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Public perceptions of natural disturbance in Canada's national parks: The case of the mountain pine beetle (*Dendroctonus ponderosae* Hopkins)

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ABSTRACT

Since the 1990s, the mountain pine beetle (MPB) population has exploded in western Canada. In national parks, MPB has the potential to impact visual quality and safety of visitors, and to spread beyond park boundaries to the industrial forest landbase. Control measures have been initiated in some parks to lessen these impacts. A study was undertaken to examine public attitudes, knowledge, issue salience, and management preferences for MPB in Banff and Kootenay national parks. Data were collected by mail survey in 2003 from 1385 residents living in or near the parks. MPB was an important issue for the majority of respondents and they had low knowledge of MPB, expressed negative attitudes towards it, and supported measures to control it. Preferred control measures included those directed at the current infestation. Proactive approaches in uninfested forests were generally not supported. Issue salience and knowledge were the best predictors of attitudes toward the MPB. Attitudes were the best predictors of support for no intervention in beetle infestations in national parks. Management implications include the lack of knowledge and support for natural disturbance and ecological integrity policies in national parks.

1. Introduction

The mountain pine beetle (MPB), *Dendroctonus ponderosae* Hopkins, is considered one of the most destructive forest pests in western Canada largely because of its impacts on timber supply, the forest industry, and forest dependent communities (Natural Resources Canada, 2005). The MPB is endemic to lodgepole pine (*Pinus contorta*) forests of British Columbia (BC), usually occurring in small numbers and widely dispersed populations. However, the beetle is subject to population fluctuations and since the 1990s the population has increased to the largest forest insect infestation recorded in North America (Taylor and Carroll, 2004). In 2003, over 4 million hectares of BCs forests were infested extending the beetle beyond what is considered its historical range (Ebata, 2004). By 2004, the outbreak had spread to over 7 million hectares (Natural Resources Canada, 2005).

The main factors contributing to the current outbreak are climate and the availability of the primary host species, mature lodgepole pine (Carroll et al., 2004). Hot, dry summers create stress in the trees, leaving them less able to combat the infestation. Periods of cold (temperatures below −25 °C in the fall or −40 °C in late winter for sustained periods) can also kill the beetle (Carroll and Safranyik, 2004). Decades of forest fire suppression have resulted in an abundance of susceptible host species in BC (Taylor and Carroll, 2004) and Alberta (Ono, 2004).

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There are few options for controlling MPB outbreaks (Langor, 2003). The most effective strategy is prevention through long-term forest management plans, including thinning stands, prescribed burning, and planting non-host species to reduce the rate of spread of small, endemic populations. Once MPB populations reach the outbreak stage, however, little can be done for effective control. Short-term control methods such as harvesting of infested and vulnerable stands, can be used to reduce MPB damage.

1.1. *Mountain pine beetle and Canada's national parks*

Protected areas, such as national parks, are commonly cited as an integral component in a biodiversity conservation strategy (e.g., Reid and Miller, 1989). Consistent with this concept, Canada's national parks have adopted ecological integrity as the first priority in park management. Ecological integrity is described as "a condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes" (Parks Canada, 2003). Based on the ecological integrity mandate, native insects and disease should be allowed to persist without interference if possible.

The MPB is endemic to all of Canada's mountain national parks but has only reached epidemic levels in Kootenay, Yoho, and Waterton (Parks Canada, 2004). Kootenay National Park in BC, has experienced several MPB outbreaks dating back to the 1940s, the most recent of which began in the 1990s. Although the park does have a prescribed burn program aimed at meeting ecological integrity objectives, at the time of this study no measures had been implemented for the express purpose of controlling the MPB. The adjacent area of Banff National Park, in the province of Alberta, has not been as affected by MPB. Although it is endemic to the park, MPB outbreaks have been much smaller and historically not a significant natural disturbance agent. Recently, however, the beetle has extended its range into previously uninfested areas of the park, spreading to the parks eastern boundary with provincial crown lands. Banff National Park has established three MPB management zones: a zone of no intervention where beetle populations fluctuate without controls; a prescribed burn zone to reduce build-up of mature lodgepole pine stands and beetle populations; and a zone with a combination of prescribed burning, sanitation cutting (logging and removal or burning of infested trees on-site) and pheromone baiting (attracting beetles to an area in preparation for the use of other controls).

