2WD	20.15	43.05
Cost to move from status quo	-37.08	-90.42
Total	-16.93	-47.37

the source of the change in the benefits differs between the groups. An increase in benefits for the whole sample comes from a positive value associated with the increase in protected areas. Easier access (i.e., changing from four-wheel drive to two-wheel drive) reduces the benefits. For the Robson Valley residents, the positive benefits are derived mainly from the change in access, and the change in protected area adds little to the overall benefits. This suggests that motorized access is more important than increased protected area for Robson Valley residents. These examples illustrate how the choice experiment results can provide policy makers with insight concerning the acceptability of the proposed scenarios and how the relative marginal values from the attribute changes provide an indication of which attributes are important to stakeholders.

Discussion

This study has shown that stakeholder groups relevant to the Enhanced Forest Management Pilot Project are diverse in their perceptions and knowledge related to biodiversity conservation. The recreation groups (backcountry hikers in Mount Robson Provincial Park and snowmobilers in the Robson Valley) differ substantially from each other and from residents of the Robson Valley and Prince George. Although these stakeholders use the forest resource, they are not well informed about biodiversity conservation issues in British Columbia.

The snowmobilers were the least knowledgeable about biodiversity, and they were not supportive of increasing the amount of protected area or of decreasing access. In contrast, hikers perceived themselves as quite knowledgeable about biodiversity issues. They viewed industry as a threat to biodiversity and were in favor of having more regulations and restrictions, increasing the amount of protected area, and limiting commercial development in protected areas as a means of conserving biodiversity.

Robson Valley and Prince George residents differed from other residents of British Columbia in several respects. Local residents were less supportive of restricting industrial activity. Biodiversity issues were more important for these residents and they rated themselves as better informed. However, they did not score any higher on the more objective true or false questions.

The low levels of knowledge among the subsamples are reflected further in their assessment of threats to forest biodiversity. For example, Alberta subgroups listed issues that are not important in British Columbia, such as grazing, and oil and gas exploration, but are prominent conservation issues in Alberta. The fact that the individuals in the subsample were from Alberta might have influenced their perceptions of these activities. Also, most of the subsamples perceived natural disturbances caused by fire, and insects and disease, as threats. In particular, all of the British Columbia resident groups viewed insects and disease as the greatest threat to forest biodiversity. This is probably a result of the mountain pine beetle outbreak that has occurred recently in the province and the media coverage it has generated. The mountain pine beetle is a native species and outbreaks are part of a natural cycle. According to B.C. Parks and the B.C. Ministry of Forests websites,[5] although the Interior forests are experiencing an epidemic, the mountain pine beetle is not implicated as a threat to biodiversity. This particular epidemic, and the exceptionally large area it affects, are largely the result of past fire suppression activities and current weather patterns which have left the forest more susceptible to outbreaks. The beetle epidemic will result in forests that are more varied in composition, structure, and age and, thus, may actually increase biodiversity. This misunderstanding among the British Columbia public is an issue that should be addressed if effective management of the beetle and biodiversity are to occur. Residents will need to understand the ecological implications and possible effects on biodiversity of various mountain pine beetle management options before they can provide informed input on its management. Although the recreation groups from Alberta did not perceive insects and disease as threatening, they too should be informed because the insect may affect their enjoyment of the area; the visual quality of the area may decline, and the death of trees will increase the avalanche hazard in winter and erosion hazard in summer. This study has revealed a definite need to inform stakeholders about natural ecosystem processes and their effects on biodiversity.

The fact that a majority of respondents in all groups identified the provincial government as the agency that should have a lead role in conserving biodiversity—combined with the public's perceptions of the effectiveness of potential methods to conserve biodiversity—provides some direction for government. The most popular methods for conserving biodiversity were "educating the public and industry," and "encouraging industry to use eco-friendly practices." Methods that involve regulations and restrictions on industry were not popular, except among the hikers. This suggests that most stakeholders are not totally supportive of legislating biodiversity conservation. Rather, they prefer that the provincial government take a lead role in educating and encouraging as a means of conserving biodiversity.

The choice experiment also reveals differences between the subsamples. For the whole sample, all of the attributes chosen for the tasks (except the intermediate access level) were significant in explaining the option selected. However, respondents in the Robson Valley subsample used fewer attributes in their trade-offs because only the cost, the two stand age levels, and the low biodiversity attributes were significant. While none of the recreational access attributes was significant for the Robson Valley residents, it is noteworthy that the signs of the coefficients were different from the whole sample, with the Robson Valley residents desiring more motorized access.