MPB and its management in national parks is a potentially contentious issue. Its presence within the parks' lodgepole pine ecosystems represents a natural disturbance agent. Therefore, it may play an important role in rejuvenating the ecosystem by creating gaps in the forest cover allowing new and increased growth for young trees and increased species diversity (Parks Canada, 2004). Actions to control the beetle could be viewed as inconsistent with the principles of ecological integrity. On the other hand, the current outbreak of MPB may be viewed as a symptom of an unhealthy ecosystem that is, at least partially, the result of fire suppression policies in the parks. Undertaking management activities (such as prescribed burning) to restore ecosystems to more natural levels of variation is considered consistent with the ecological integrity mandate. Additionally, MPB infestation has the potential to impact upon the visual quality of park scenery, presents a hazard to park users (dead and falling trees), and has the potential to spread beyond park boundaries to the neighboring industrial forest landbase impacting local and provincial economies.

Managing the beetle in national parks presents a challenge in terms of devising control measures that are compatible with the ecological integrity mandate, that are acceptable to the public, and that do not have a negative effect on visitor experiences. Gauging public support for proposed control measures and the factors that influence support can provide guidance to park managers in selecting control options, provide direction for public education programs, ensure a broad range of public values and concerns are represented in decisions, and reduce conflict among various stakeholders (Shindler et al., 2002).

1.2. *Human dimensions of natural disturbance*

Managing for ecological integrity and conservation of biodiversity in protected areas requires an understanding of the human dimension (e.g., attitudes and preferences) as well as the ecological. Much of the social science literature on natural disturbance has focused on the economic impacts on resource-based industries (e.g., Leuschner et al., 1978), visual quality impacts (e.g., Buhyoff et al., 1982), variation in community (e.g., Flint, 2004) and private landowner (e.g., Molnar et al., 2003) response to insect infestations, and attitudes, knowledge, and acceptance of wildfire and fuel management options and policies outside of protected areas (e.g., Loomis et al., 2001). The social aspects of natural disturbance in protected areas, however, have received less attention. The literature on protected areas is focused primarily on the effects of wildfire or prescribed burns on recreation and non-market values (e.g., Englin et al., 1996) and acceptance of fire policies (e.g., Bright et al., 1993). Understanding stakeholders' attitudes related to natural disturbance, acceptance of managing natural disturbance, and the factors influencing these are important elements in understanding social aspects of ecological integrity and conserving biodiversity within protected areas.

1.3. *Correlates of attitudes and preferences*

Although several conceptualizations of attitudes can be found in the literature, we adopt the definition of attitude as a favorable or unfavorable assessment of an attitude object. For this study the attitude object is the MPB in national parks. Typically, attitude is expressed as positive or negative evaluations such that individuals are described as having positive attitudes toward an object if the object is assessed favorably and a negative attitude if it is assessed unfavorably (Vaske and Donnelly, 1999). For example, positive attitudes toward large carnivores have included a favorable assessment of their right to exist, that their numbers should be increased, that they are symbols of the greatness of nature, and that it is important to know that they exist. Negative attitudes have included assessments that they should be hunted, that they should be restricted in their range, and that they should be

eliminated from areas with livestock (Ericsson and Heberlein, 2003; Kaczensky et al., 2004).

Attitudes toward natural resource management issues may be influenced by several factors including environmental worldview, knowledge and salience of the issue, and sociocultural influences. Attitudes toward a management issue, in turn, influence judgement of acceptable management and policy options. Individuals with positive attitudes toward fire, for example, are generally more supportive of prescribed burn policies and have a more positive assessment of the potential outcomes from wildfire (Loomis et al., 2001; Manfredo et al., 1990). Similarly, positive attitudes towards large carnivores are related to support for policies aimed at expanding their range (Bright and Manfredo, 1996; Enck and Brown, 2002; Kaczensky et al., 2004).

Environmental worldviews are non-issue specific beliefs that form the basis for attitudes and behaviors directed at more specific environmental issues. Individuals with a strong ecological worldview tend to have proenvironmental attitudes on a wide range of issues. For example, an ecological worldview has been found to influence attitudes toward the protection of national forests in the United States (Vaske and Donnelly, 1999), and support for protection-oriented forest management in Canada (McFarlane and Boxall, 2003) and environmental policies across cultures (Rauwald and Moore, 2002).