Another important difference between the subsamples is the cost attribute. The analysis of the subsamples revealed that the cost coefficient was significant only for the Robson Valley and Prince George groups. The significant cost coefficient for the whole sample occurred because of these two groups. The lack of significance for the cost attribute for the other

[5] *http://wlapwww.gov.bc.ca/bcparks/conserve/pine_beetle/pine_beetle.htm* and *http://www.for.gov.bc.ca/hfp/bark_beetles/*

subsamples (i.e., both Alberta groups and the other British Columbia group) suggests that the cost amounts used in the choice experiment were too small to affect respondents' choices. Also, the cost may not have been important to Albertans if they assumed that the tax would apply only to British Columbia residents.

Also, differences exist between the Robson Valley residents and the whole sample regarding the means to protect biodiversity. Models for both samples show that managing for a low biodiversity emphasis is negative and significant, but the high biodiversity emphasis and protected areas attributes are not significant for the Robson Valley residents. This suggests that the Robson Valley residents are more likely to prefer a "working forest" that is managed in a manner that includes environmental concerns. The whole sample, on the other hand, seems to prefer more protected areas, and to reduce the amount of forest under active management. The stand age attribute is also important, especially in the shifts between levels. This is likely due to the mix of ages within each of the stand age attribute levels. The old and mature level had an 80% mature component suggesting little forestry activity would occur. The middle-aged level had a 30% mature component. This might be viewed by respondents as providing a reasonable level of old-growth forest, and thus be considered a reasonable compromise between protecting old growth and carrying out economic activity.

The choice experiment was our first attempt at measuring some of the trade-offs inherent in conserving biodiversity at the landscape level. The success of a choice experiment depends to a large extent on the selection of the attributes and their levels. Most of the attributes chosen for this research had been used in other studies or were derived in consultation with staff at the B.C. Ministry of Forests regional office. Using these attributes in a choice experiment involving recreationists and the public of British Columbia commenting on biodiversity at a landscape level was a new application, and thus might require refinement. However, the majority of respondents seemed to understand the task at hand and chose to make trade-offs, which suggests that the attributes were relevant.

A significant number of respondents chose the status quo option for all of the choice tasks. While this is not that unusual, and we cannot know for certain why this occurred, several possible explanations exist for such responses. Respondents may have selected the status quo option as an expression of protest against the cost of change, or as an expression of actual preference for the status quo. It is also possible that respondents selected the status quo because they were not willing to exert the mental effort required to assess the relative utility of the choices.

However, some concerns still remain about the choice experiment portion of the study, which can be resolved only with further work. One of the problems is the geographical scale involved. Forest management occurs at the landscape level, but the public may not be accustomed to thinking about the forest in this manner. They are perhaps more likely to think of the forest on a much smaller scale, such as a meadow, or a small stand of trees. The attributes chosen and the use of percent of region in most of the attribute levels may have allowed respondents to think at their normal scale of reference and still be able to make a decision based on a landscape level of management. Further studies will be necessary to determine whether respondents are using the proper frame of reference to choose between options.

As well, that many respondents exhibited a lack of knowledge about biodiversity puts some doubt on what people were actually valuing in the choice experiment; this lack of knowledge may have resulted in some respondents choosing the status quo rather than making trade-offs with unknown implications or consequences.

The objective of conserving biodiversity is a relatively new one for many forest managers; to date, both the means of achieving the objective and the exact results of any given plan are uncertain. This uncertainty about the consequences of various plans may also have led even those who are informed about the issues to select the status quo. For them, it may have been a matter of staying with a known situation, rather than risk making things worse by changing procedures.

Overall, the choice experiment provides much useful information about how stakeholders will respond to a proposed forest management plan given certain benefits they will derive from it. It also poses some new questions about the accuracy of the general public's process of opinion formation. The amount of information provided in the survey certainly did not make the respondents instant experts, nor was it meant to. The survey was designed to determine how the public, with its current level of knowledge, would respond to a management plan. The public's current level of knowledge, however, might not be adequate to make informed choices about complex natural resource management issues such as biodiversity conservation. The perceived threat from forestry practices and the negative benefit associated with the resource extraction management scenario suggests that the stakeholders are largely uninformed about the inclusion of biodiversity objectives in forest management planning; or, if they are informed, they do not believe that the objectives are being met. These results suggest that stakeholders need more information about forest management practices, and about the effectiveness of forestry practices in conserving biodiversity.

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