Although it is often assumed that increased levels of knowledge will impact on attitudes and enhance support for resource management decisions, the literature suggests the influence of knowledge of management issues is inconclusive. Studies on wildfire, for example, suggest that as knowledge increases attitudes become more positive and individuals are more supportive of prescribed burn policies (e.g., Manfredo et al., 1990; Loomis et al., 2001). In contrast, studies of other natural resource management issues (especially highly controversial issues such as large carnivore restoration) suggest that individuals with higher levels of knowledge can have neutral or more negative attitudes and are less supportive of protection-oriented policies (Bright and Manfredo, 1996; Ericsson and Heberlein, 2003; Kaczensky et al., 2004).

Salience of the management issue should also influence attitudes. Issues of high personal importance are frequent subjects of conscious thought, making attitudes more cognitively accessible and better predictors of support for specific management options than attitudes toward unimportant issues (Bright and Manfredo, 1995). Individuals who regard a natural resource issue with high personal importance tend to have more extreme attitudes and show mixed support for resource management policies (Bright and Manfredo, 1995; Enck and Brown, 2002; Kaczensky et al., 2004).

Sociocultural influences such as age, sex, level of education, socialization influences, and area of residence can also influence attitudes and management preferences. Studies suggest that younger individuals, women, and people with higher levels of education tend to exhibit more positive attitudes toward natural resource issues and tend to be more supportive of protection-oriented management (Dietz et al., 1998; Vaske et al., 2001; Kaczensky et al., 2004). People employed in a natural resource-based industry (such as forestry) and local residents, tend to have more negative attitudes toward issues that may impact upon their economic livelihood and affect their communities and are less supportive of protection-oriented management (Enck and Brown, 2002; Kaczensky et al., 2004).

In 2003, we undertook a study to examine familiarity with the MPB, attitudes toward the MPB, acceptance of potential control measures within national parks, and information needs of residents living in or near Banff and Kootenay national parks. Specifically, the study addressed the following research questions: (1) What does the public know about MPB? (2) What is the public's attitude towards MPB in national parks? (3) How accepting is the public of management actions to control MPB populations in national parks? and (4) What factors influence attitudes toward MPB and support for intervention in the MPB outbreak in national parks?

To examine factors that influence attitudes and support for intervention, we test a model whereby a proecological worldview is hypothesized to have a positive effect on attitudes toward MPB and support for no intervention in beetle outbreaks in national parks. Attitudes toward the MPB, in turn, are hypothesized to have a positive influence on support for no intervention (i.e., people who hold positive attitudes toward MPB will likely tolerate more damage from the MPB and be less supportive of controlling the infestation in national parks). Higher levels of knowledge of the MPB are expected to result in more positive attitudes and support for no intervention. Issue salience is expected to affect attitudes and support for no intervention negatively. The lower the personal importance of MPB in national parks, the more positive the attitude and the more support for no intervention. We hypothesize that women, younger individuals and those with higher levels of education will have a more positive attitude and be more supportive of no intervention. Having a household member dependent on the forest sector and residing in BC (where the MPB outbreak is having the greatest impact) are hypothesized to have a negative effect on attitudes and support for no intervention.

2. Methods

2.1. *Sample selection*

Samples representing three geographically defined populations were obtained by telephone solicitation. The BC communities of Radium, Invermere, Windermere, Edgewater and Fairmont Hot Springs served as the sample frame for local residents of KNP. This sample is referred to as the "Columbia Valley." The sample frame for local residents of BNP included the communities of Banff, Canmore, and Harvie Heights in Alberta. This sample is referred to as the "Bow Valley". The city of Calgary, Alberta was also included in the study. Calgary is a large urban center located within a 1–1.5 h drive from the parks.

During the telephone solicitation, 4099 qualified respondents (respondents had to be a resident of the household, over 18 years old, and equal numbers of men and women were sought) were reached. Of these, 1889 agreed to participate in a mail survey: 635 from the Columbia Valley, 625 from the Bow Valley, and 629 from Calgary.

2.2. The questionnaire

Dillman's (2000) Tailored Design Method was used to guide survey design and implementation. The questionnaire collected a variety of information related to park management including use of the parks, views on threats to the parks, preferences for obtaining park information, environmental worldview, salience and knowledge of MPB, attitude towards the MPB, preferences for controlling MPB in the parks, and demographic characteristics.

Environmental worldview was assessed using the New Ecological Paradigm (NEP) scale (Dunlap et al., 2000). The NEP represents fundamental views on the relationship between people and the environment. The NEP consists of 15 statements rated on a scale of 1–5 with 1 = strongly disagree and 5 = strongly agree. A principal components factor analysis was consistent with Dunlap et al. (2000) results suggesting the NEP scale consists of one factor. Reliability was assessed using Cronbach's alpha ($\alpha = 0.83$). Statements with a negative loading were reverse coded and a NEP score was created by summing the individual statement scores. Possible scores range from a low of 15 to a high of 75 with higher scores indicating a proecological worldview.

Salience of the MPB issue was measured by rating the statement "How important is the mountain pine beetle issue in Canada's national parks to you personally?" on a 5-point scale ranging from not important at all to very important.

Knowledge of the MPB was assessed using a subjective, self-rated format and an objective indicator. In the self-rated format respondents indicated their familiarity with the beetle on a 4-point scale consisting of 1 = never heard of it; 2 = heard of it but know nothing about it; 3 = heard of it and have some knowledge about it; and 4 = know a lot about it. Respondents who indicated that they had never heard of the MPB or had heard of it but knew nothing about it were not asked the objective knowledge, attitudinal, or management preference questions. The objective knowledge indicator consisted of 14 true or false statements. These were developed based on MPB literature and consultation with research scientists and entomologists familiar with the MPB. The statements were rated as true or false with a not sure option. The number of correct responses was used as an objective indicator of knowledge.

Attitude towards the MPB in the national parks was measured using a series of nine evaluative statements: five statements representing a positive evaluation (e.g., "the MPB helps ensure that forests are healthy") and four representing a negative evaluation (e.g., "the MPB is a threat to biodiversity"). Respondents rated the statements on a 5-point scale with 1 = strongly disagree and 5 = strongly agree. Principal factor analysis identified two factors corresponding to the positive and negative evaluations. Reliability of the factors was assessed using Cronbach's alpha. One statement ("there is no way to control the spread of mountain pine beetle") did not load on the factors and was excluded from the analysis.

Management preferences for MPB in national parks were assessed using 11 control options, including an option of allowing the outbreak to run its course without intervention. Respondents indicated their acceptance of each on a 5-point scale with 1 = strongly oppose and 5 = strongly favor and a no opinion option. The management preferences were preceded with background information about MPB in Banff and Kootenay national parks and a brief explanation of the control options.

Demographic information included age, sex, education, and dependence of a household member on income from natural resource sectors. Sex was measured as a dummy variable with 0 = male and 1 = female. Having a household member dependent on the forest sector was also treated as a dummy variable with 0 = no and 1 = yes. Education was measured in 8 categories ranging from grade 9 or less to a graduate university degree.

The questionnaire was mailed in November 2003, followed about 2 weeks later by a reminder postcard. A second questionnaire was sent to those who had not responded about 4 weeks after the initial mailing. A total of 1 385 questionnaires were returned. Adjusting for non-deliverables, this represents a 75% response on the mail survey. Response rates for the samples were: Columbia Valley 77%, Bow Valley 73%, and Calgary 75%.

2.3. Data analyses

All statistical analyses were performed using SAS statistical package (version 9.1 for windows). Differences among group means were examined using analysis of variance (ANOVA) and Tukey's studentized range test. A chi-square test of independence was used to examine the association between place of residence and the distribution of self-rated familiarity with the MPB, level of education, forest sector dependence, and sex. For statistical tests we used $p \leqslant 0.05$ as the significance level.

We developed two regression models using ordinary least squares. The first examines the explanators of attitudes toward the MPB, and the second examines the explanators of support for no intervention in MPB outbreaks in national parks. For the regression analyses education categories were converted to years of education based on the midpoints of the categories. The midpoints ranged from 5 (grade 9 or less) to 18 years (a graduate university degree). We created a composite attitudinal score by reverse coding statements that represented a negative evaluation of the MPB and summing the ratings on all statements. A summed score with a possible minimum of 8 (representing a very negative attitude towards MPB) and maximum of 40 (representing a very positive attitude towards MPB) was calculated for each respondent. We controlled for the effects of living in BC, where the infestation is the greatest, by treating Columbia Valley residence as a dummy variable. Correlations among the independent variables were modest ($r < 0.50$) suggesting that collinearity was not a concern.

3. Results

3.1. Ecological worldview

Respondents scored high on the NEP indicating a proecological worldview. Bow Valley ($M = 58.1$, $SD = 9.0$) residents differed significantly from the Columbia Valley ($M = 55.7$, $SD = 9.6$) and Calgary ($M = 55.0$, $SD = 9.0$) residents ($F = 13.57$, $df = 2$, $p < 0.0001$).

3.2. Issue salience

All groups rated the MPB issue in national parks as important to them personally: Columbia Valley $M = 4.5$, SD = 0.81, Bow Valley $M = 4.2$, SD = 0.89, Calgary $M = 3.8$, $SD = 1.08$. Residents living close to the parks (the Columbia Valley and the Bow Valley), rated the MPB issue significantly more important than Calgary residents ($F = 61.10$, df = 2, $p < 0.0001$).

3.3. Knowledge of mountain pine beetle

Residents of the Columbia and Bow valleys rated themselves quite well informed about MPB, whereas Calgary residents considered themselves much less informed ($\chi^2 = 273.48$, df = 6, $p < 0.0001$) . Nearly 100% of respondents from the Columbia and Bow valleys had at least heard of MPB and over 82% of both groups indicated they had at least some knowledge of the beetle. In particular, a larger portion of Columbia Valley (17.5%) than Bow Valley (8.1%) and Calgary (1.1%) residents indicated they knew a lot about MPB. Residents of Calgary were the least familiar with MPB: a majority indicated they had either never heard of MBP (14.2%) or had heard of it but had no knowledge (39.1%).

The objective knowledge measure indicates that respondents who rated themselves as having at least some knowledge of the MPB, were not very knowledgeable about the insect. A majority of all groups incorrectly thought or were not sure that a single MPB can kill a young tree (65.4%), that MPB was imported from Europe (83.8%), and that MPB is found in national parks across Canada (76.3%). Most did not know that MPB infests mostly old pine trees (71.5%) and is beneficial to some birds (55.8%). However, there are some facts that were well known. For example, a majority knew that MPB causes visible damage (93.2%), can be carried in firewood (87.9%), is prone to population fluctuations (60.2%), does not infect wildlife (80.7%), and that mild winters have contributed to the current outbreak (84.3%). Not as many were aware that fire suppression is also a contributing factor in the current outbreak (56.7%) or that MPB is a naturally occurring insect in the mountain parks (55.8%). Residents of the Columbia Valley ($M = 8.0$, SD = 2.8) and Bow Valley ($M = 8.1$, $SD = 2.9$) had the highest mean knowledge scores, whereas Calgary residents ($M = 7.0$, SD = 2.7) had a significantly lower score ($F = 11.71$, df = 2, $p < 0.0001$).

3.4. Attitude towards mountain pine beetle

Overall, respondents had a negative evaluation of the MPB in national parks (Table 1). All groups agreed ($M > 3.0$) that the beetle is a threat to biodiversity, is an ecological disaster for national parks, and results in economic losses in tourism. They also disagreed ($M < 3.0$) that the beetle should have a right to exist in the parks, that the beetle should be protected in national parks, that the beetle helps ensure a healthy forest, that the beetle is important in rejuvenating the forest, and that the beetle is more beneficial than harmful. There was no significant difference among the groups on the mean attitudinal score.

3.5. Management preferences

All groups agreed that "allowing the outbreak to follow its course without intervention" was not an acceptable option ($M < 3.0$) (Table 2). Preferred management options were "sanitation cutting to remove infested trees from small areas", and "the use of pheromones to attract beetles to one area". Other acceptable ($M > 3.0$) options included "prescribed burning in infested forests in the parks", "sanitation cutting to remove infested trees from large areas", and "thinning the forest to remove some of the uninfested but susceptible trees"

Table 1 – Attitudes of residents in or near Banff and Kootenay national parks toward the mountain pine beetle

Attitudinal statement[a]	Resident group					
	Columbia Valley		Bow Valley		Calgary	
	n	M[b] (SD)	*n*	M (SD)	*n*	M (SD)
Positive statements: (Cronbach's α = 0.86)						
Mountain pine beetle should have a right to exist in the parks	419	2.1b (1.3)	366	2.4a (1.3)	222	2.2a,b (1.2)
The mountain pine beetle helps ensure that forests are healthy	422	2.2b (1.2)	365	2.5a (1.3)	223	2.2a,b (1.1)
The mountain pine beetle is important in rejuvenating the forest	420	2.4a (1.3)	360	2.5a (1.2)	222	2.4a (1.1)
The mountain pine beetle should be protected within the parks	422	1.6b (1.0)	364	1.8a (1.0)	224	1.8a (1.0)
Overall, the mountain pine beetle is more beneficial than harmful for the parks	423	1.9a (1.1)	363	2.1a (1.1)	225	2.0a (1.1)
Negative statements: (Cronbach's α = 0.74)						
The mountain pine beetle is a threat to biodiversity in the parks	417	4.0b (1.1)	362	3.7a (1.2)	219	3.9b (1.0)
The mountain pine beetle results in substantial economic losses to the tourism industry	421	3.2b (1.3)	368	2.8a (1.2)	222	3.2b (1.1)
Mountain pine beetle outbreaks are an ecological disaster for the parks	422	3.7b (1.3)	366	3.3a (1.3)	224	3.7b (1.2)
Attitudinal score[c]	314	18.8a (6.8)	306	20.1a (7.0)	185	18.9a (6.1)

a Rated on a scale of 1–5 where 1 = strongly disagree and 5 = strongly agree.
b Any two means in a row that do not share a letter are significantly different at $p < 0.05$ according to Tukey's studentized range test.
c Negative statements were reverse coded and an attitudinal score created by summing responses to all statements. Higher scores indicate a more positive attitude.

Table 2 – Management preferences of residents in or near Banff and Kootenay national parks for mountain pine beetle

Control method[a]	Resident group					
	Columbia Valley		Bow Valley		Calgary	
	n	M[b] (SD)	N	M (SD)	*n*	M (SD)
Allowing the outbreak to follow its course without intervention	484	1.6b (1.0)	435	1.9a (1.2)	457	1.8a,b (1.1)
Chemical control on small areas	476	2.5a (1.4)	435	2.2b (1.2)	454	2.5a (1.3)
Sanitation cutting to remove infested trees from small areas	480	4.1a (1.1)	430	4.1a (1.0)	453	4.0a (1.0)
Sanitation cutting to remove infested trees from large areas	474	3.7a (1.3)	426	3.7a (1.2)	449	3.6a (1.2)
Thinning the forest to remove some of the uninfested but susceptible trees from small areas	477	3.5a (1.3)	435	3.5a (1.2)	455	3.4a (1.2)
Thinning the forest to remove some of the uninfested but susceptible trees from large areas	480	3.4a (1.4)	431	3.2a,b (1.3)	453	3.1b (1.2)
Prescribed burning in infested forests in the parks	484	3.6a (1.3)	435	3.7a (1.3)	455	3.8a (1.1)
Prescribed burning in uninfested but susceptible forests in the parks	483	2.7a,b (1.3)	434	2.8a (1.3)	452	2.6b (1.2)
Selective logging to remove all healthy but susceptible trees from small areas	483	3.0b (1.5)	436	2.7a (1.4)	454	2.7a (1.2)
Selective logging to remove all healthy but susceptible trees from large areas	483	2.7a (1.5)	433	2.3b (1.3)	454	2.4b (1.2)
The use of pheromones to attract beetles to one area	484	3.9a (1.2)	435	3.9a (1.2)	459	4.0a (1.0)

a Rated on a scale of 1–5 where 1 = strongly oppose and 5 = strongly favor.
b Any two means in a row that do not share a letter are significantly different at $p < 0.05$ according to Tukey's studentized range test.

from small or large areas. Options that were generally not supported included chemical control (use of monosodium methanearsenate), and controls on uninfested areas of the parks such as selective logging to remove all healthy, susceptible trees and prescribed burning in uninfested, susceptible forests. There were few differences among the groups on the preference ratings. Notably, the Columbia Valley residents were slightly more in favor of selective logging to remove healthy, susceptible trees and Bow Valley residents were less in favor of chemical control.

3.6. *Demographic characteristics*

Respondents from the Columbia Valley were significantly older, had lower levels of education, and more were dependent on the forest industry for their economic livelihood than residents of the Bow Valley or Calgary. The mean age of Columbia Valley respondents was 51.0 compared to 45.7 for Bow Valley and 44.5 for Calgary respondents ($F = 29.93$, df = 2, $p < 0.0001$). Considerably fewer Columbia Valley respondents (27.5%) had a university education compared to Bow Valley (43.6%) and Calgary (41.8%) ($\chi^2 = 31.50$, df = 2, $p < 0.0001$). Only 7.7% of Bow Valley and 6.1% of Calgary respondents were dependent on the forest sector compared to 28.6% of Columbia Valley respondents ($\chi^2 = 120.16$, df = 2, $p < 0.0001$).

3.7. *Regression analysis*

Regression results are presented in Table 3. Of the demographic variables, only education influenced attitudes. Respondents with higher levels of education had a more positive attitude toward the MPB. Environmental worldview had a positive influence: the higher the NEP score the more positive the attitude. Increased knowledge of MPB also had a positive effect on attitudes. As issue importance increased, attitudes became more negative. Issue salience had the largest beta coefficient indicating it had the greatest influence on attitude. These variables explained 33% of the variance in attitude.

Table 3 – Regression analyses of factors influencing attitude towards mountain pine beetle and support for no intervention in mountain pine beetle outbreaks in national parks

Independent variables	Standardized beta coefficients	
	Attitudinal score (*n* = 654)	No intervention (*n* = 650)
Age	−0.031	0.071*
Sex	0.009	0.023
Education	0.100**	−0.027
Forest sector dependence	−0.024	−0.057
Columbia Valley resident	0.020	0.027
Knowledge score	0.304**	−0.007
New Ecological Paradigm score	0.110**	0.062*
Issue salience	−0.419**	−0.165**
Attitudinal score	0	0.589**
F value	41.93**	62.29**
Adjusted R^2	0.334	0.459

* $p < 0.05$.
** $p < 0.01$.

Support for no intervention in MPB outbreaks in national parks had a positive association with age, the NEP and attitude scores. Older respondents and those with a more proecological worldview and more positive attitude were more supportive of not intervening to control the beetle in national parks. Salience of the MPB issue had a negative influence on support for no intervention; the more important the issue the less support for letting the beetle run its course in national parks. Attitude had the strongest influence as shown by the high beta coefficient. This suite of variables explained 46% of the variance in support for no intervention.

4. Discussion

A review of the literature revealed few studies that examined the social aspects of natural disturbance in protected areas

and no studies were found related to public perceptions of an insect infestation and its management in national parks. This study addresses this gap by examining perceptions of MPB and its management among local residents of Banff and Kootenay national parks in western Canada.

Generally, respondents had a negative attitude towards the MPB and supported intervention to control MPB outbreaks in national parks. Although MPB in national parks was an important issue for residents, they were not very well informed about the beetle. Consistent with our hypotheses, greater knowledge of the MPB, lower issue salience, a high NEP score, and high levels of education, were associated with a more positive attitude towards the MPB. Attitudes in turn influenced support for intervention in MPB outbreaks in national parks; those with more positive attitudes were less supportive of intervening to control the beetle. The greater the personal importance of the issue, the more support for intervention. Older residents and those with a proecological worldview were less supportive of intervention. Contrary to our hypotheses, sex, forest sector dependence, and residing in BC (the Columbia Valley) did not influence attitudes or support for intervention. Management implications of these findings center around the lack of knowledge of MPB, and public support for MPB control options and natural disturbance policies in national parks.

4.1. *Educating the public*

Results revealed that residents lack a basic understanding of the MPB, its potential beneficial role in ecosystems, and its impact on the environment. This study suggests lack of knowledge may be influencing the negative attitudes whereby MPB is perceived as an ecological disaster for national parks and as a threat to biodiversity in the parks. Messages conveyed through the media and provincial government and industry sources have emphasized the negative impacts of MPB on timber supply areas outside of the national parks and may be influencing respondents' views of MPB in national parks. In other words, respondents are not making a distinction between MPB on industrial forest lands and MPB in national parks. There appears to be a role for communications to emphasize the MPBs historical presence in the parks, its role in park ecosystems, and the linkage between managing MPB and the broader issue of ecosystem health and ecological integrity objectives. However, educating the public may pose challenges.

Results from the multivariate analysis suggest that as information is gained, attitudes become more positive, which in turn leads to less support for intervening in beetle outbreaks. Public education programs aimed at communicating the ecological aspects of MPB may result in reducing support for the current policy of controlling the beetle in some national parks. Molnar et al. (2003) also found that knowledge of an insect infestation did not translate into support to control the insect. Even though private land owners in the southern United States had high levels of awareness of the southern pine beetle (*Dendroctonus frontalis*), most had not taken action to prevent a beetle infestation on their properties and were willing to let the beetle run its course. The objective of public education, however, should not be to convert the public to an agency's perspective. Rather it should aim to inform so that the public is better able to participate in policy deliberations and make informed choices (Manfredo et al., 1990; Shindler et al., 2002).

Alternatively, simply providing MPB facts might not change attitudes or influence support for management approaches. Rather than change attitudes, increased knowledge may serve to reinforce and rationalize attitudes especially among those with extremely negative or positive attitudes and for those whom the MPB is of high personal importance (Bright and Manfredo, 1995). The influence of issue salience in this study is most evident among the Columbia Valley residents for whom the issue was of high personal importance and, despite having a relatively high knowledge score, had a negative view of MPB and showed strong support for controlling the beetle in national parks.

Similar to other studies, some variability was found between communities' assessment of the insect infestation. Based on the attitudinal and preference scale results, respondents residing near the MPB outbreak in BC (i.e, residents of the Columbia Valley) generally had a more negative view of the MPB and exhibited stronger support for controlling the beetle in national parks. Flint (2004) had similar findings in her study on the perceived impacts of spruce bark beetle (*Dendroctonus rufipennis* Kirby) on public lands in Alaska whereby communities assessed the impacts differently depending on their experience with the beetle.

Thus, communications directed at the public should not only include facts on the MPB but should also communicate information on ecosystem health and natural variability in park ecosystems, and the role of natural disturbance (including fire). The aim of communication strategies should be to provide residents with the information they need to make an informed response to park policy on MPB and should be targeted to address the concerns of specific communities. For example, in addition to information about the MPB, communities adjacent to the national parks that have an economic dependence on the forest sector may benefit from information on what is being done to prevent the beetle from spreading to the industrial landbase. More distant communities that may be a source of visitors to the park may benefit from information addressing visitor safety and park aesthetics.

4.2. *Support for MPB controls and natural disturbance policies*

In terms of managing the beetle, local residents and park managers share some common ground: allowing the infestation to spread unchecked is an unacceptable option. However, local residents did not support a carte blanche approach to beetle control. Preferences were expressed for removing infested trees over small areas using the least invasive means possible. These include measures undertaken by Banff National Park such as sanitation cutting and burning infested areas and the use of pheromone baiting. The use of chemicals and selective logging of healthy, susceptible trees generally were not supported suggesting residents may view these as incompatible with the national parks mandate. However, the preferred option by park managers of a proactive, long-term approach, such as the use of prescribed burns to reduce

the build-up of mature pine stands, was not supported by the public. This suggests a lack of support for the prescribed burn approach which uses a natural disturbance agent (i.e., fire) to restore ecosystem variability. Controversy over prescribed burning is not unique to this study. Rather, it appears that regardless of the land management objectives prescribed burning can be a contentious issue. Whether to reduce the risk of catastrophic wildfire (Shindler and Toman, 2003) or to reintroduce fire as an ecological process to protected areas (Manfredo et al., 1990) the public appears largely divided.

Although this study did not examine the reasons behind residents' preferences, concern over risks associated with prescribed burning, being poorly informed about fire outcomes and fire effects, and potential impacts on the recreational experience may be influencing the lack of support for a prescribed burn approach. Manfredo et al. (1990), for example, found that concerns over threats to human life and effects on wildlife and the potential for prescribed burns to escape their planned boundaries were important factors in their acceptance. Englin et al. (1996) found that burned areas along backcountry canoe routes in protected areas was a disamenity and visitors avoided routes where fires had occurred within the previous 10 years. Thus, the public might be accepting of ecological integrity principles to a point, but natural disturbance and managing for ecological integrity may not always be tolerated. That is, there may be limits on the social acceptance of natural disturbance in parks especially if it is perceived as a threat to biodiversity, local economies, human health and property, or park aesthetics.

The results from this study may be influenced by the unprecedented extent of the MPB outbreak in BC which has been described as a "catastrophic natural disaster" (Province of British Columbia, 2005). Hence, these findings may not be typical of public perceptions of other natural disturbance agents that occur in low incidence or have few social and economic impacts. More research is needed to determine the extent to which more natural levels of disturbance are tolerated by the public and visitors to protected areas.

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